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GROUNDWATER MONITORING WORK PLAN FOR THE FORMER CARBORUNDUM COMPANY – ELECTRIC PRODUCTS DIVISION, HYDE PARK FACILITY
TOWN OF NIAGARA, NIAGARA COUNTY, NEW YORK
SITE NO. 932036

FINAL WORK PLAN

Prepared For:

BP
4850 E 49TH St, MBC3-149
Cleveland, OH 44125

Prepared By:

Duke Engineering & Services, Inc.

TM0013-001

September 28, 2000

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Groundwater Monitoring Work Plan for the Former Carborundum Company - Electric Products Division, Hyde Park Facility Town of Niagara, Niagara County, New York
SITE NO. 932036

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EXECUTIVE SUMMARY

The former Carborundum Company's Hyde Park facility ("site" or "facility") in Niagara Falls is listed on the New York State Department of Environmental Conservation's (NYSDEC's) list of Inactive Hazardous Waste Disposal Sites. The facility is listed as a Class 2 site, No. 932036. A Class 2 site is defined as a site that poses a significant threat to the public health or the environment and one that requires mitigative action.

A Remedial Investigation (RI), Phase II RI, Feasibility Study (FS) and Interim Remedial Measure (IRM) have been completed at the site by Duke Engineering & Services Inc. (DE&S) for BP. An IRM was executed at the site from September 1998 to August 1999 to delineate the extent of soil contamination and to remove contaminated soil. Excavation during the IRM was conducted up to but not beyond property boundaries. Some soils containing VOCs above NYSDEC Soil Cleanup Objectives and the Action Level for vinyl chloride were identified along the eastern property boundary, but were not removed during the IRM because off-site excavation was not within the approved scope of work.

The NYSDEC has prepared a Record of Decision (ROD) for the site. The ROD divides the site into three operable units (OU1, OU2, and OU3). OU1 is on-site soil, which was addressed through execution of the IRM. The NYSDEC has proposed no further action for OU1. OU2 is groundwater beneath the site. The FS proposed options to address contaminated groundwater, and a preferred remedy was selected in the ROD. This document describes the work plan for implementing the preferred remedy, groundwater monitoring. OU3 is off-site soil east of the site, which will undergo further study. An OU3 Investigation Work Plan will be prepared and presented in a separate document.

The purpose of this work plan is to develop a program and schedule for monitoring groundwater at the site. The specific objectives of the monitoring program include the following:

i) Assess if natural attenuation of contaminants will allow groundwater to attain the NYSDEC Groundwater Standards and Guidance Values (derived from 6 NYCRR

Part 703.5, or for the cases where no standards exist, from the Division of Water Technical and Operational Guidance Series 1.1.1).

ii) Document changes in groundwater contaminant concentrations and distributions with time.

iii) Reduce, to the extent practicable, off-site migration of shallow groundwater that does not meet NYSDEC Groundwater Standards and Guidance Values.

iv) Assess the potential for groundwater infiltration of the sanitary sewer to have impacted groundwater contaminant distributions in the southern portion of the site along Rhode Island Avenue.

The work program will include the installation of monitoring wells and periodic collection of groundwater samples to define the VOC contaminant distribution in groundwater over time. In addition, samples will be collected from sanitary sewers south of the site to investigate the potential for sewers to impact contaminant distributions south of the site. A well and sewer survey will be conducted to re-establish the elevation of existing wells, and to determine elevations for newly installed wells and sewer sampling points.

Installation of four additional monitoring well clusters is proposed to refine the extent and character of contamination in groundwater at the site and to monitor small areas of VOC concentrations in soil that exceed NYSDEC Soil Cleanup Objectives following the IRM. Groundwater monitor wells will be completed as well couplets in a manner similar to that used during previous well couplet installation on the site. Monitor well locations will be numbered from MW16A and B to MW19A and B, continuing the previous well numbering system.

Continuous soil sampling and PID screening of soils will be conducted from ground surface to the bottom of each monitoring well borehole to screen soils for potential zones of contamination. Soil sampling for laboratory analysis will not be conducted unless evidence of contamination is identified during drilling (i.e., visual staining/odors and high PID readings). If evidence of contamination is identified, a soil sample will be collected for analysis of VOCs.

Groundwater sampling will consist of periodic purging and sampling of monitoring wells and analysis of samples for VOCs. Sampling will be conducted on a semi-annual basis (twice per year) in the spring and fall seasons. The purpose of spring sampling is to evaluate groundwater conditions during periods of high water levels. Sampling in the fall will examine groundwater conditions during a period of relatively low water levels, and will also allow comparison of new data to old sampling data collected in the fall in 1997 and 1999. A groundwater database will be generated to compile subsequent rounds of sampling data for comparison.

An investigation of the Town of Niagara sanitary sewer located south of the site beneath Rhode Island Avenue will be conducted to evaluate the potential for sewers to impact groundwater contaminant distributions south of the site. The investigation will consist of sampling sewer effluent along Rhode Island Avenue south and east of the site. Results of this effluent sampling will provide information on the possibility that groundwater contaminated with VOCs is migrating into the sanitary sewer system.

The analytical parameter list for the groundwater monitoring program was developed from the list of COCs based on the results of previous groundwater and soil sampling conducted at the site. All groundwater and sewer effluent samples collected from the site will be analyzed for VOCs using SW-846 protocol Method 8260.

Documentation of the natural attenuation process may require analysis of some parameters in addition to VOCs in groundwater. To evaluate the potential operation of natural attenuation processes on contaminated groundwater at the Former Carborundum Company site, selected wells will be sampled for the following additional parameters as suggested by the ITRC (1999):

- Methane, ethene, ethane, propane, propene
- TOC, BOD, COD
- Iron (II & III)
- Chloride, nitrate, nitrite, sulfate
- Sulfide

Ten well clusters will undergo sampling for these additional parameters. The well clusters chosen for these analyses are located along the groundwater flow path in upgradient, cross-gradient, downgradient locations and in source areas, as suggested in the Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water (USEPA 1998).

Field measured parameters will include the standard conductivity, temperature, pH, and turbidity used to determine the condition of groundwater entering the well prior to sampling. Additional field parameters that may be indicators of the natural attenuation process such as dissolved oxygen (DO) and oxidation reduction potential (ORP) will be monitored.

In addition to the measurement of field parameters as described above, a field analysis will be conducted for ferrous iron (Iron [II]). The analysis of this parameter must be done immediately because ferrous iron is not stable and cannot be measured accurately if shipped to a laboratory.

Interim and annual reports will be prepared as part of the Groundwater Monitoring Program. An interim report consisting of a brief summary of results will be prepared and submitted to the NYSDEC within 60 days following the first round of sampling each year. An annual report that presents detailed results of sampling completed in that year and previous years will be prepared at the end of each year and will be submitted by March 1st. Each annual report will include a description of the extent and character of VOCs in groundwater, results of sewer sampling, water level monitoring results, and a description of other work items completed (i.e., installation of monitoring wells, piezometers, etc). Summary tables, figures and graphs will be used to present current and cumulative sampling results. The report will document the extent of groundwater containing COCs above NYSDEC Groundwater Standards/Criteria, well construction details, a summary of sampling procedures and results, and a summary of site hydrogeologic conditions. A discussion of the effectiveness of the monitoring program will also be provided, along with recommendations for changes to the work plan.

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1 INTRODUCTION

The former Carborundum Company's Hyde Park facility ("site" or "facility") in Niagara Falls is listed on the New York State Department of Environmental Conservation's (NYSDEC's) list of Inactive Hazardous Waste Disposal Sites. The facility is listed as a Class 2 site, No. 932036. A Class 2 site is defined as a site that poses a significant threat to the public health or the environment and one that requires mitigative action.

A Remedial Investigation (RI), Phase II RI, Feasibility Study (FS) and Interim Remedial Measure (IRM) have been completed at the site by Duke Engineering & Services Inc. (DE&S) for BP. Results of the RI and Phase II RI indicated that soils existed on the property that contained volatile organic compounds (VOCs) and/or polycyclic aromatic hydrocarbons (PAHs) at concentrations that exceeded NYSDEC Soil Cleanup Objectives. An IRM was executed at the site from September 1998 to August 1999 to delineate the extent of soil contamination and to remove contaminated soil. A total of 35,606 tons of contaminated soil were removed from the site. Excavation during the IRM was conducted up to but not beyond property boundaries. Some soils containing VOCs above NYSDEC Soil Cleanup Objectives and the Action Level for vinyl chloride were identified along the eastern property boundary, but were not removed during the IRM because off-site excavation was not within the approved scope of work.

The NYSDEC has prepared a Record of Decision (ROD) for the site. The ROD divides the site into three operable units (OU1, OU2, and OU3). OU1 is on-site soil, which was addressed through execution of the IRM. Over 90% of contaminated soil was removed from within the site boundaries. Remaining contaminated soil in OU1 is located at depths of greater than 10 feet below ground surface and does not pose a threat to the health of site employees or nearby residents. Therefore, the NYSDEC has proposed no further action for OU1. OU2 is groundwater beneath the site. The FS proposed options to address contaminated groundwater, and a preferred remedy was selected. This document describes the work plan for implementing the preferred remedy, groundwater monitoring. OU3 is off-site soil east of the site, which will undergo further study. An OU3 Investigation Work Plan will be prepared and presented in a separate document.

1.1 PURPOSE AND OBJECTIVES OF GROUNDWATER MONITORING

The purpose of this work plan is to develop a program and schedule for monitoring groundwater at the site. The specific objectives of the monitoring program include the following:

i) Assess if natural attenuation of contaminants will allow groundwater to attain the NYSDEC Groundwater Standards and Guidance Values (derived from 6 NYCRR Part 703.5, or for the cases where no standards exist, from the Division of Water Technical and Operational Guidance Series 1.1.1).

ii) Document changes in groundwater contaminant concentrations and distributions with time.

iii) Reduce, to the extent practicable, off-site migration of shallow groundwater that does not meet NYSDEC Groundwater Standards and Guidance Values.

iv) Assess the potential for groundwater infiltration of the sanitary sewer to have impacted groundwater contaminant distributions in the southern portion of the site along Rhode Island Avenue.

2 PROJECT TEAM ORGANIZATION AND RESPONSIBILITIES

The groundwater monitoring work program will be managed by DE&S, who will provide qualified technical staff familiar with the site. The health and safety plan (HSP), quality assurance project plan (QAPP), and Citizen Participation Plan (CPP) that were prepared for the 1996 RI program and were accepted for use during the Phase II RI and IRM, are proposed for use in the monitoring program with minor modifications.

The project team organization will consist of the project manager, project advisor, QA officer, technical staff and subcontractors. Identification of key staff and subcontractors and a description of responsibilities is provided in the following section. An organizational chart of the project team is shown on Figure 2-1.

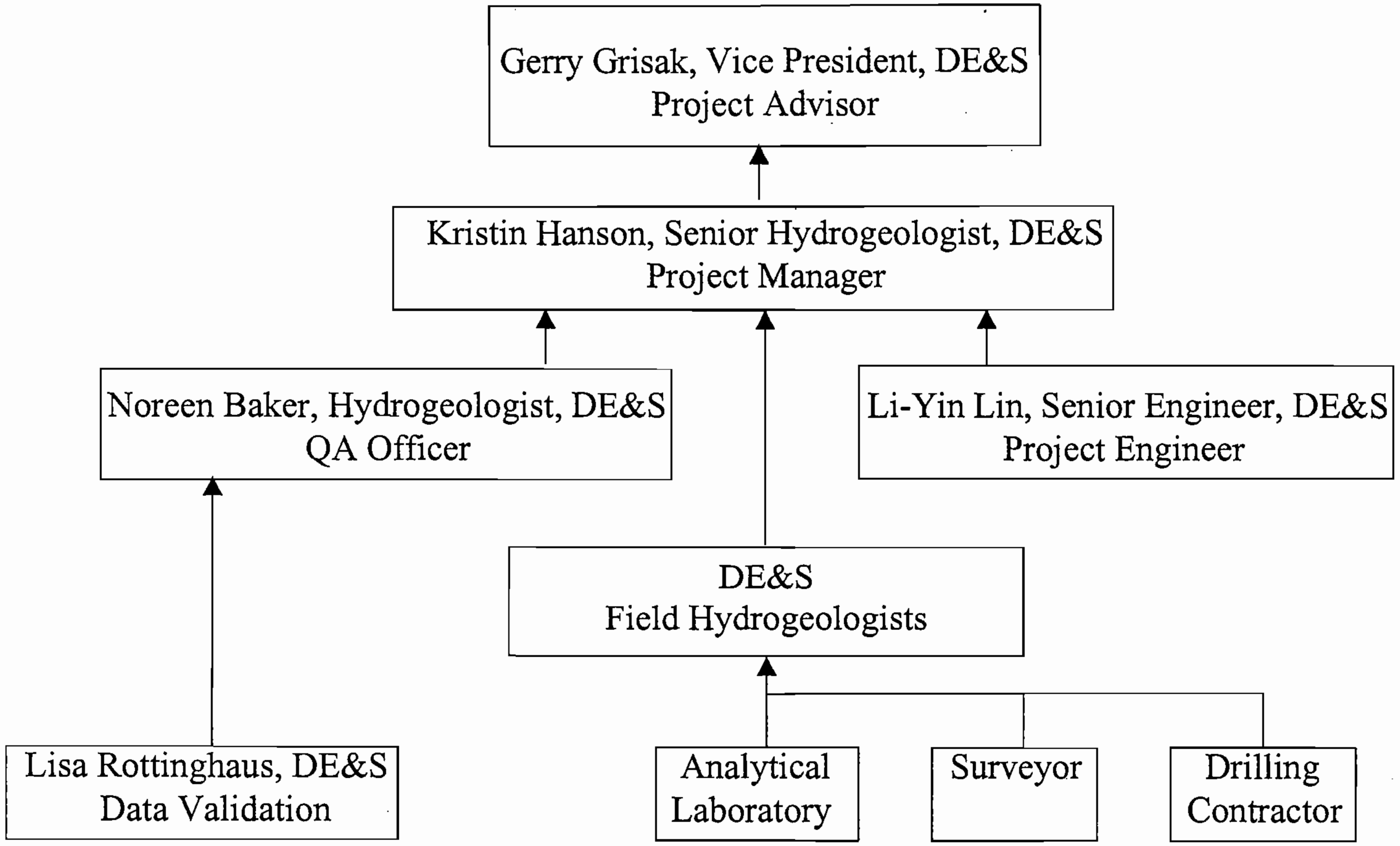
2.1 PROJECT MANAGER

Project Manager for the monitoring program is Ms. Kristin Hanson. Ms. Hanson has been familiar with this project since the 1997 Phase II RI, and managed the FS and IRM portions of the project. Ms. Hanson will be responsible for reviewing the design and development of the Groundwater Monitoring Work Plan and will ensure that project goals and objectives are met. She will implement the project according to the work plan, HSP and QAPP, and will ensure that the work proceeds on schedule and within budget. She will ensure selection of experienced contractors to carry out surveying, drilling and laboratory analytical work. Ms. Hanson will serve as the primary contact for DE&S regarding project issues.

2.2 PROJECT ADVISOR

Mr. Gerry Grisak, DE&S Vice President and project advisor during the RI, Phase II RI, FS, and IRM, will continue to provide technical and management support during all phases of the Groundwater Monitoring work program.

Figure 2-1 Project Team Organization



2.3 QUALITY ASSURANCE OFFICER

The QA Officer for this project will be Ms. Noreen Baker, a Hydrogeologist with DE&S and QA Officer during the RI, Phase II RI, and IRM. She will ensure that field QA procedures are implemented according to the QAPP. Ms. Baker has more than ten years experience in geological and hydrogeological programs and has specific experience as a QA Officer on several projects.

Data validation will be conducted by Ms. Lisa Rottinghaus, a geologist with DE&S who reports to Ms. Baker. Ms. Rottinghaus has worked on numerous projects performing quality assurance and data validation services. She has over 5 years of experience in the field and has completed EPA Contract Laboratory Program training. Ms. Rottinghaus has specific experience as a member of a QA team reviewing and validating data using EPA National Functional Guidelines for Organic Data Review.

2.4 TECHNICAL STAFF

Ms. Li-Yin Lin, DE&S Senior Engineer, will serve as project engineer. Ms. Lin will be responsible for reviewing DE&S specification documents and for overseeing engineering components of the monitoring program. Ms. Lin is a New York State Certified Professional Engineer and has over 18 years of relevant project experience in civil and environmental engineering.

Ms. Victoria Pianarosa and Mr. Michael Marcotte will serve as Field Hydrogeologists, with responsibility for managing on-site operations on a day to day basis. During the field program they will conduct on site supervision and direct communication with field personnel. They will coordinate subcontractor activities and will inform the contract laboratory of the timing for the receipt of field samples for analysis. Ms. Pianarosa and Mr. Marcotte performed these functions during the IRM and the October 1999 groundwater sampling tasks and are familiar with site protocol and reporting requirements.

2.5 SUBCONTRACTORS

DE&S will select experienced and reliable survey, analytical and drilling subcontractors who are familiar with conditions in the area of the site or have previously completed contract work with the State. Survey work will be completed by a survey professional licensed in the State of New York. Monitoring well drilling and installation at the site will be carried out by a qualified contractor familiar with well installation techniques. Analytical work will be carried out by Severn Trent Laboratories, a New York State certified analytical laboratory who has conducted previous analytical work at the site. Sampling and analytical protocols will be in accordance with previous sampling programs at the site. Analytical reports will be provided in ASP Category B deliverables format.

3 SITE BACKGROUND AND PHYSICAL SETTING

This section describes the site history, physical setting and summarizes previous work carried out at the site.

3.1 SITE HISTORY

The Carborundum Company's former Hyde Park facility is bordered on the west side by Hyde Park Boulevard and on the south side by Rhode Island Avenue in the Town of Niagara, Niagara County, New York. A location map showing the site is provided on Figure 3-1. Silicon carbide heating elements and electronic components have been manufactured at the plant since 1936 when it was purchased by the Carborundum Company from the Globar Company. The facility was sold to CESIWID, Inc. in December 1993. CESIWID has since changed its name to Kanthal Globar, and continues to manufacture similar products. As part of the sales agreement, the Carborundum Company retained the responsibility to complete required remedial efforts for pre-existing environmental conditions. BP purchased the Carborundum Company, and acquired the responsibility for environmental issues at the site.

A site map is shown on Figure 3-2. The west half of the site is occupied by the plant buildings. The east half of the site consists of a paved parking lot and a gravel area (former storage area) that was formerly used to store metal scrap and empty drums prior to off-site disposal. Prior to 1962 this area was also used to burn cardboard, paper and scrap wood, (URS Consultants, Inc., 1990) and is classified as an inactive hazardous waste disposal site.

Based on employee interviews, materials such as sand, silicon carbide, empty drums, scrap graphite, scrap steel and obsolete equipment, including electrical equipment, were stored in the former storage area. This area is currently clear of scrap materials. None of the interviews indicated that liquid wastes were intentionally disposed of on-site. Liquid wastes were disposed in the sanitary sewer or sent off-site for disposal. Solvents that have been used on-site include toluene, xylene, trichloroethylene, 1,1,1-trichloroethane, carbon tetrachloride and acetone. A small storage cage on a concrete slab was used to store drums prior to their disposal off-site.

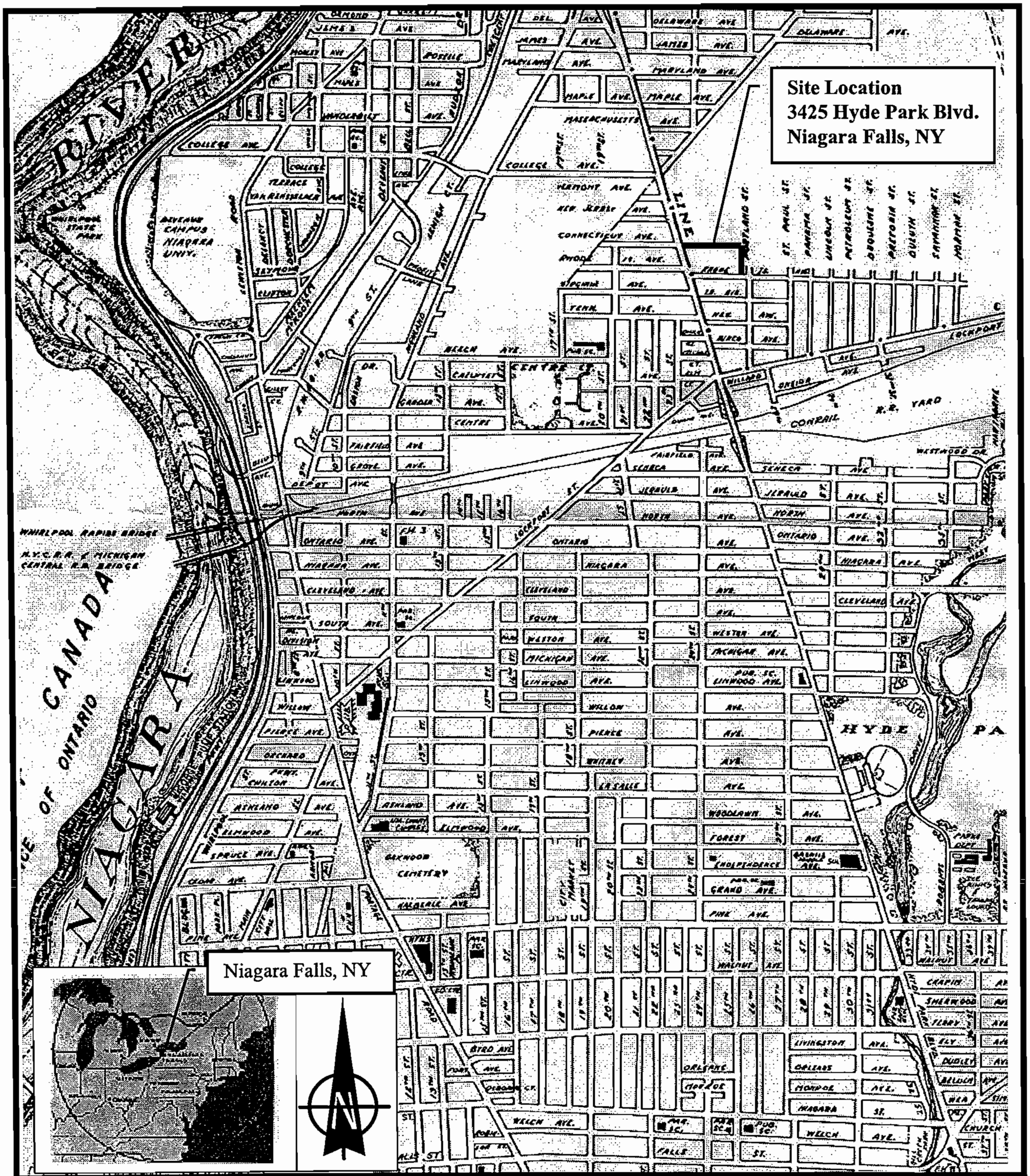


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Figure 3-1

Site Location Map

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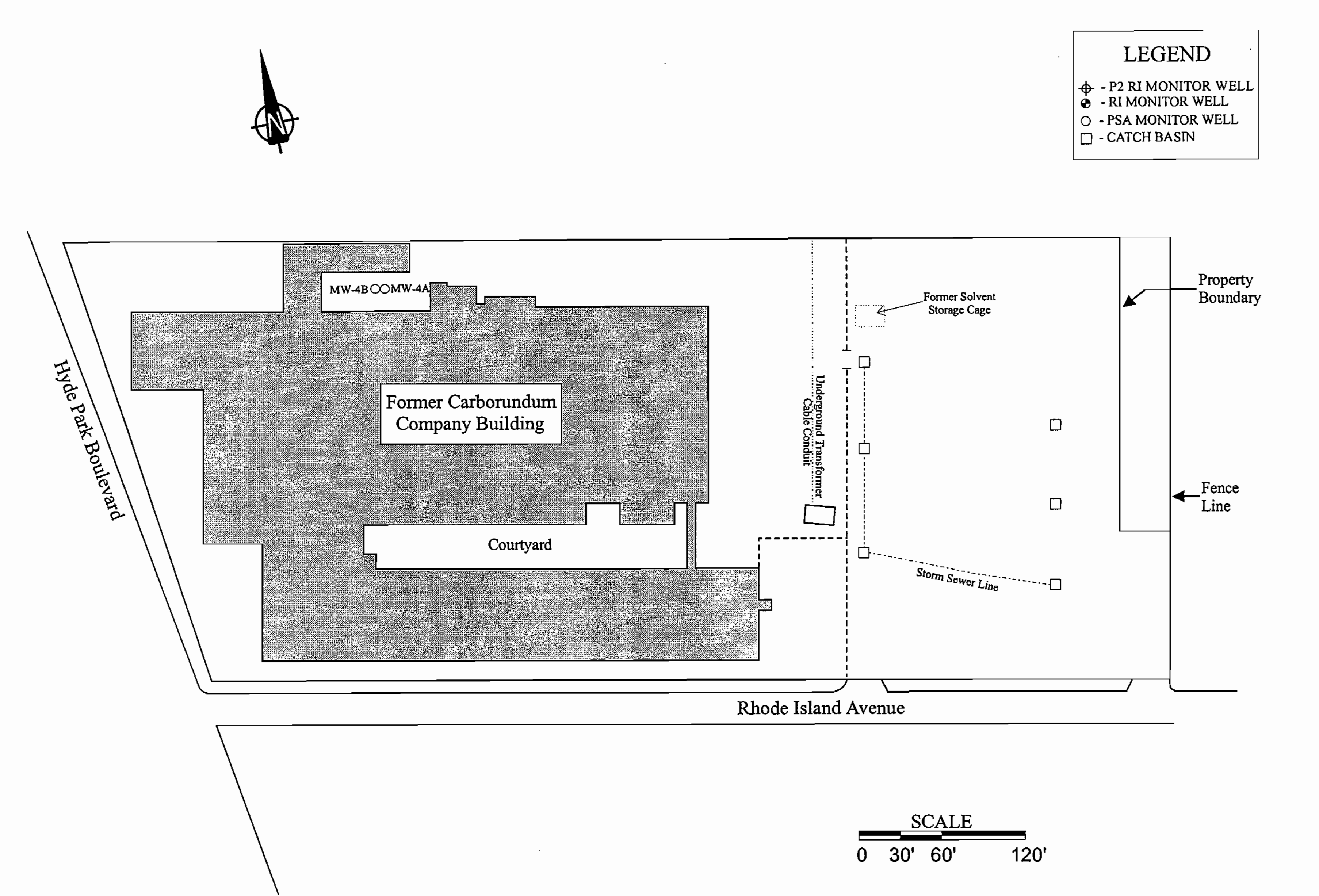

Note: MW-9 Destroyed During IRM

Figure 3-2	Job #: TM0013-001	Site Map
Date: June 2000	Drawn/File Name: VP/Fig3_2.cdr	Former Carborundum Company - Electric Products Division

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This structure was demolished during the IRM. Fewer than three drums of solvent were used in any calendar month (INTERA, 1993).

Scrubber water from metal spraying operations was previously discharged onto the ground in the courtyard area before entering the facility's sewer system. This waste stream would have contained copper, aluminum, nickel, brass, and/or zinc. Since 1984 this material has been hard piped to the sewer system and is discharged under a valid wastewater discharge permit from the Department of Wastewater Facilities of the City of Niagara Falls.

The facility reported disposal of solid material wastes at Lynch Park, Niagara Falls (1930-1978) and Newco Waste Systems (1972-1978). BFI Waste Systems or BFI's prior owners are believed to have disposed of all the facility's non-hazardous solid material waste since 1978.

Employee interviews indicated that fill material was brought to the site in the early 1960s to level the east half of the property. The source and quality of the fill is not known. Employee interviews also indicated that a coal tar spill in the mid-1960s on the adjacent Union Carbide property to the north entered the site near the former solvent storage cage. It is not certain whether any cleanup of this spill was conducted.

3.2 PHYSICAL SETTING

The topography at the site is flat with a gentle slope across the property to the south. Elevation at the site is approximately 600 feet above mean sea level. The land immediately north of the former Carborundum Company site is five to six feet higher in elevation and is occupied by an industrial park. This area, currently owned by Niagara Vest Inc., was formerly owned and occupied by Union Carbide.

General geology in the area consists of glaciolacustrine sediments and till 17 to 32 feet in thickness overlying Middle Silurian dolostone bedrock of the Lockport Dolomite. The water table ranges from 2 to 8 feet below ground surface on site (INTERA Inc. 1997a). Perched groundwater conditions have been reported at the northeast edge of the site (URS 1990, INTERA Inc. 1993). The major aquifer in the area is the weathered portion of bedrock that occurs in the upper 15 to 20 feet of the Lockport Dolomite. Flow directions are southwesterly across the site for groundwater in both shallow overburden and in bedrock. Groundwater velocities range from 3.5 feet per year in overburden to 184 feet per year in the upper portion of bedrock (INTERA, 1998).

The area immediately north and west of the former Carborundum Company facility is occupied by light and heavy industry while the area immediately east and south is residential.

3.3 PREVIOUS INVESTIGATIONS

Environmental conditions and concerns relating to the facility have been described in reports from eight investigations/studies that have been conducted at the facility:

- 1985: the Carborundum Company retained Earth Dimensions Inc. of East Aurora, New York to undertake soil sampling and monitor well installation to characterize soil and groundwater contamination at the site (Earth Dimensions Inc, 1985).
- 1990: NYSDEC contracted URS Consultants Inc. of Buffalo, New York to undertake a data records search to provide a preliminary assessment and hazard ranking of the site (URS Consultants, Inc., 1990).
- 1992: the Carborundum Company retained INTERA Inc. to complete a Preliminary Site Assessment of the property that included soil sampling, monitor well installation and groundwater sampling (INTERA Inc., May 1993).
- 1993: INTERA Inc. conducted follow up soil sampling to help delineate the extent of soil contamination (INTERA Inc., Aug. 1997).
- 1995: INTERA Inc. conducted a Remedial Investigation of the site that included soil sampling from test pits and boreholes, monitor well installation and groundwater sampling (INTERA Inc., Aug. 1997).
- 1997: DE&S (formerly INTERA Inc.) conducted a Phase II Remedial Investigation that included soil sampling from boreholes and surface soil, the installation of one down gradient bedrock monitoring well, and groundwater sampling (DE&S, August 1998).
- 1999: DE&S conducted borehole drilling, test pit sampling, removal of 35,606 tons of contaminated soil, and verification sampling as part of an IRM (DE&S, 1999a, b, c, d) and also conducted Post-IRM groundwater sampling (DE&S 2000a).

- 2000: A Feasibility Study was completed that discussed the results of the IRM program and evaluated the options available to address groundwater contamination (DE&S, 2000b).

A brief summary of the work program for each of these investigations is provided in the following sections.

3.3.1 1985 - Preliminary Site Assessment

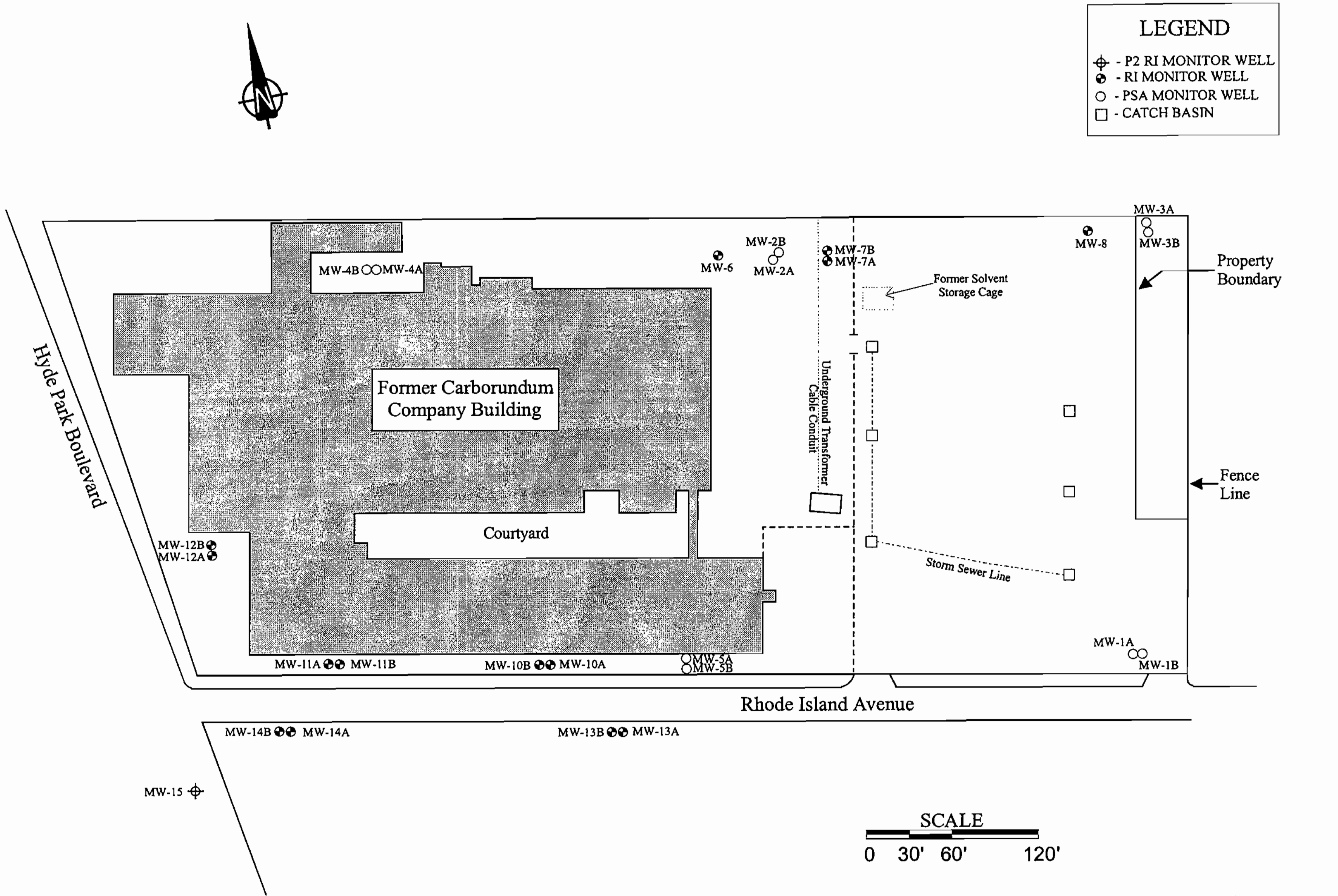
The investigation carried out by Earth Dimensions Inc. included the installation of five groundwater monitoring wells to depths of 14 ft BGS. Two wells were installed in the former storage area, two along the south end of the plant building adjacent to Rhode Island Avenue, and one near the railway spur area. Two soil borings were also completed. Four soil samples were collected for analysis of VOCs, PCBs, and selected metals. Three groundwater samples were collected for analysis of total organic carbon (TOC), total organic halogen, VOCs, and selected metals. Results are reported in Earth Dimensions Inc. (1985).

3.3.2 1990 - Data Records Search and Preliminary Assessment

URS performed a file search of NYSDEC and Niagara County Health Department files and a site inspection to observe site conditions and measure air quality at the site. Results of the assessment are reported in URS (1990).

3.3.3 1992 - Preliminary Site Assessment

The work program conducted by INTERA Inc. included the installation of five monitor well couplets in the overburden and bedrock (MW-1A/B, MW-2A/B, MW-3A/B, MW-4A/B and MW-5A/B), hydraulic conductivity testing of overburden and bedrock wells, groundwater sampling of monitor wells, and soil sampling from six soil boreholes and from monitor well boreholes. Soil samples were analyzed for VOCs, semi-volatile organic compounds (SVOCs), PCBs, metals, total cyanide, and dioxin. Groundwater samples were analyzed for the Superfund Target Compound List (TCL) parameters, which include VOCs, SVOCs, non-volatile organic compounds, PCBs, total metals, soluble metals, and total cyanide. Results of the investigation are reported in INTERA Inc. (1993). Monitoring well locations are shown in Figure 3-3.



Note: MW-9 Destroyed During IRM

Figure 3-3	Job #: TM0013-001	Existing Monitoring Well Locations
Date: June 2000	Drawn/File Name: VP/Fig3_3.cdr	Former Carborundum Company - Electric Products Division

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3.3.4 1993 - Follow-Up Soil Sampling

Follow-up soil sampling conducted by INTERA Inc. included sampling from 11 borehole locations in the former storage area. Soil samples were analyzed for VOCs. Results are reported in the Remedial Investigation report, INTERA, Inc. (1997).

3.3.5 1995 - Remedial Investigation

The RI work program conducted by INTERA Inc. included the installation of six monitor well couplets in the overburden and bedrock (MW-7A/B, MW-10A/B, MW-11A/B, MW-12A/B, MW-13A/B and MW-14A/B), installation of three bedrock monitor wells (MW-6, MW-8 and MW-9), hydraulic conductivity testing of bedrock wells, groundwater sampling of monitor wells, soil sampling from seven soil boreholes and from monitor well boreholes, sewer bedding material sampling from five test pits, a fish and wildlife impact assessment, and a preliminary risk assessment. Soil samples were analyzed for VOCs, PAHs, and TOC. Groundwater samples were analyzed for VOCs. The results of the RI are reported in INTERA Inc. (1997). Monitoring well locations are shown in Figure 3-3.

3.3.6 1997 - Phase II Remedial Investigation

The work program conducted by DE&S, formerly INTERA Inc., included the installation of one bedrock monitor well downgradient of the facility and off-site (MW-15), groundwater sampling of all monitor wells on-site, soil sampling from four boreholes and from four surface locations, and an updated preliminary risk assessment. Soil and groundwater samples were analyzed for VOCs. The results of the Phase II RI are reported in DE&S (1998). The location of MW-15 is shown on Figure 3-3.

3.3.7 1999 – IRM

The IRM consisted of the installation and sampling of 39 boreholes to supplement previous soil sampling data and further define the lateral and vertical extent of contaminated soils on site. A test pit sampling program consisting of the installation and sampling of 67 test pits within the identified areas of soil contamination to pre-characterize soils for off-site disposal was also conducted, thereby significantly reducing the need to stockpile soils on-site pending testing (DE&S 1999c). A total of 35,606 tons of contaminated soils were excavated and removed from the site for off-site disposal. A total of 263 verification soil samples were collected from excavation side walls and floors to characterize soils remaining on site. Some contaminated soils were left on the site at depths of greater than 10 feet, beyond the reach achievable by excavation equipment based on soil conditions encountered on site. An estimated total of 1,980 yd^3 of soils containing VOCs above NYSDEC Soil Cleanup Objectives remains on-site. Some verification samples collected from the excavation wall along the east property boundary between 0-16 ft depth contained VOCs above Cleanup Objectives and the Action Level for vinyl chloride. This area of impacted soil is estimated to be 800 ft^2 in size, and is currently referred to as OU3. IRM results are reported in DE&S 1999d. Post-IRM groundwater sampling was conducted in monitoring wells MW-1 to MW-15, except MW-9 that was abandoned during the IRM excavation. The results are reported in a Post-IRM Groundwater Sampling Report (DE&S 1999e).

3.3.8 2000 - Feasibility Study

A Feasibility Study was completed that evaluated the options available to address groundwater contamination based on the results of the IRM program. The goals of the remedial program for groundwater were established as reducing, to the extent practicable, off-site migration of groundwater that does not attain NYSDEC Ambient Water Quality Criteria. Several remedial options were evaluated based on their ability to be protective of human health and the environment, be cost effective, comply with existing statutory laws, and on their use of permanent solutions, alternative technologies, or resource recovery technologies. The proposed remedy was groundwater monitoring. This remedy was accepted and selected following a public consultation process by the NYSDEC. The elements of the selected remedy are 1) Development of a groundwater monitoring program that includes new well installations, a sanitary sewer investigation, and preparation of interim and annual reports of results for the NYSDEC; 2) Installation of required monitoring wells; 3) Twice-yearly collection and analysis of groundwater and sewer samples; 4) Preparation of annual reports for NYSDEC review with program review after 5 years of monitoring; and 5) Evaluation of the necessity for deed restrictions should site zoning change.

3.3.9 Investigations at Neighboring Properties

A currently inactive hazardous waste landfill was operated by Union Carbide in an area approximately 1000 feet northeast of the former Carborundum Company facility (Site No. 932035). NYSDEC retained Ecology and Environment to conduct a Preliminary Site Assessment (PSA) of the former landfill site in 1989 and a more detailed PSA in 1991. Results of these site assessments indicate that VOCs and metals are present in groundwater in the vicinity of the landfill. In addition, PAHs and metals are present in soils and sediment in the landfill area. Results of these investigations are reported in Ecology and Environment (1991).

The Vanadium Corporation of America Site (# 932001) is located north of the Former Carborundum Company Facility and Union Carbide properties and is owned by SKW Alloys Inc. and Airco Properties Inc. In 1989, Ecology and Environment undertook a Preliminary Site Assessment of the 62-acre landfill for the NYSDEC. The site was used as a landfill for disposal of ferrous metal dusts, slags and other metal wastes since approximately 1920. Groundwater samples collected on the site indicated the presence of metals and total organic carbon (samples were not analyzed for VOCs). Results of the investigations are reported in Ecology and Environment (1989).

3.4 NATURE AND EXTENT OF GROUNDWATER CONTAMINATION

3.4.1 Contaminants of Concern

Contaminants of concern (COCs) have been identified at the site on the basis of analytical results from groundwater samples collected during the PSA, RI, Phase II RI, and Post-IRM Groundwater Sampling event. COCs include the following specific VOCs:

- vinyl chloride
- 1,2-dichloroethene
- trichloroethene

- benzene
- 1,1-dichloroethane

3.4.2 Extent of Groundwater Contamination

VOCs have been detected in groundwater monitoring wells on the site during four sampling events conducted as part of the PSA in 1992, RI in 1996, Phase II RI in 1997, and Post-IRM groundwater sampling in 1999. Only wells MW-1 through MW-5 were sampled as part of the PSA. In 1996 during the RI, wells MW-6 through MW-14 were installed and sampled. In 1997, as part of the Phase II RI, MW-15 was installed and all the wells on the site were sampled. Table 3-1 provides a summary of groundwater analytical results from the PSA, RI, Phase II RI, and Post-IRM groundwater sampling. Overburden wells are designed with an "A" (i.e., MW-11A). Wells designated with a "B" or wells with no alphabetic designation are installed in bedrock.

3.4.2.1 Overburden Groundwater Contamination

Groundwater contamination extends over the western portion of the site in the overburden (shallow) groundwater. Figure 3-4 depicts total VOC concentration contours constructed from groundwater sampling data obtained from shallow, overburden wells in October 1999. Concentrations are elevated in MW-7A located in the northern portion of the site near the former solvent storage area where soils with high concentrations of VOCs were removed as part of the IRM. VOC concentrations are also elevated in MW-10A, located downgradient of the former solvent storage cage along the south property boundary. VOCs have not been detected in wells MW-13A and 14A, located off-site to the south across Rhode Island Avenue. This indicates that significant concentrations of contaminants are not moving off-site in shallow groundwater.

The most commonly detected VOCs in shallow groundwater were trichloroethene and two of its degradation products, 1,2-dichloroethene and vinyl chloride. The average total VOC concentration in shallow groundwater detected during the PSA/RI round of sampling in 1992/96 was 1,498 µg/L. The highest individual VOC concentration detected was trichloroethene (TCE) at 8,700 μg/L. During the 1997 Phase II RI round of groundwater sampling the average total VOC concentration was 890 μg/L. The highest individual VOC concentration detected was 1,2-dichloroethene, a breakdown product of TCE, at 5,206 μg/L. By the October 1999 round of Post-IRM sampling, the average total VOC concentration had dropped to 510 μg/L with an individual VOC maximum concentration of 2,900 μg/L for 1,2-dichloroethene. This indicates that concentrations of total VOCs at the site have decreased significantly since the start of investigations. This is likely due to improved solvent handling practices at the site, on-going natural degradation of previously released contaminants and source removal. The fact that TCE concentrations have dropped and concentrations of TCE breakdown products, such as 1,2-dichloroethene, have risen further supports the hypothesis that natural degradation of contaminants is occurring at the site.

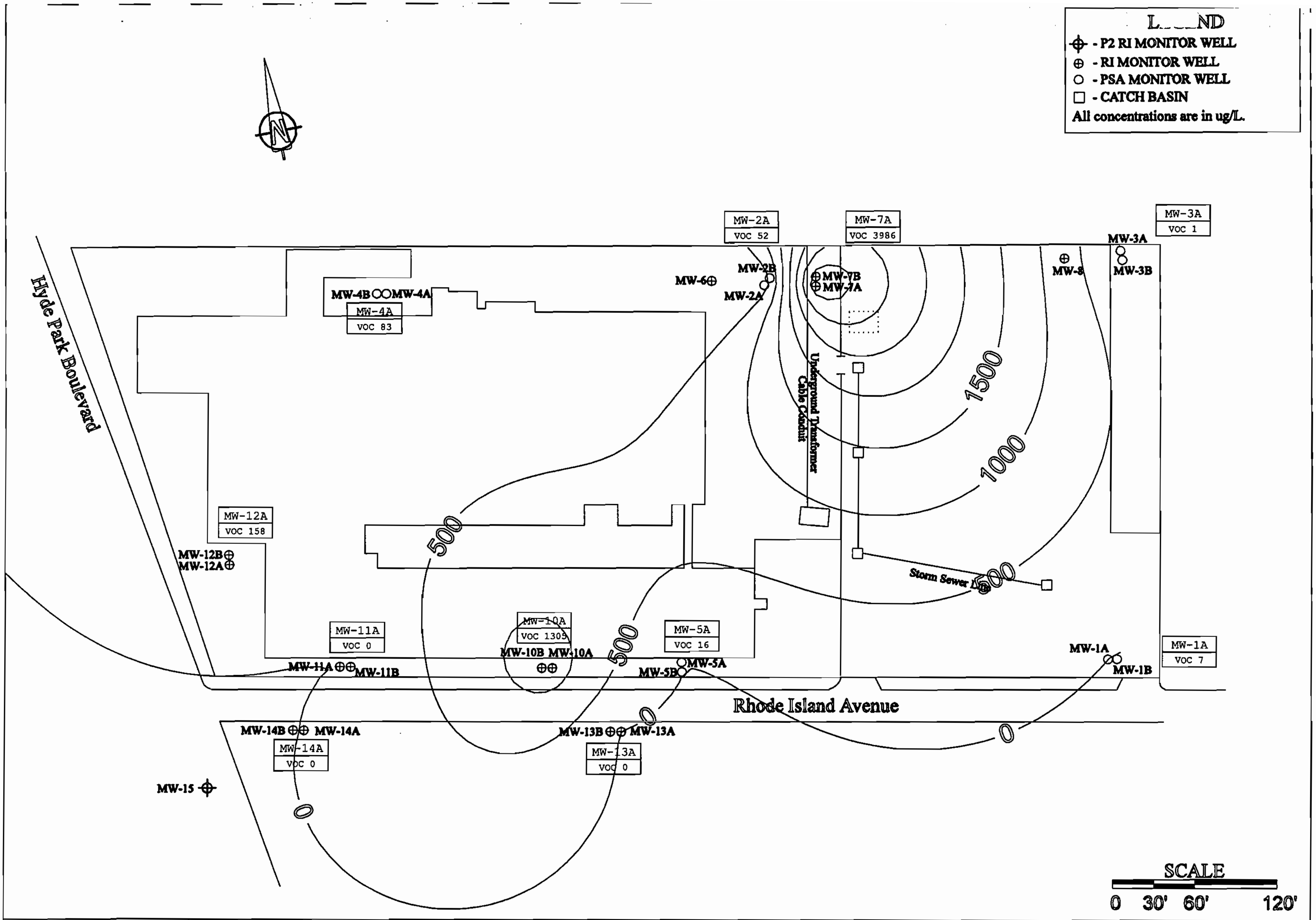

Figure 3-4

Job #: TM0013-001

Total VOC Concentrations in Overburden Wells - Oct. 1999

Date: June 2000

File Name: Total VOC-Oct 99 Shallow.dwg

Former Carborundum Company - Electric Products Division

Duke Engineering & Services (Canada), Inc.
A Duke Energy Company
3075 14th Avenue, Suite 207
Markham, Ontario
Canada
L3R 0G9
(905) 513-9400
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3.4.2.2 Bedrock Groundwater Contamination

Groundwater contamination extends over most of the site in the bedrock (deeper) groundwater. Figure 3-5 depicts total VOC concentration contours constructed from groundwater sampling data obtained from deeper, bedrock wells in October 1999. Concentrations are elevated in MW-10B, located along the south property boundary, compared to the rest of the wells on site. Concentrations are also elevated in wells located in the southwestern portion of the property and in the wells off-site to the south. This indicates that contaminated groundwater is moving off-site in deeper groundwater.

The most commonly detected VOCs in deeper groundwater were the same as in the shallow groundwater: trichloroethene and two of its degradation products 1,2-dichloroethene and vinyl chloride. The average total VOC concentration in deeper groundwater detected during the PSA/RI round of sampling in 1992/96 was 729 µg/L. The highest individual VOC concentration detected was 1,2-dichloroethene at 2,300 µg/L. During the 1997 Phase II RI round of groundwater sampling the average total VOC concentration was 391 µg/L. The highest individual VOC concentration detected was 1,2-dichloroethene at 921 µg/L. By the October 1999 round of Post-IRM sampling, the average total VOC concentration had increased slightly to 462 µg/L with an individual VOC maximum concentration of 2,100 µg/L for 1,2-dichloroethene. The pattern of contaminant distributions in deeper groundwater also support overall reduction in total VOC concentrations on the site. Because breakdown products are found in deeper groundwater, it is likely that natural degradation of contaminants is occurring at depth as well as in shallow groundwater.

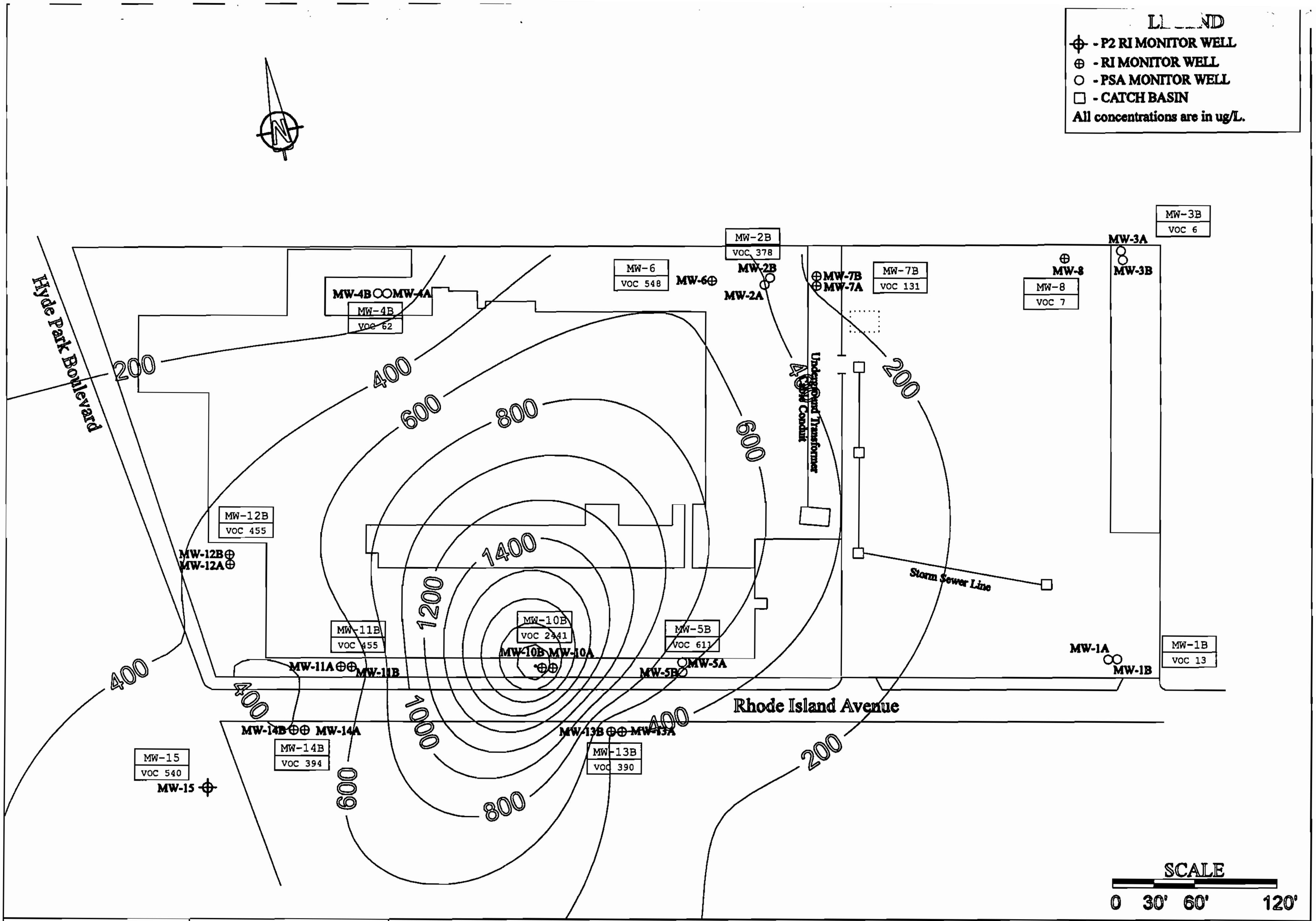


Figure 3-5	Job #: TM0013-001	Total VOC Concentrations in Bedrock Wells - Oct. 1999	Duke Engineering & Services (Canada), Inc. A Duke Energy Company
Date: June 2000	File Name: Total VOC-Oct 99 Deep.dwg	Former Carborundum Company - Electric Products Division	3075 14th Avenue, Suite 207 Markham, Ontario Canada L3R 0G9 (905) 513-9400 fax (905) 513-9405

Table 3-1 Selected Groundwater Analytical Results

Contaminant Of Concern	**Well ID, Sample Date (mm/yy) and Concentration (µg/L)**												**Water Quality Standard (µg/L)**	
	MW-1A			**MW-1B**			**MW-2A**			**MW-2B**				
	8/92	**11/97**	**10/99**	**8/92**	**11/97**	**10/99**	**8/92**	**11/97**	**10/99**	**8/92**	**11/97**	**10/99**	**1.**	**2.**
Vinyl chloride	2J	<2	<10	<10	<2	2J	<10	<2J	<10	**66**	**59J**	**46**	**2**	
cis- and trans-1,2-dichloroethene	**14**	<5	<5	**10**	<5	**6**	<10	<5J	<5	**2300**	**450J**	**325**		**5**
Trichloroethene	<10	<5	<5	<10	<5	<5	<10	<5J	<5	**670**	**6J**	**6**		**5**
Benzene	<10	<0.7	<5	<10	<0.7	<5	<10	<0.7J	<5	**1J**	<0.7J	<5	**0.7**	
1,1-dichloroethane	2J	<5	<5	3J	<5	1J	3J	**12J**	**29**	<10	<5J	0.5J		**5**

Note: 1. NYSDEC (1991) (6NYCRR Part 703)
2. NYSDEC (1991) (TOGS 1.1.1)
* well located on upgradient boundary
J indicates estimated value
1200 indicates that concentration exceeds water quality standard
Wells MW-1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, 5A, and 5B sampled August 1992 during the Preliminary Site Assessment
Wells MW-6, 7A, 7B, 8, 9, 10A, 10B, 11A, 11B, 12A, 12B, 13A, 13B, 14A, and 14B sampled May 1996 during the Remedial Investigation
All wells sampled November 1997 during the Phase II Remedial Investigation
All wells sampled October 1999 after completion of the IRM (Except MW-9, which was destroyed during the IRM)

Table 3-1 Selected Groundwater Analytical Results (continued)

Contaminant Of Concern	Well ID, Sample Date (mm/yy) and Concentration (µg/L)												Water Quality Standard (µg/L)	
	MW-3A			MW-3B			MW-4A			MW-4B				
	8/92	11/97	10/99	8/92	11/97	10/99	8/92	11/97	10/99	8/92	11/97	10/99	1.	2.
Vinyl chloride	<10	<2	<10	**5**	<2J	2J	**13**	**32J**	**47**	**26**	**22**	**23**	**2**	
cis- and trans-1,2-dichloroethene	<10	<5	1J	**18**	5J	4J	**230**	**49J**	**30**	**130**	**45**	**33**		**5**
Trichloroethene	4J	<5	<5	<10	<5J	<5	3J	<5J	4J	5J	<5	0.9J		**5**
Benzene	<10	<5	<5	0.6J	<5J	<5	<10	<5J	<5	<10	<0.7	<5	**0.7**	
1,1-dichloroethane	<10	<0.7	<5	<10	<0.7J	<5	2J	<0.7J	2J	<10	2J	3J		**5**

Note: 1. NYSDEC (1991) (6NYCRR Part 703)
2. NYSDEC (1991) (TOGS 1.1.1)
* well located on upgradient boundary
J indicates estimated value
1200 indicates that concentration exceeds water quality standard
Wells MW-1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, 5A, and 5B sampled August 1992 during the Preliminary Site Assessment
Wells MW-6, 7A, 7B, 8, 9, 10A, 10B, 11A, 11B, 12A, 12B, 13A, 13B, 14A, and 14B sampled May 1996 during the Remedial Investigation
All wells sampled November 1997 during the Phase II Remedial Investigation
All wells sampled October 1999 after completion of the IRM (Except MW-9, which was destroyed during the IRM)

Table 3-1 Selected Groundwater Analytical Results (continued)

Contaminant Of Concern	Well ID, Sample Date (mm/yy) and Concentration (µg/L)												Water Quality Standard (µg/L)	
	MW-5A			MW-5B			MW-6*			MW-7A*				
	8/92	11/97	10/99	8/92	11/97	10/99	5/96	11/97	10/99	5/96	11/97	10/99	1.	2.
vinyl chloride	**1300**	**14**	1J	**75**	**33J**	**61**	<100	**68J**	**68**	<1000	**11J**	**86**	2	
cis- and trans-1,2-dichloroethene	**1900**	**110**	**14**	**520**	**270J**	**530**	**1000**	**595J**	**480**	**1200**	**5206J**	**2900**		5
Trichloroethene	<200	<5	0.8J	**71**	5J	**8**	<100	<5J	<5	**8700**	**1400J**	**170**		5
Benzene	<200	<0.7	<5	<10	<0.7J	<5	<100	<0.7J	<5	<1000	**4J**	**2J**	0.7	
1,1-dichloroethane	<200	<5	<5	3J	<5J	1J	<100	<5J	<5	<100	**1500J**	**690**		5

Note: 1. NYSDEC (1991) (6NYCRR Part 703)
2. NYSDEC (1991) (TOGS 1.1.1)
* well located on upgradient boundary
J indicates estimated value
1200 indicates that concentration exceeds water quality standard
Wells MW-1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, 5A, and 5B sampled August 1992 during the Preliminary Site Assessment
Wells MW-6, 7A, 7B, 8, 9, 10A, 10B, 11A, 11B, 12A, 12B, 13A, 13B, 14A, and 14B sampled May 1996 during the Remedial Investigation
All wells sampled November 1997 during the Phase II Remedial Investigation
All wells sampled October 1999 after completion of the IRM (Except MW-9, which was destroyed during the IRM)

Table 3-1 Selected Groundwater Analytical Results (continued)

Contaminant Of Concern	Well ID, Sample Date (mm/yy) and Concentration (µg/L)												Water Quality Standard (µg/L)	
	MW-7B*			MW-8*			MW-9			MW-10A				
	5/96	11/97	10/99	5/96	11/97	10/99	5/96	11/97	10/99	5/96	11/97	10/99	1.	2.
vinyl chloride	<100	**23J**	**40**	<10	<2J	2J	<10	**4J**	Well Abandoned, no sample	**38J**	**65**	**73**	2	
cis- and trans-1,2-dichloroethene	**370**	**110J**	**89**	<10	**6J**	5	**11**	**6J**		**690**	**1212**	**1200**		5
Trichloroethene	<100	<5J	<5	<10	<5J	<5	<10	<5J		<250	<5	<5		5
Benzene	<100	<0.7J	<5	<10	<0.7J	<5	<10	<0.7J		<250	<0.7	0.6J	0.7	
1,1-dichloroethane	<100	<5J	<5	<10	<5J	<5	<10	<5J		<250	**18**	**22**		5

Note: 1. NYSDEC (1991) (6NYCRR Part 703)
2. NYSDEC (1991) (TOGS 1.1.1)
* well located on upgradient boundary
J indicates estimated value
1200 indicates that concentration exceeds water quality standard
Wells MW-1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, 5A, and 5B sampled August 1992 during the Preliminary Site Assessment
Wells MW-6, 7A, 7B, 8, 9, 10A, 10B, 11A, 11B, 12A, 12B, 13A, 13B, 14A, and 14B sampled May 1996 during the Remedial Investigation
All wells sampled November 1997 during the Phase II Remedial Investigation
All wells sampled October 1999 after completion of the IRM (Except MW-9, which was destroyed during the IRM)

Table 3-1 Selected Groundwater Analytical Results (continued)

Contaminant of Concern	Well ID, Sample Date (mm/yy) and Concentration (µg/L)												Water Quality Standard (µg/L)	
	MW-10B			MW-11A			MW-11B			MW-12A				
	5/96	11/97	10/99	5/96	11/97	10/99	5/96	11/97	10/99	5/96	11/97	10/99	1.	2.
Vinyl chloride	**120J**	**52**	**210J**	<10	<2	<10	<50	**56**	**69**	**13J**	**14J**	**16**	**2**	
cis- and trans-1,2-dichloroethene	**1900**	**921**	**2100**	<10	<5	<5	**390**	**705J**	**385**	**430**	**120J**	**130**		**5**
Trichloroethene	**90J**	**28**	**120**	<10	<5	<5	<50	<5	<5	<50	<5J	<5		**5**
benzene	<250	<0.7	**1J**	<10	<0.7	<5	<50	<0.7	<5	<50	<0.7J	<5	**0.7**	
1,1-dichloroethane	<250	<5	3J	<10	<5	<5	<50	<5	0.7J	<50	<5J	2J		**5**

Note:
1. NYSDEC (1991) (6NYCRR Part 703)
2. NYSDEC (1991) (TOGS 1.1.1)

* well located on upgradient boundary

J indicates estimated value

1200 indicates that concentration exceeds water quality standard

Wells MW-1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, 5A, and 5B sampled August 1992 during the Preliminary Site Assessment

Wells MW-6, 7A, 7B, 8, 9, 10A, 10B, 11A, 11B, 12A, 12B, 13A, 13B, 14A, and 14B sampled May 1996 during the Remedial Investigation

All wells sampled November 1997 during the Phase II Remedial Investigation

All wells sampled October 1999 after completion of the IRM (Except MW-9, which was destroyed during the IRM)

Table 3-1 Selected Groundwater Analytical Results (continued)

Contaminant of Concern	**Well ID, Sample Date (mm/yy) and Concentration (µg/L)**												**Water Quality Standard (µg/L)**	
	MW-12B			**MW-13A**			**MW-13B**			**MW-14A**				
	5/96	**11/97**	**10/99**	**5/96**	**11/97**	**10/99**	**5/96**	**11/97**	**10/99**	**5/96**	**11/97**	**10/99**	**1.**	**2.**
Vinyl chloride	**16J**	**53J**	**73**	<10	<2J	<10	<100	**31J**	**35**	<10	<2J	<10	**2**	
cis- and trans-1,2-dichloroethene	**250**	**250J**	**380**	<10	<5J	<5	**810**	**410J**	**330**	<10	<5J	<5		**5**
Trichloroethene	**18J**	<5J	<5	<10	<5J	<5	**48J**	**36**	**22**	<10	<5J	<5		**5**
benzene	<50	<0.7J	<5	<10	<0.7J	<5	<100	<1J	<5	<10	<0.7J	<5	**0.7**	
1,1-dichloroethane	<50	<5J	2J	<10	<5J	<5	<100	<10J	1J	<10	<5J	<5		**5**

Note: 1. NYSDEC (1991) (6NYCRR Part 703)
2. NYSDEC (1991) (TOGS 1.1.1)
* well located on upgradient boundary
J indicates estimated value
1200 indicates that concentration exceeds water quality standard
Wells MW-1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, 5A, and 5B sampled August 1992 during the Preliminary Site Assessment
Wells MW-6, 7A, 7B, 8, 9, 10A, 10B, 11A, 11B, 12A, 12B, 13A, 13B, 14A, and 14B sampled May 1996 during the Remedial Investigation
All wells sampled November 1997 during the Phase II Remedial Investigation
All wells sampled October 1999 after completion of the IRM (Except MW-9, which was destroyed during the IRM)

Table 3-1 Selected Groundwater Analytical Results (continued)

Contaminant of Concern	**Well ID, Sample Date (mm/yy) and Concentration (μg/L)**						**Water Quality Standard (μg/L)**	
	MW-14B			**MW-15**				
	5/96	**11/97**	**10/99**	**5/96**	**11/97**	**10/99**	**1.**	**2.**
Vinyl chloride	<50	**65J**	**63**	n/a	**68**	**79**	**2**	
cis- and trans-1,2-dichloroethene	**310**	**765J**	**330**	n/a	**640**	**460**		**5**
Trichloroethene	<50	<5J	<5	n/a	<10	<5		**5**
benzene	<50	<0.7J	<5	n/a	<1	<5	**0.7**	
1,1-dichloroethane	<50	<5J	0.8J	n/a	<10	1J		**5**

Note:
1. NYSDEC (1991) (6NYCRR Part 703)
2. NYSDEC (1991) (TOGS 1.1.1)

* well located on upgradient boundary

J indicates estimated value

1200 indicates that concentration exceeds water quality standard

Wells MW-1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, 5A, and 5B sampled August 1992 during the Preliminary Site Assessment

Wells MW-6, 7A, 7B, 8, 9, 10A, 10B, 11A, 11B, 12A, 12B, 13A, 13B, 14A, and 14B sampled May 1996 during the Remedial Investigation

All wells sampled November 1997 during the Phase II Remedial Investigation

All wells sampled October 1999 after completion of the IRM (Except MW-9, which was destroyed during the IRM)

4 GROUNDWATER MONITORING WORK PROGRAM

The work program will include the installation of monitoring wells and periodic collection of groundwater samples to define the VOC contaminant distribution in groundwater over time. In addition, samples will be collected from sanitary sewers south of the site to investigate the potential for sewers to impact contaminant distributions south of the site. A well and sewer survey will be conducted to re-establish the elevation of existing wells, and to determine elevations for newly installed wells and sewer sampling points.

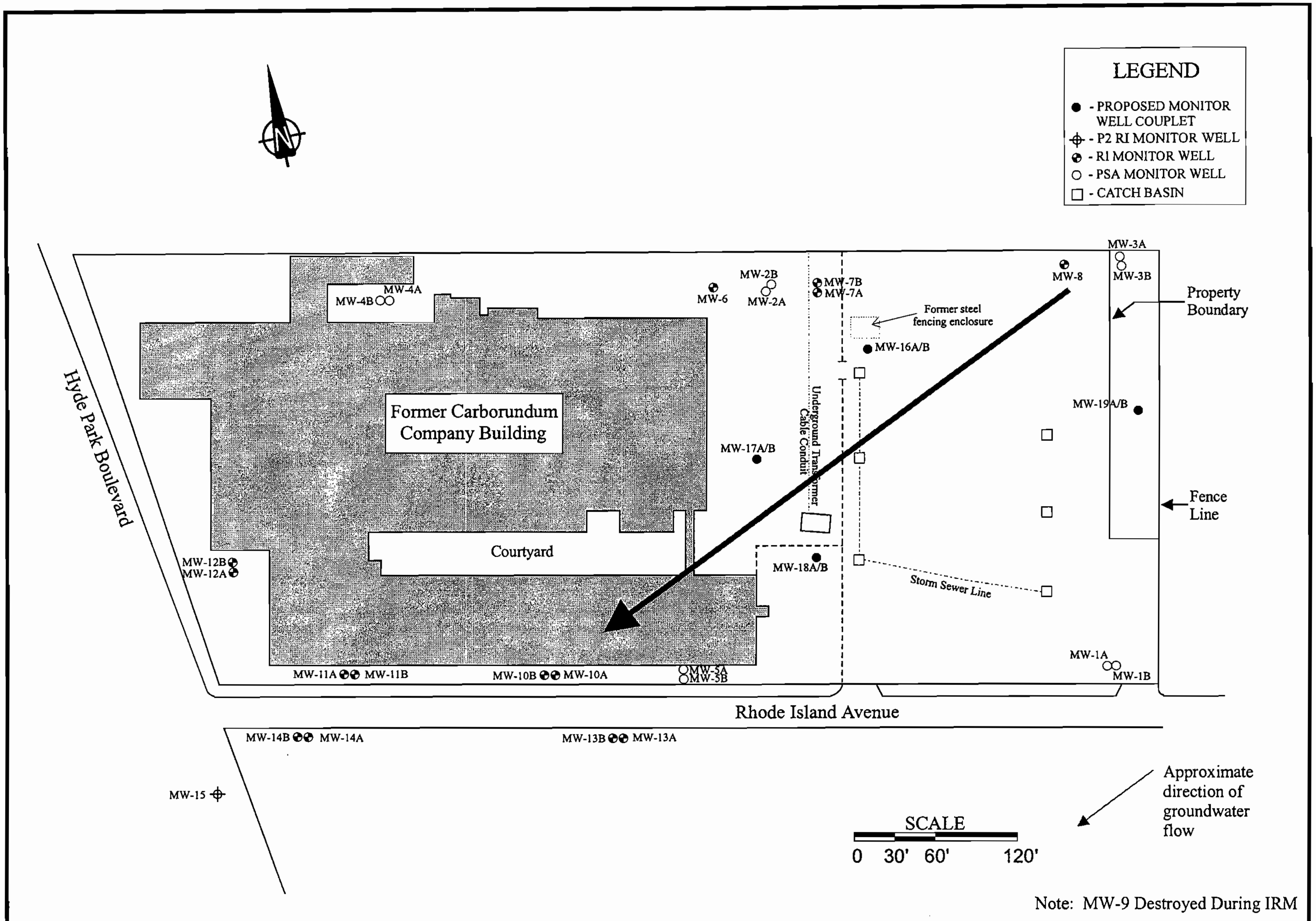
4.1 MONITORING WELL INSTALLATION

Monitoring well installation is proposed to refine the existing monitoring well network and to monitor potential impacts to groundwater from small areas of contaminated soil remaining on-site following completion of the IRM.

4.1.1 Rationale for Well Locations

Installation of four additional monitoring well clusters is proposed to refine the extent and character of contamination in groundwater at the site and to monitor small areas of VOC concentrations in soil that exceed NYSDEC Soil Cleanup Objectives following completion of the IRM. Proposed well locations are depicted on Figure 4-1.

- Well couplet MW-16 will be installed near the former solvent storage area that was identified as an area of high VOC concentrations in soil during the IRM. A small area of contaminated soil at a depth of 24 ft that contains vinyl chloride above NYSDEC soil action levels could not be removed during the IRM. MW-16 will be located immediately downgradient of this area to evaluate its potential impact to groundwater.
- Well couplet MW-17 will be installed just east of the building along the groundwater flow path between MW-7 and MW-10, the two wells with the highest VOC concentrations on the site. The purpose of this well cluster is to evaluate contaminant distributions along the line of the groundwater plume, and to evaluate the potential for vertical gradients to affect contaminant distributions in groundwater.
- MW-18 will be installed near the brick storage shed east of the main building in a location downgradient of VOC-contaminated soils remaining at depth in area 2A following the IRM.



Note: MW-9 Destroyed During IRM

Figure 4-1	Job #: TM0013-001	Proposed Monitoring Well Locations	Duke Engineering & Services (Canada), Inc. A Duke Energy Company
Date: June 2000	Drawn/File Name: VP/Fig4_1.cdr	Former Carborundum Company - Electric Products Division	3075 14th Avenue, Suite 207 Markham, Ontario Canada L3R 0G9 (905) 513-9400 fax (905) 513-9405

- MW-19 will be installed near the east property boundary to evaluate potential impacts from VOC-contaminated soil remaining on the east property boundary and at depth in area 2A following the IRM.

Groundwater monitor wells will be completed as well couplets in a manner similar to that used during previous well couplet installation on the site. One shallow monitoring well will be installed in the Pleistocene overburden above the Lockport Dolomite and a deeper monitoring well will be installed into the upper section of the Lockport Dolomite. Each well will be installed in separate boreholes to ensure the integrity of the borehole seal and to prevent leakage between wells. Monitor well locations will be numbered from MW16A and B to MW19A and B, continuing the previous well numbering system.

4.1.2 Shallow Monitoring Well Installation

During the drilling of the monitor wells, an exclusion zone will be established around the drilling rig with caution tape. Unauthorized individuals will not be allowed to enter the exclusion zone. The drilling contractor will place 6 mil plastic sheeting over the ground surface at each well location to minimize contamination of surface soils. A four-foot by eight-foot sheet of 5/8-inch thick plywood will be placed over the plastic as a working surface and an appropriately sized hole will be cut into the plywood to accommodate down-hole tools.

At each couplet location, a shallow monitor well will be completed into the Pleistocene overburden, to a depth similar to other shallow wells on the site, using hollow stem auger drilling techniques. Drilling will be carried out by a qualified drilling contractor using a truck-mounted CME 55 drill rig or equivalent equipped with 4.25 in I.D. hollow stem augers.

Hollow stem augering will be completed to a depth no greater than 20 feet. If refusal is encountered prior to 20 feet, then the bottom of the well casing will be set 3 feet above the refusal depth after first sealing the auger hole with 2 feet of bentonite capped with 1 foot of sand. A monitor well consisting of 2 in I.D. schedule 40 flush jointed PVC riser pipe with a 5 ft long screen will be installed inside the hollow stem auger. The monitor well will be capped and will extend approximately 3 feet above ground surface in non-traffic areas. Wells will be protected with a 5 foot long, locking steel casing that will be installed at surface to protect the monitor well casing. The casing will be sealed with a cement pad sloped to ensure that surface water runoff drains away from the well. Wells installed in potential traffic areas will be cut just below ground surface and will be finished with a flush-mounted protective cover.

As the augers are removed, coarse, clean silica sand will be installed between the augers and the well casing to approximately 1 foot above the screened interval of the monitor well. The top of the sand pack will be measured with a tape to ensure that it is completed above the screen. A bentonite seal 2 feet in thickness will be placed above the sand pack. A grout consisting of 3-5 percent bentonite and Portland cement will be placed into the annulus above the bentonite seal. Well construction will be similar to that used for existing wells on site.

4.1.3 Deep Monitoring Well Installation

Deep monitor wells will be installed into the upper 15 feet of the Lockport Dolomite at each couplet location identified on Figure 4-1. Boreholes for 2 inch diameter monitor wells will be advanced using 4.25 inch I.D. hollow stem augers to the top of bedrock. A temporary 4 inch I.D. steel casing with a spin bit will be advanced into the top of bedrock. An HQ-sized core barrel and drill rods fitted with a diamond bit will be used to complete the borehole into bedrock using air rotary methods. The air compressor will be equipped with a filter to prevent introduction of contaminants into the borehole. The air rotary method was chosen because this method was used successfully on the site during previous well installation activities.

Drill cores will be logged by a geologist for lithology, color, texture, fracture density and evidence of contamination. Cores will be stored in labeled core boxes and retained by BP on site.

Installation of deep bedrock monitor wells will follow the same installation procedure as described for the shallow overburden monitor wells except a 10 foot long screen will be installed in the hole to optimize the intersection of fractures and groundwater in the upper portion of the

Lockport Dolomite. A sand pack will extend to approximately 1 foot above the top of the screen. A bentonite seal 2 feet in thickness will be placed above the sand pack and the hole will be completed with a bentonite/Portland cement grout to surface. The well will be protected with an above ground locking steel casing or a flush mounted, surface casing and lockable well cap.

Above ground locking steel casings will be protected from damage from vehicular traffic by the installation of three bollards consisting of steel casing filled with concrete.

4.1.4 Well Development

Each well will be developed by means of purging using a bailer, surge block and/or pump. Development will be conducted for a maximum of three hours or until turbidity reaches 50 nephelometric units (NTUs) and temperature, pH and conductivity stabilize. Previous experience from the site suggests that the turbidity in the overburden wells and some bedrock wells will not reach 50 nephelometric units after 3 hours of well development. If groundwater in the well exceeds 50 NTUs after three hours of developing, but temperature, conductivity, and pH have stabilized, the well will be considered developed.

Groundwater produced during well development will be disposed to the City of Niagara Falls sanitary sewer system via a Town of Niagara sewer manhole located in Rhode Island Avenue, per a City of Niagara Falls wastewater discharge permit dated August 11, 1999, see Appendix A.

4.2 SOIL, GROUNDWATER AND SEWER SAMPLING

4.2.1 Soil Sampling

Collection of continuous split-spoon soil samples and PID screening of soils will be conducted from ground surface to the bottom of each monitoring well borehole to screen soils for potential zones of contamination. Continuous soil sampling will be conducted at one well per couplet using a split spoon sampler following ASTM-D-1586 standards. The stratigraphy of each surface soil or split spoon sample will be logged in the field by a geologist for color and texture. Soil sampling for laboratory analysis is not expected during well installation. If evidence of contamination is identified during drilling (i.e., visual staining/odors and high PID readings), a soil sample will be collected for analysis of VOCs.

4.2.2 Groundwater Sampling

Groundwater sampling will be conducted as part of the groundwater monitoring program. Sampling will consist of periodic purging and sampling of monitoring wells and analysis of samples for VOCs. Sampling will be conducted on a semi-annual basis (twice per year). In Year One, sampling will be conducted in the spring and fall seasons. The purpose of spring sampling is to evaluate groundwater conditions during periods of high water levels. Sampling in the fall will examine groundwater conditions during a period of relatively low water levels. Fall sampling will also allow comparison of new data to old sampling data collected in the fall in 1997 and 1999. Sampling in subsequent years may be conducted during different seasons. A groundwater database will be generated to compile subsequent rounds of sampling data for comparison.

Each monitor well will be sampled after the wells have been purged. Each well will be equipped with a dedicated hand inertial pump, which will consist of a foot valve attached to a high density polyethylene riser tube. Sampling will occur following the purging of 3 to 5 borehole volumes of water from the well. A borehole volume will be calculated as the volume of the standing water in the well plus the water contained within the sand pack. Purge water will be discharged as per a City of Niagara Falls wastewater discharge permit dated August 11, 1999. During purging, groundwater will be monitored for pH, temperature, conductivity and turbidity. In addition, observations of the discharge water will be made for color, odor and turbidity as well as for the presence of non-aqueous phase liquids. During transfer of the sample from the pump to the sample bottle, care will be taken to avoid any unnecessary agitation, which may result in loss of VOCs. Weather conditions at the time of sampling will be recorded. All observations will be recorded in a field notebook.

4.2.3 Sewer Sampling Investigation

An investigation of the Town of Niagara sanitary sewer located south of the site beneath Rhode Island Avenue will be conducted to evaluate the potential for sewers to impact groundwater contaminant distributions south of the site. Sanitary sewer effluent samples will be collected from a manhole in Rhode Island Avenue east of Panama Street, which is two blocks east of the eastern site boundary. This will serve as an "upgradient" sampling location. Two effluent samples will be collected from manholes located immediately south of the site in Rhode Island Avenue. One will be collected from the manhole located closest to, but not in, Hyde Park Boulevard (MH1). A second will be collected from the manhole east of MH1. These two samples will be "site" sampling locations, see Figure 4-2 for sewer sampling locations. Sewer effluent samples will be collected prior to well purging and water disposal activities to avoid sampling of any purged groundwater that is disposed to the sewers during well purging and sampling. Results of this effluent sampling will provide information on the possibility that groundwater contaminated with VOCs is migrating into the sanitary sewer system.

Sewer effluent samples will be collected by removing the manhole cover and using a telescoping pole to collect a sample. A clean, wide-mouth glass laboratory jar will be attached to the end of the telescoping pole and used to collect a grab sample of liquid flowing in the sewer. The grab sample will then be transferred to laboratory-prepared sample containers for analysis. Sewer effluent samples will be analyzed for VOCs, the contaminant of concern in groundwater on the site.

In order to determine how the sewer system may be influencing groundwater flow and contaminant transport, a licensed surveyor will survey the location and elevation of each manhole where sampling will take place. If possible, the surveyor will also make a direct measurement of the elevation of the bottom of the sewer pipe at each sampling location. If direct survey is not possible, the distance to the bottom of each sewer pipe will be measured from a surveyed point at ground surface. This will provide information on the elevation of the sewer bottom versus the elevation of the water table.

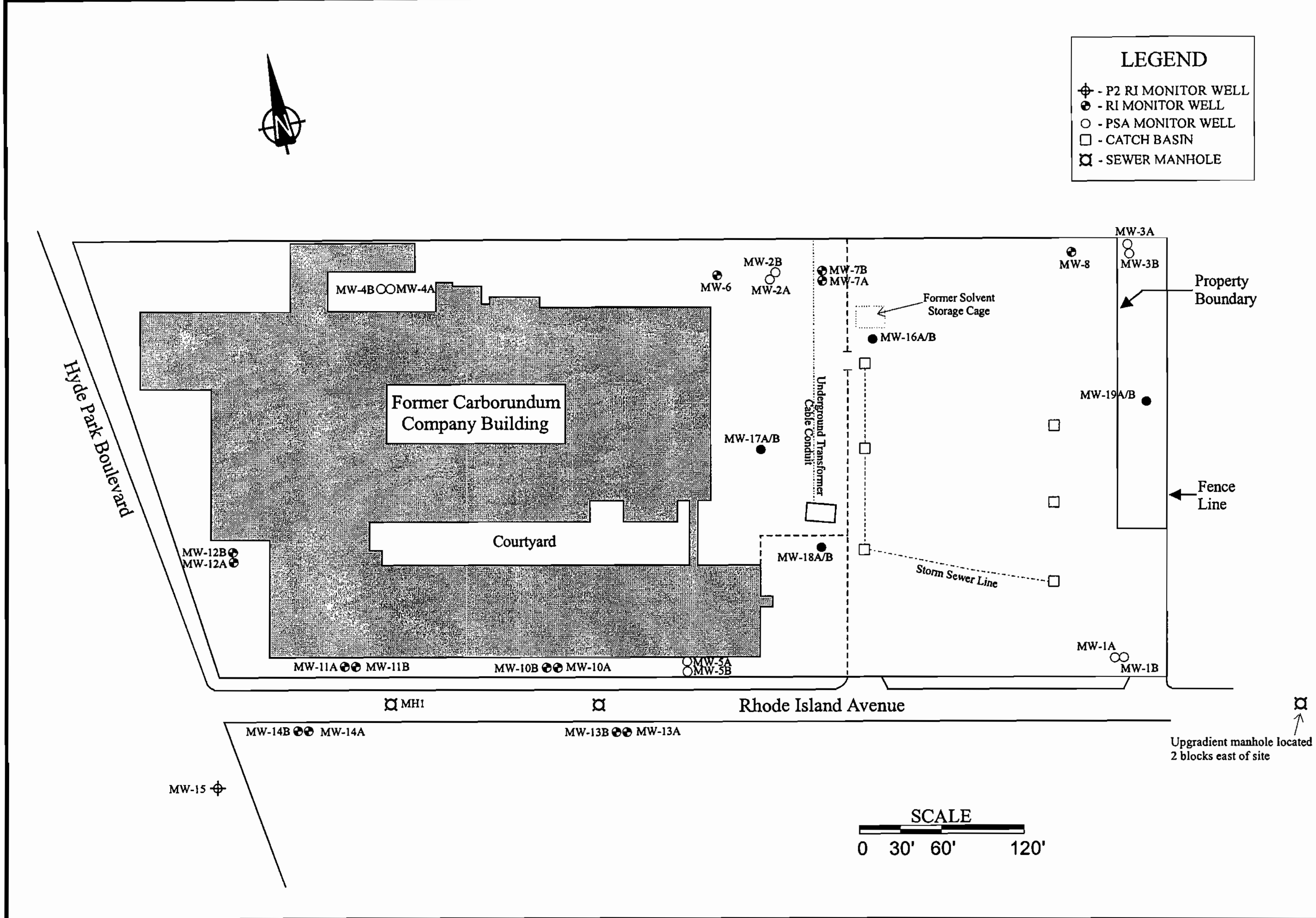


Figure 4-2	Job #: TM0013-001	Proposed Sewer Sampling Locations	**Duke Engineering & Services (Canada), Inc.** A Duke Energy Company
Date: June 2000	Drawn/File Name: VP/Fig4_2.cdr	Former Carborundum Company - Electric Products Division	3075 14th Avenue, Suite 207 Markham, Ontario Canada L3R 0G9 (905) 513-9400 fax (905) 513-9405

4.3 WATER LEVEL MONITORING

New and existing monitor wells will be surveyed for location relative to site landmarks and vertically to National Geodetic Vertical Datum by a licensed surveyor. The elevation of the top of the PVC riser and ground surface at each well location will be surveyed. The measured location on top of the PVC riser will be permanently marked. Water level measurements will be made from the marked location on top of the PVC riser. Water levels in the monitor wells will be measured using an electric water level tape to within ±0.01 inches. Water levels will be recorded upon completion of new well installation, after new well development, and prior to purging and groundwater sampling in both new and existing wells. To prevent cross-contamination, after each measurement and prior to lowering the tape into another well, the water level tape will be decontaminated using the following procedures:

- paper towel wipe
- non-phosphate detergent wash
- deionized water rinse
- paper towel wipe

4.4 DECONTAMINATION PROCEDURES

Decontamination of drilling equipment will take place on a decontamination pad constructed at a secure location on site. The pad will consist of 6 mil heavy plastic sheeting attached to 2 inch by 6 inch boards. The plastic will be protected from damage by boards and plywood. The pad will be fitted with a sump. Decontamination of equipment will consist of removing accumulated solids by scraping and brushing, followed by steam cleaning. A portable steam cleaner will be used to decontaminate the drilling assembly and all downhole materials including augers, temporary casing, drill rods and core barrels. Equipment will be moved to the pad for decontamination before drilling commences and after the completion of each pair of monitor wells. Each individual well pair will be drilled using separate downhole tools. If this is not possible then all downhole equipment will be decontaminated between individual wells. All the downhole drilling equipment required to complete both the shallow and deep boreholes will be decontaminated before use at each subsequent well pair installations.

Decontamination effluent consisting of water and suspended matter will be removed from the sump into containers clearly labeled as "Liquid Purging/Decontamination Wastes". Once solids have settled, the water will be discharged to the sanitary sewer under a City of Niagara Falls wastewater disposal permit, see Appendix A. Solid wastes will be stored in 55-gallon drums and labeled as "Solid Drilling/Decontamination Waste". Drums will be moved to a secure area to be temporarily stored pending the results of sampling to determine the most appropriate method of disposal.

4.5 SOIL DISPOSAL AND SITE RESTORATION

Soil cuttings generated during drilling that are considered contaminated will be containerized and left on site pending sampling and appropriate disposal. Soil cuttings that are generated from wells installed in zones of clean fill documented in the IRM will be disposed as clean soil. The surface will be restored to its previous condition.

4.6 HEALTH AND SAFETY

Health and safety procedures are outlined in the Health and Safety Plan prepared for the RI/FS (Intera 1997). This plan has been updated and included in Appendix B for use during the Groundwater Monitoring Program.

5 SAMPLE ANALYSIS AND DATA VALIDATION

5.1 SAMPLE ANALYSIS

All analytical work will be completed by Severn Trent Laboratories, a New York State Certified analytical laboratory who has conducted previous analytical work at the site. The lab will report results in accordance with ASP Category B deliverables. All samples will be delivered to the laboratory in refrigerated coolers under chain of custody within 48 hours of collection following the handling protocols used previously at the site.

5.1.1 Soil Analytical Parameters

Soil sampling is not planned as part of the well installation and groundwater monitoring program. If soil samples are collected, they will be analyzed according to SW-846 protocol Method 8260 for VOCs.

5.1.2 Groundwater and Sewer Effluent Analytical Parameters

The analytical parameter list for the Groundwater Monitoring program was developed from the list of COCs based on the results of previous groundwater and soil sampling conducted at the site. All groundwater and sewer effluent samples collected from the site will be analyzed for VOCs using SW-846 protocol Method 8260.

Documentation of the natural attenuation process may require analysis of some parameters in addition to VOCs in groundwater. Natural attenuation can occur through several processes including methanogenesis, sulfate reduction, reductive dechlorination, etc. Two case studies have been published for two sites located in Niagara Falls, NY with similar geology (overburden and fractured bedrock) with chlorinated solvent contamination in groundwater. It was found that at both sites methanogenesis and sulfate-reduction were the primary microbial processes that contributed to natural attenuation (ITRC 1999).

To evaluate the potential operation of natural attenuation processes on contaminated groundwater at the Former Carborundum Company site, selected wells will be sampled for the following additional parameters as suggested by the ITRC (ITRC 1999):

- Methane, ethene, ethane, propane, propene
- TOC, BOD, COD
- Iron (II & III)
- Chloride, nitrate, nitrite, sulfate
- Sulfide

Ten well clusters will undergo sampling for these additional parameters. The well clusters chosen for these additional analyses (described below) are located along the groundwater flow path in upgradient, cross-gradient, downgradient locations and in source areas, as suggested in the Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water (USEPA 1998).

- Well cluster MW-3 will serve as an upgradient well because it is located upgradient from the areas of identified soil contamination.
- Well cluster MW-16 will serve as a source area location because it will be installed near the former solvent storage cage where the highest soil concentrations were observed during the IRM. Well cluster MW-7 may be used as a source area well if VOC concentrations in MW-16 are found to be low.
- MW-17 is located between the source area and the property boundary along the approximate direction of groundwater flow, and will be used as a monitoring point in the center of the estimated groundwater contaminant distribution area.
- MW-10 will be used as a downgradient well located near the property boundary.
- MW-14 will be used as a well located downgradient of the leading edge of groundwater contamination in the overburden.
- Wells MW-18 and MW-1 will be sampled to examine conditions perpendicular to the groundwater flow path to the east.
- MW-4 will be sampled to examine conditions perpendicular to the groundwater flow path to the west.

- Wells MW-5 and MW-11 will be sampled because they are located along the south property boundary approximately perpendicular to the groundwater flow path.

5.1.3 Groundwater Field Parameters

Field measured parameters will include the standard conductivity, temperature, pH, and turbidity used to determine the condition of groundwater entering the well prior to sampling. Additional field parameters that may be indicators of the natural attenuation process such as dissolved oxygen (DO) and oxidation reduction potential (ORP) will be monitored. DO concentrations will be measured using a YSI Model 55 Handheld Dissolved Oxygen System or a similar meter with a 25 foot probe cable. The probe will be lowered into each well immediately after purging. The probe will be agitated through the water at a rate of 1 ft/second while measuring DO concentration. ORP will be measured using an Orion 290A pH-Concentration Meter fitted with an ORP probe or a similar meter. The ORP probe will be inserted into a flow-through cell and measurements will be collected at each well following purging. All probes used for collecting direct field measurements will be decontaminated using the following procedures:

- paper towel wipe
- non-phosphate detergent wash
- deionized water rinse
- paper towel wipe

In addition to the measurement of field parameters as described above, a field analysis will be conducted for ferrous iron (Iron [II]). The analysis of this parameter must be done immediately because ferrous iron is not stable and cannot be measured accurately in a laboratory due to shipping delays. Field analysis of Iron II will be performed using a Hach Model IR-18C color disc method with 1, 10 Phenanthroline. The color disc method uses a continuous-gradient color wheel for color matching. Typical accuracy is ±10%. This method has a detection range of 0-10 mg/L. The field sample collected for determining ferrous iron concentration must be sediment free; therefore, each sample should be collected prior to purging each well.

5.2 QUALITY ASSURANCE/QUALITY CONTROL MEASURES

Blind field replicate samples will be collected and analyzed at the rate of one replicate for every ten field samples. Field replicates will provide an indication of laboratory precision, as discussed in the Quality Assurance Program Plan (QAPP, Intera 1995), attached as Appendix C. Travel blanks will also be collected to ensure that samples collected from the field are not contaminated with COCs during sample handling or shipment. One travel blank will be shipped in each cooler containing samples for VOCs analysis. A summary of the sampling and quality assurance program is provided in Table 5-1. A summary of sample type, container type, sample volumes, preservation methods and sample maximum holding times are provided in Table 5-2.

Water samples for VOC analysis will be collected unfiltered and without headspace in 40 ml clean, laboratory prepared, labeled bottles. Preservation will consist of maintaining sample temperature at 4°C. Samples will be stored in refrigerated coolers, sealed and delivered to the laboratory within 48 hours of collection. All samples will be listed on a chain-of-custody record. This record will be initialed by the laboratory and will accompany the shipment of clean sample bottles. The laboratory will relinquish custody of the bottles to DE&S field personnel who will complete the records for each sample taken. The custody record will be signed off by field personnel on delivery of the samples to the laboratory. Further details on sampling are provided in Appendix C.

Table 5-1 Summary of Sampling and QA Program

Sample Media	Sample Type	Number of Field Samples	Number of Field Replicates	Expected Number of Travel Blanks	Expected Number of Laboratory Blanks and Spikes	Analytical Method
Soil	VOCs	None expected	None expected	1/sample shipment (est. 6)	None expected	SW846 Method 8260B
Sewer Effluent		3	1		1	
Ground water		33	3		6	
Ground water	Methane, Ethene, Ethane, Propane, Propene	20	2	0	3	USEPA RSK175
	TOC	20	2	0	3	USEPA 415.1
	BOD	20	2	0	3	USEPA 405.1
	COD	20	2	0	3	USEPA 410.1
	Total Iron (mathematical calculation will be made of Iron III conc.)	20	2	0	3	USEPA 6010B
	Chloride	20	2	0	3	Standard Method 325.2
	Nitrate/Nitrite	20	2	0	3	USEPA 353.2, 354.1
	Sulfate	20	2	0	3	USEPA 375.4
	Sulfide	20	2	0	3	USEPA 376.2

Table 5-2 Summary of Sampling Specifications

Sample Type	Container Type	Sample Volume	Preservation Method	Maximum Holding Time (Days)
VOCs in soil	wide mouth glass jar with teflon top	4 oz	Cool 4°C	7
VOCs in water	40mL glass vial with septum top	3x40 mL	Hydrochloric acid, Cool 4°C	7
Methane, Ethene, Ethane, Propane, Propene	40mL glass vial with septum top	3x40 mL	Hydrochloric acid, Cool 4°C	7
TOC	40mL glass vial with septum top	3x40 mL	Sulfuric acid	7
BOD*	1L plastic	1L	None	48 hrs
COD	250 mL plastic	250 mL	Sulfuric acid	28
Total Iron	500 mL plastic	500 mL	Nitric acid	6 months
Chloride	250 mL plastic	250 mL	None	28
Nitrate/Nitrite	250 mL plastic	250 mL	Sulfuric acid	48 hours/28 days
Sulfate	250 mL plastic	250 mL	None	28
Sulfide	250 mL plastic	250 mL	Sodium hydroxide and zinc acetate	7

* note: the lab runs BOD analyses on Mondays and Wednesdays from 4pm to midnight. Sample collection and submission will be timed accordingly.

5.3 DATA VALIDATION

The project QA Officer will review all data generated during field and laboratory tasks. This will include:

- assessment of field work
- assessment of field sampling
- assessment of data validation report

Field work, including soil and water sampling, will be assessed for completeness and adherence to the project work plan.

All field sampling data will be assessed according to adherence to strict sampling and QA/QC protocols. Completeness of the sampling program will be assessed by determining if all samples were collected and analyzed. Assessment will also be made with respect to preservation techniques, quality control samples, chain of custody procedures and sample holding times. Data collected for laboratory analysis to evaluate natural attenuation processes will also be reviewed to be the sure the appropriate analytical method was used and appropriate instrument calibration was performed.

Analytical data for VOCs will be validated and qualified by applying standard statistical methods to the laboratory results. The precision and accuracy of the laboratory method will be assessed by how well replicate samples and analyte recovery data fall within statistically defined control limits. Data validation procedures will be based on the assessment of analytical reports submitted in accordance with ASP Category B deliverables. Complete details of data assessment are provided in the QAPP.

6 DATA EVALUATION AND REPORTING

Following data validation, groundwater sampling data will be reviewed for the purposes of assessing changes in the extent and character of contamination at the site, and to evaluate the rate of natural degradation of contaminants. Sampling results will be added to a cumulative database that can be used to present and evaluate subsequent rounds of analytical results.

6.1 GROUNDWATER MONITORING PROGRAM REPORT

Interim and annual reports will be prepared as part of the Groundwater Monitoring Program. An interim report consisting of a brief summary of interim monitoring analytical results, groundwater elevation and contaminant contours in both the overburden and bedrock zones will be prepared and submitted to the NYSDEC within 60 days of completing the first round of sampling each year. An annual report will be submitted by March 1st of every year and will report and evaluate data for the previous calendar year. The first annual report will be due March 1, 2001, and will cover sampling data collected in October 1999 and from the Fall 2000 monitoring. Each annual report will also include a description of the extent and character of VOCs in groundwater, results of sewer sampling, water level monitoring results, and a description of other work items completed (i.e., installation of monitoring wells, piezometers, etc). Summary tables, figures and graphs will be used to present current and cumulative sampling results. The report will document the extent of groundwater containing COCs above NYSDEC Groundwater Standards/Criteria, well construction details, a summary of sampling procedures and results, and a summary of site hydrogeologic conditions. A discussion of the effectiveness of the monitoring program will also be provided, along with recommendations for changes to the work plan.

The report will include a discussion of the following components:

- Introduction - background information to the study, purpose of the work program and scope of work.
- Work Program - detailed description of the field program including rationale for sampling locations, sampling methods and field QA/QC.

- Results of Work Program - presentation of field sampling and testing data and laboratory analytical data. Monitoring well boreholes and well installation details will be described on well logs. Laboratory analytical data will be summarized in tabular form.
- Data Validation - discussion of QA/QC and data validation results.
- Extent of Contamination - discussion of the results of field work will be provided in terms of the extent of groundwater contamination and how concentrations have changed with time. A discussion of the natural attenuation process will also be provided. Results will be evaluated against the goals of the monitoring program to determine if changes to the program are required.
- Summary and Conclusions
- Recommendations

6.2 PROGRESS REPORTS AND MEETINGS

Two meetings per year, or as mutually agreed to, will be held with BP, DE&S and the NYSDEC. The purpose of these meetings will be to discuss the monitoring program and results, or other pertinent project issues.

7 PROJECT SCHEDULE

The groundwater monitoring program will be scheduled to begin in the fall of 2000. Therefore, monitoring well installation, development, and the well and sewer location/elevation survey is proposed for October 2000. The first round of groundwater sampling is proposed for October 2000 and the second round is proposed for April 2001.

The schedule for reporting and other aspects relating to the completion of this project for Year 1 and Year 2 and subsequent years is estimated as shown on Figures 7-1 and 7-2.

FIGURE 7-1 YEAR 1 Monitoring Schedule (Mar '00 to Mar '01)

ID	Task Name	Duration
1	Monitoring Well Installation & Development	5d
2	Well and Sewer Survey	1d
3	Water Level Monitoring Round	1d
4	Groundwater and Sewer Sampling Round	6d
5	Laboratory Sample Analysis Round	15d
6	Data Validation and Evaluation Round	15d
7	Prepation of Interim Report	10d
8	Submission of Interim Report	1d
9	Preparation of Annual Report	15d
10	Submission of Annual Report	1d

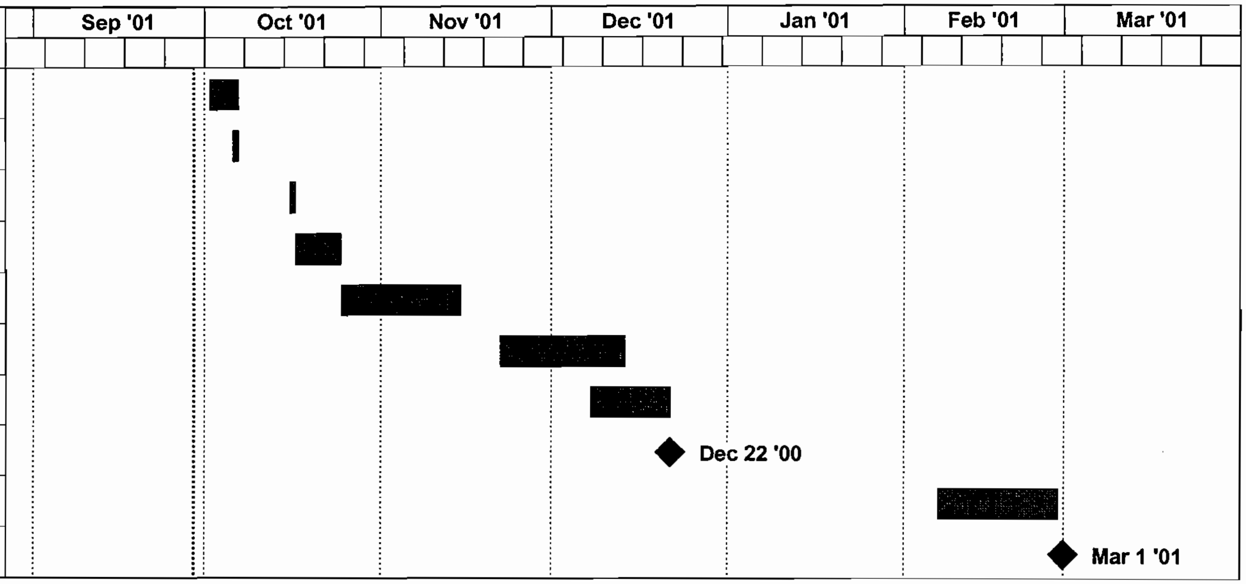


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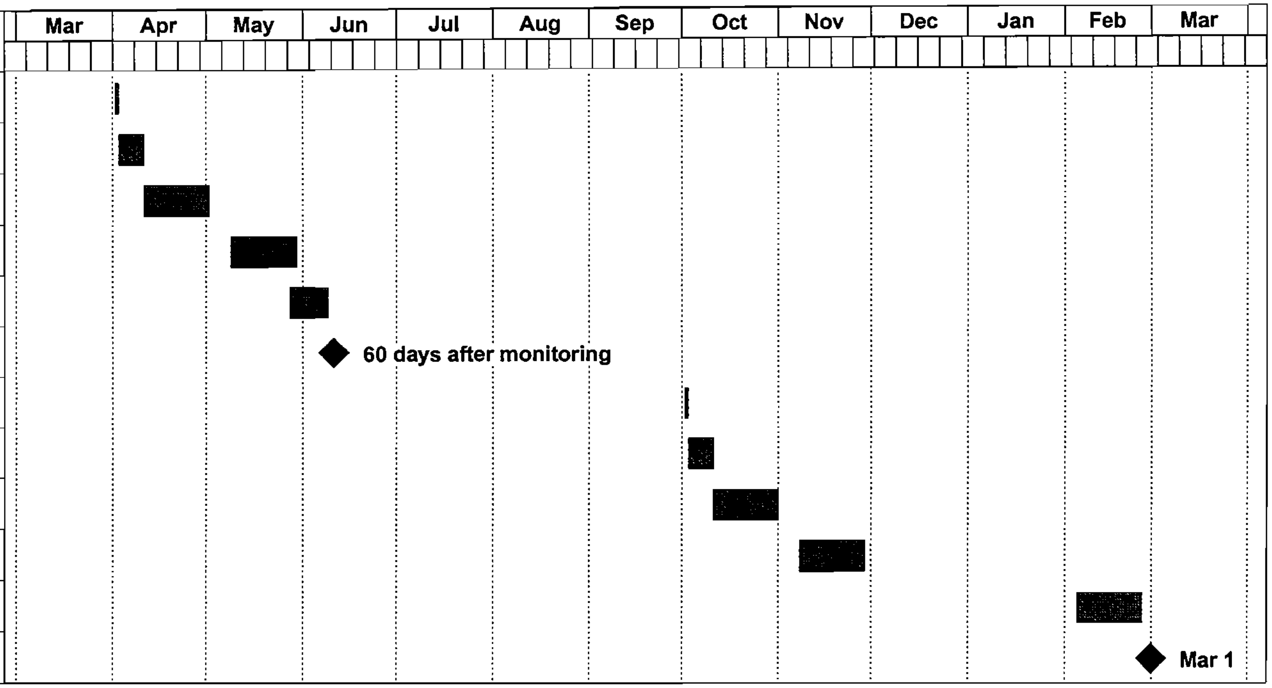
FIGURE 7-2 YEAR 2 and Subsequent Years Monitoring Schedule

ID	Task Name	Duration
1	Water Level Monitoring Round 1	1d
2	Groundwater and Sewer Sampling Round	6d
3	Laboratory Sample Analysis Round 1	15d
4	Data Validation and Evaluation Round 1	15d
5	Prepation of Interim Report	10d
6	Submission of Interim Report	1d
7	Water Level Monitoring Round 2	1d
8	Groundwater and Sewer Sampling Round	6d
9	Laboratory Sample Analysis Round 2	15d
10	Data Validation and Evaluation Round 2	15d
11	Preparation of Annual Report	15d
12	Submission of Annual Report	1d



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8 REFERENCES

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DE&S (1999d)	Execution of the Interim Remedial Measure for the Former Carborundum Company - Electric Products Division, Hyde Park Facility, Town of Niagara, Niagara County, New York, Site No. 932036, December 1999
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ITRC (May 1999) Natural Attenuation of Chlorinated Solvents in Groundwater: Principles and Practices, May 1999. Interstate Technology and Regulatory Cooperation Work Group, In Situ Bioremediation Work Team.

NYSDEC (1991a) Water Quality Regulations for Surface Waters and Groundwater NYSDEC - 6NYCRR, Part 703

NYSDEC (1991b) Ambient Water Quality Standards and Guidance Values NYSDEC TOGS 1.1.1

URS (1990) URS Consultants, Inc. Engineering Investigations at Inactive Hazardous Waste Sites, Preliminary Site Assessment, Carborundum Company Globar Plant Site No. 932036 Niagara (T), Niagara (C), Prepared for: New York State Department of Environmental Conservation, Division of Hazardous Waste Remediation.

USEPA (1998) Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water, September 1998. United States Environmental Protection Agency, Office of Research and Development. EPA/600/R-98/128.

APPENDIX A
City of Niagara Falls Water Disposal Permit

City of Niagara Falls, New York

P.O. Box 69, Niagara Falls, NY 14302-0069

August 11, 1999

Ms. Kristen E. Hanson, M.Sc.
Senior Hydrogeologist
Duke Engineering & Services (Canada), Inc.
3075 14th Avenue, Suite 207
Markham Ontario L3R0G9

Dear Ms. Hanson:

The City has completed the review of your request dated July 29, 1999 which requests permission to discharge wastewater from the Carborundum remedial site, generated incidental to periodic sample collection. It is estimated that 500 gallons of contaminated groundwater would be generated during each sampling event. Based on previous pollutant analysis collected during the excavation phase the pollutant load would be well below City Sewer Use Ordinance limits (list attached).

Based on this information the City hereby grants approval of this discharge subject to the following conditions.

a) The discharge shall be limited to a daily maximum of 1,000 gallons and a total of 6,000 gallons per year.
b) The pollutant analysis results from each sample collection event will be submitted to the City as soon as available.
c) This discharge is subject to all conditions and limitations contained in the City of Niagara Falls Sewer Use Ordinance Chapter 250.
d) The cost of disposal will be a flat rate of $1000.00 per year. The amount will be made payable to "The City Controller" and submitted by January 15 of each year.

Sincerely,
DEPARTMENT OF WASTEWATER FACILITIES

Albert C Zaepfel

Albert C. Zaepfel
Industrial Monitoring Coordinator

Att
ACZ:vr
Cc: W. Bolents
K. Martineau
Semi-Ann. Report NYSDEC/USEPA
File – Duke Eng. (ICU)
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8/29/96

LOCAL ORDINANCE LIMITS

PARAMETER	LBS/DAY
Volatile Organics	
Benzene	0.062
Carbon Tetrachloride	0.046
Chlorodibromomethane	0.015
Monochlorobenzene	0.200
Dichlorobromomethane	0.011
Chloroform	0.055
1,1-Dichloroethylene	0.065
1,2-Dichloroethylene	0.065
Bromoform	0.020
Ethyl Benzene	0.047
1,1,2,2-Tetrachloroethane	0.027
Tetrachloroethylene	0.114
Toluene	0.344
1,1-Trichloroethane	0.020
1,2-Trichloroethane	0.020
Trichloroethylene	0.088
Methylene Chloride	0.150
Vinyl Chloride	0.030
Acid Extractable Organics	
Monochlorophenol	0.063
Dichlorophenol	0.038
Monochlorocresol (Chloro-Methyl-Phenol)	0.036
Trichlorophenol	0.102
Pentachlorophenol	0.038
Base/Neutral Extractable Organics	
Dimethyl Phthalate	0.052
Butyl Benzyl Phthalate	0.102
Di-N-Butyl Phthalate	0.052
Diethyl Phthalate	0.204
Di-N-Octyl Phthalate	0.052
Monochlorotoluene	1.400
Nitrosodiphenylamine	0.025
Dichlorobenzene	0.016
Dichlorotoluene	0.016
Acenaphthene	0.024

LOCAL ORDINANCE LIMITS

PARAMETER	LBS/DAY
Base/Neutral Extractable Organics	
Fluoranthene	0.009
Chrysene	0.009
Naphthalene	0.022
Benzo(a)Anthracene	0.009
Pyrene	0.009
Phenathrene	0.017
Trichlorobenzene	0.076
Trichlorotoluene	0.076
Hexachlorobutadiene	0.009
Tetrachlorobenzene	0.076
Hexachlorocyclopentadiene	0.088
Hexachlorobenzene	0.009
Monochlorobenzotrifluoride	0.200
Dichlorobenzotrifluoride	0.200
PCB's and Pesticides	
Hexachlorocyclohexane	0.014
PCB (as Arochlor 1248)	0.006
Endosulfan I + Endosulfan II + Endosulfan Sulfate	0.002
Mirex	0.006
Dechlorane Plus	0.006
Heptachlor + Heptachlor Epoxide	0.002
Metals (Total)	
Cadmium	0.008
Chromium	0.040
Copper	0.965
Lead	0.320
Mercury	0.008
Nickel	0.400
Zinc	1.380

LOCAL ORDINANCE LIMITS

PARAMETER	LBS/DAY
Other	
Total Phenols	0.474
Soluble Organic Carbon	48.8
Total Suspended Solids	200.0
Phosphorus	2.0
Cyanide	0.155
Flow	0.025 (MGD)

APPENDIX B
Health and Safety Plan

Duke Engineering
& Services (Canada), Inc.SM
A Duke Energy Company

240 Duncan Mill Road, Suite 103
Toronto, Ontario M3B 1Z4

Tel : (416) 447-9400
Fax: (416) 447-9405

Health and Safety Plan for Well Installation and Groundwater Monitoring at the Former Carborundum Company - Electric Products Division Hyde Park Facility

Town of Niagara, Niagara County, New York

Site No. 932036

Prepared For:
BP
4850 E 49th St, MBC3-149
Cleveland, Ohio
44125

Prepared By: Duke Engineering & Services Inc.

Project No. TM0013-001

August, 1995
revised September, 2000

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1. INTRODUCTION

This document is a Health and Safety Plan (HSP) that describes the health and the safety policy and procedures that will be utilized and enforced during the implementation of the Well Installation and Groundwater Monitoring Program at the former Carborundum Company Electric Products Division facility (the facility) in Niagara Falls, Niagara County, New York. The facility is currently occupied by KANTHAL-GLOBAR Inc. (KANTHAL-GLOBAR). The purpose of the HSP is to ensure the safe operation of all field activities, especially those posing potential health and safety hazards to the field team, facility personnel and the surrounding community. This HSP is adapted from the HSP prepared and approved for the RI/FS at the site, dated August 1995. This document was tailored to address health and safety issues associated with activities that will be conducted during the Groundwater Monitoring Program.

1.1. Policy

In the conduct of all operations, the primary responsibilities of Duke Engineering & Services Inc. (DE&S) and its affiliates are the health and safety of employees, contractors, and the public; and the protection of the environment. Accordingly, in this investigation, all operations at the facility will be conducted with regard to all applicable regulations. All project goals, standards of performance, and deadlines will be accomplished to the highest level of technical competence only insofar as safety and health issues allow.

This HSP provides guidelines for the safe conduct of field operations. Because employee safety is of primary importance in all job-related activities, the effective adherence to the procedures and guidelines within this plan should be combined with common sense, judgement, and experience. In the event that any safety concern arises during the course of a job-related activity and this HSP does not adequately address the situation, advice will be sought from the DE&S Site Safety Officer (SSO), and Mr. Nathan I. Bigman, BP Site Safety Coordinator (SSC), and Mr. Carl Horst, the KANTHAL-GLOBAR Plant Safety Officer (PSO). Operations will only proceed when all questions regarding the health and safety of personnel and/or the public have been resolved.

1.2. Background

Many of the guidelines presented in the HSP have been adapted from the NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities and the U.S. Environmental Protection Agency's National Enforcement Investigations Center (NEIC) Safety Manual, both of which adhere to the requirements set forth by the Occupational Safety and Health Act (OSHA).

1.3. Purpose & Scope

The purpose of the HSP is to provide safety guidelines and procedures to be followed by all employees.

The HSP identifies work-place-specific hazards and provides precautionary guidelines to ensure safe working conditions. Potential hazards may involve:

- Fire and Explosion
- Industrial Hygiene
- Hazardous Gases and Liquids
- Industrial Safety including heavy equipment operations
- Material Handling, Storage and Decontamination

The HSP includes safe operational procedures for conducting borehole drilling and groundwater sampling including general conduct in soil sampling and basic data collection, use of specialized equipment, and actions in the event of emergencies. All field operations will also comply with KANTHAL-GLOBAR's safety requirements for the plant. All personnel will be briefed by the PSO prior to initiating field activities.

1.4. Responsibility

The development of the HSP is the responsibility of the Project Manager with input from the SSO and SSC. The final HSP is reviewed by the SSC.

The Project Manager is responsible for ensuring that the HSP is implemented at the start of the project; thereafter, day to day implementation of the HSP becomes the responsibility of the SSO and the SSC.

The BP SSC and the KANTHAL-GLOBAR PSO will brief the Project Manager and SSO on safety hazards and procedures before commencing any work on the site.

At the beginning of the work program, the SSO will conduct a comprehensive briefing session with subcontractors and field personnel and thereafter hold daily briefing sessions prior to the start of work each day to discuss the work plan for that day and review any changes to the work plan or HSP. The SSO will communicate regularly with the SSC to discuss the work activities and whether modifications to the work plan or HSP will be required for future work.

A copy of the HSP will be provided to all personnel involved in the field project. Field personnel including DE&S staff and drilling and surveying subcontractors will be required to review the document and sign the document indicating that they have read it prior to commencing work on the project. A copy of the signature page is provided as Appendix A. Key contacts are listed on Table 1.1.

Table 1.1 Key Contacts

Carborundum Company/BP Site Safety Coordinator		
Principal:	Mr. Nathan I. Bigman	(bus):011 972-9-745-4854
Alternate:	Mr. Richard Frankoski	(bus): (216) 271-8035
KANTHAL-GLOBAR Plant Safety Officer		
Principal:	Mr. Carl F. Horst	(bus): (716) 286-7625 (home): (716) 297-5888
DE&S Project Manager		
Principal:	Ms. Kristin Hanson	(bus): (416) 447-9400 (home): (905) 602-4184
Alternate:	Mr. Ken Raven	(bus): (613) 232-2525 (home): (613) 526-2763
DE&S Site Safety Officer		
Principal:	Mr. Michael Marcotte	(bus): (416) 447-9400 (home): (416) 483-1230
Alternate:	Mr. Rob Timlin	(bus): (613) 232-2525 (home): (613) 591-2419 (pager): (613) 788-2422

2. ENVIRONMENTAL CONCERNS

2.1. Previous Investigations & Results

During 1992 and 1993, the Carborundum Company retained DE&S to undertake soil and groundwater sampling to determine the nature and extent of contamination on the property. DE&S was retained by the Carborundum Company to undertake a remedial investigation/feasibility study (RI/FS) in 1996. A Phase II RI was subsequently performed in 1997. In 1998 DE&S conducted additional soil sampling as part of the IRM to further define the extent of soil contamination on the property and to improve the estimate of the volume of impacted soil on the site. In 1999 DE&S conducted excavation of the contaminated soil areas as part of the IRM. Over 90% of the contaminated soil on site was excavated and disposed offsite. Subsequent to a feasibility study completed by DE&S in 2000, the chosen method of remediation for groundwater, designated operable unit (OU) 2, on the site is groundwater monitoring. Four additional monitoring well couplets will be installed prior to the first round of groundwater sampling. Figure 3-1 shows the locations of existing monitoring wells and proposed additional monitoring well couplets. The Town of Niagara sewer system will also be sampled at three locations.

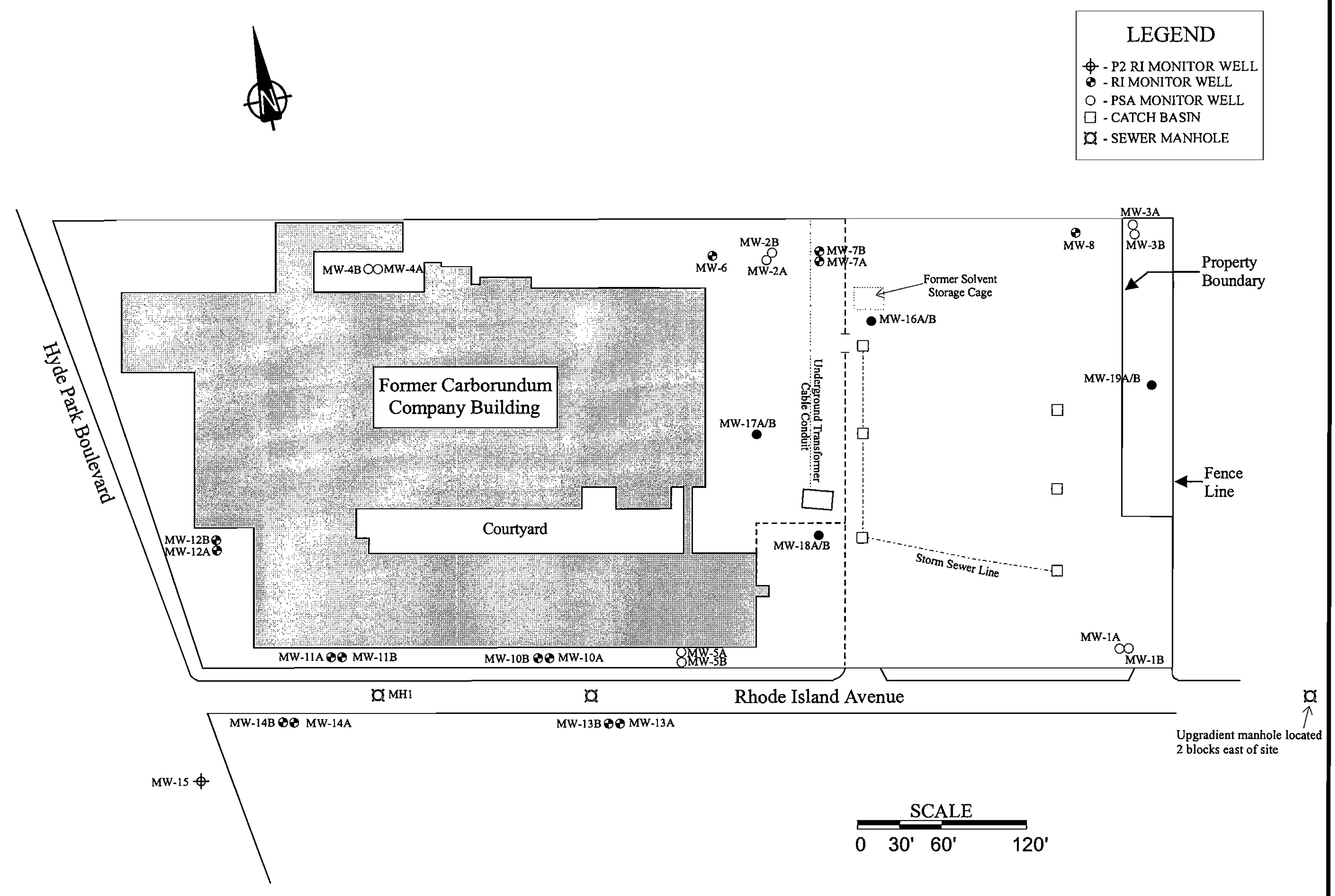


Figure 2-1	Job #: TM0013-001	Monitoring Well and Sewer Sampling Locations	Duke Engineering & Services (Canada), Inc. A Duke Energy Company
Date: June 2000	Drawn/File Name: VP/HSP2_1.cdr	Former Carborundum Company - Electric Products Division	3075 14th Avenue, Suite 207 Markham, Ontario Canada L3R 0G9 (905) 513-9400 fax (905) 513-9405

The Hazard Ranking System (HRS) score for the facility was calculated using the 1990 amended version of HRS and the EPA PREscore model. The site was scored using two approaches. The first approach was to assign reasonable and site specific conditions. The second approach was to assume very conservative conditions. The conservative assumptions allowed the nearest upgradient drinking water well to be considered as a downgradient well and considered the human consumption of sport fish from the Niagara River. In both instances, the overall HRS score for the site is very low.

Site Specific Conditions			Conservative Assumptions		
Sgw	=	0.00	Sgw	=	1.14
Ssw	=	0.30	Ssw	=	0.30
Ss	=	0.61	Ss	=	0.61
Sg	=	1.81	Sg	=	1.81
S	=	0.96	S	=	1.12

The overall site scores of 0.96 and 1.12 are well below the EPA cutoff value of 28.50 for placing a site on the National Priorities List, and the low values indicate that the overall environmental impact from the site is extremely low.

2.2. Nature & Extent of Environmental Issues

The nature and extent of environmental issues at the site are discussed under the following headings:

- Contaminants of concern
- Extent of contamination

2.2.1 Contaminants of Concern

Contaminants of concern (COCs) have been identified at the site on the basis of the preliminary site assessment conducted in 1992 and the follow up work conducted in 1993, and IRM and the RI/FS completed in 2000.

In soils, COCs prior to execution of the IRM (soil removal) included two groups of contaminants, VOCs and PAHs. The VOCs occured in all 5 contaminated areas on the site and include the following specific compounds:

1,2-dichloroethene
vinyl chloride
acetone
xylenes
trichloroethene
toluene
ethyl benzene

The PAHs were restricted to a small area in the vicinity of the north property fence and railroad spur and included the following specific compounds:

naphthalene
fluorene
anthracene
fluoranthene
benzo(a)anthracene
benzo(b)fluoranthene
benzo(a)pyrene
acenaphthylene
phenanthrene
pyrene
chrysene
benzo(k)fluoranthene
indeno(1,2,3-cd)pyrene

Removal of contaminated soils during the IRM removed over 90% of contaminated soils from the site. Some PAHs remain at low concentrations that are not considered to be a concern near the railroad spur area in the northern portion of the site. Some elevated concentrations of VOCs remain, but are located at depths of >10 ft and are not considered to be a concern.

PCBs were found in a soil sample from the courtyard area during the RI, but the concentration was below the TSCA guidance level of 10 ppm. Elevated levels of copper, nickel and zinc were found in three RI soil samples; two located in the former materials storage area and the third located in the courtyard. These metals are relatively immobile and do not pose a significant hazard to human health or the environment. No pesticides were detected in any of the soil samples.

In groundwater, COCs include soluble VOCs that exceeded State Groundwater Quality Standards or Guidance Values including:

vinyl chloride
trichloroethene

1,2-dichloroethene
1,1-dichloroethane
benzene

Elevated levels of aluminum, iron and antimony identified in several wells during the RI are considered to be due to natural sources within the overburden and bedrock and were within the potential range of background values for the Niagara Falls area. These levels are not considered to be actionable.

Semi-volatile organic compounds including PAHs, PCBs, and pesticides were not detected in any of the groundwater samples.

Detailed chemical hazard evaluation forms for selected VOC contaminants of concern that have been identified in groundwater and soil at the site are provided in HSP Appendix B.

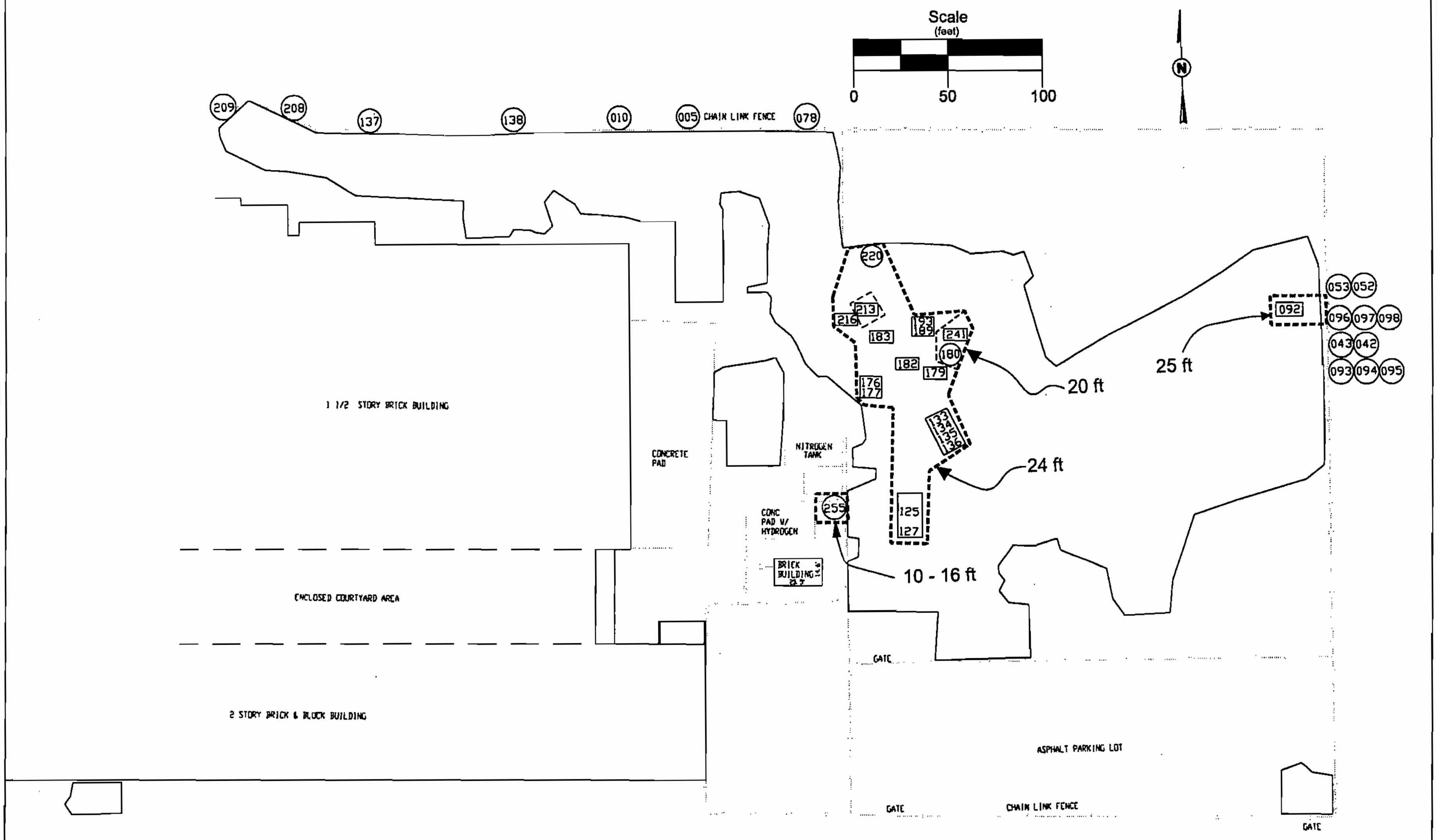
2.2.2 Extent of Contamination

2.2.2.1 Soil

A total of 35,606 tons, or approximately 23,700 yd^3 of soil were excavated and removed from the site (DE&S, 1999). An estimated total of 1980 yd^3 remains on-site at depths below 10 feet. The volume of soil remaining represents approximately 8% of the total volume of identified contaminated soil. Over 90% of contaminated soils have been removed from the property, including over 2000 tons of action level soil. Areas where contaminated soil remains on-site are shown on Figure 2-2.

2.2.2.2 Groundwater

It is likely that groundwater contamination in the shallow overburden on the site resulted from activities at the site. It is also likely that remediation of contaminated soil removed a significant source of the contamination to shallow groundwater beneath the site.



Note:

All samples displayed exceed cleanup objectives.
Samples 213 an 043 exceed action level for vinyl chloride.

Figure #:
2-2

Contaminated Soil Remaining On-Site

Project #: TM8097
Date: August 18, 1999
Drawn by: MSM
File Name: 8097Contamination.dwg

Legend

- ▬ ▬ ▬ ▬ Estimated extent of remaining contamination
- ── Top of bank - actual excavation
- 10 - 16 ft Approximate depth range of contamination
- ○ Wall Sample
- ☐ Floor Sample

Duke Engineering & Services (Canada), Inc.
A Duke Energy Company

240 Duncan Mill Rd.
Suite 103
Toronto, Ont.
M3B 1Z4
Phone (416) 447-9400
Fax (416) 447-9405

2.2.3 Potential Environmental Impacts

2.2.3.1 Soil

The major potential environmental impact from contaminated soil at the site could occur through (i) the volatilization of VOCs to air and direct inhalation, and (ii) by direct dermal contact with soils contaminated with VOCs and PAHs. The maximum potential exposure could occur to on-site workers during excavation associated with site remediation. Because of dilution, lesser impacts could occur via volatilization of VOCs to off-site residents and/or workers in the immediate area of the site.

2.2.3.2 Groundwater

Groundwater containing dissolved VOCs is moving beneath the site in overburden and bedrock and flowing downgradient toward the Niagara River. The major pathway of exposure would occur through ingestion of drinking water from a drinking water well located within the boundary of the contaminant plume. There are no known drinking water wells located within a distance of one mile downgradient from the site. The actual risk to human health via groundwater ingestion is believed to be negligible.

2.2.3.3 Surface Water

The closest surface water body located downgradient from the site is the Niagara River. Major receptors within the Niagara River include aquatic habitat and potable water supplies. The Niagara River is the main source of potable water supply to the Town of Niagara. Water intakes for the water supply are located upgradient from any discharge to the River that may occur from groundwater flowing from the site.

Surface water runoff from the site is unlikely to have any greater impact than runoff elsewhere in a developed urban environment.

3. SITE OPERATION

The field program will consist of installing monitoring wells and sampling groundwater as described in the Groundwater Monitoring Work Plan document.

3.1. Utilities

All underground utilities on site will be identified by DE&S and KANTHAL-GLOBAR prior to the initiation of site work. Estimated drilling locations will be staked and underground utilities will be located by the utility companies or utility locating service.

Drilling will proceed using extreme caution, and will not be conducted in the immediate vicinity of the buried lines.

High pressure hydrogen cylinders and buried lines exist on site. No drilling will take place in the vicinity of these features.

3.2. On-Site KANTHAL-GLOBAR Operations

On-site KANTHAL-GLOBAR operations will continue during the work. The washrooms, water fountains and lunchroom areas in the KANTHAL-GLOBAR facility are available to DE&S and their subcontractors during the IRM work. However, safety glasses and steel toe boots must be worn to enter the facility. Used protective outer clothing such as Tyvek coveralls and disposable gloves must not be worn into the facility. Care must be taken to observe the surroundings when walking through the plant due to potential injury from operations that include use of large machinery, such as forklifts.

3.3. Work Zones

To ensure safe working conditions and to protect field personnel, employees of KANTHAL-GLOBAR Inc. and the general public, a work zone will be established during on-site activities.

The zone of field activity is termed the **Exclusion Zone**. The perimeter area of the Exclusion Zone will be identified by "CAUTION" tape and will include the area surrounding the active drilling and/or sampling area. Access into the Exclusion Zone will be restricted to authorized personnel involved in the work program.

The area immediately surrounding the exclusion zone will serve as a support zone where clean equipment and supplies can be staged. Areas such as the Kanthal-Globar building where work is not to be conducted will be considered clean zones. Personnel engaged in activities in the Exclusion Zone will be required as a minimum to wear Level D personal protection. The actual level of personal protection required will be defined by air monitoring as outlined in Section 5.

3.4. Groundwater Monitoring Well Installation Procedures

Well installation will be conducted with caution to avoid underground utilities and above ground power lines. General construction safety precautions shall be followed around drilling equipment. Drilling staff will follow operation manuals and safety requirements for drilling equipment. DE&S field staff will not impede the drilling staff and will maintain adequate distance from the drill rig during operation.

During the drilling of the monitor wells, an exclusion zone will be established around the drilling rig with caution tape. Unauthorized individuals will not be allowed to enter the exclusion zone. The drilling contractor will place 6 mil plastic sheeting over the ground surface at each well location to minimize contamination of surface soils. A four-foot by eight-foot sheet of 5/8-inch thick plywood will be placed over the plastic as a working surface and an appropriately sized hole will be cut into the plywood to accommodate down-hole tools.

3.5. Groundwater Monitoring Well Sampling Procedures

Groundwater monitoring well purging and sampling will be conducted so as to minimize splashing of water onto surrounding areas. Splashing will be minimized by using large buckets and sufficient lengths of tubing. A Solinst Hydrolift will also be used to minimize potential injuries from repetitive actions associated with inertial hand pumps. Monitoring well locations are in off-site public areas as well as on Kanthal-Globar property; therefore, traffic cones and vests will be used to maximize visibility of the sampling crew. Work activities will only be conducted during daylight hours.

3.6. Soil Cuttings

The soil cuttings generated during drilling will be stored in drums and located in the north-east corner of the site along the north property boundary until appropriate disposal arrangements can be made.

3.7. Development and Purge Water

Water that accumulated during the development and purging of wells will be discharged to the City of Niagara Falls sewer system under an industrial wastewater discharge permit. Holding tanks may also be used to temporarily store water on-site for settling or testing prior to permitted discharge.

3.8. Site Security

KANTHAL-GLOBAR has 24-hour security for their normal facility operations and will provide overnight security checks on the on-site operations/equipment.

4. PERSONAL PROTECTION

Personal protective equipment (PPE) is required for all employees engaged in activities where there is a potentially hazardous or contaminated work location, or where there is a risk of exposure to accidents. For most working conditions, four levels of PPE are defined as indicated on Table 5.2. Ideally, the level of protection warranted by the project will be pre-determined by the Project Manager in consultation with the Site Safety Officer before undertaking work activities. Provisions will be made to allow for increasing the level of employee protection in the event conditions change, or monitoring results indicate an increased level of protection is necessary.

The level of protection for personnel will be initially set at modified Level D. Air monitoring will be conducted using a photoionization detector (PID) or equivalent on a frequent basis to assure that the appropriate level of protection is maintained or upgraded as necessary. PPE will be available at the site should air monitoring indicate that higher levels of protection are necessary. The decision to change levels of protection will be made jointly by the SSC and SSO and/or their designee.

A summary of the PPE requirements for Level D and Level C are as follows:

Level D

- Boots with steel toe and shank
- Safety glasses or chemical splash glasses
- Hard hat
- Cotton coveralls (optional)
- Work gloves (optional)

Modified Level D

- Clothing same as Level D

- Chemical resistant outerwear (Tyvek or similar material)
- Chemical resistant safety boots (neoprene or similar material) with steel toe and shank
- Surgical inner gloves
- Chemical resistant outer gloves
- Full face or half mask NIOSH approved air purifying respirators (APR) readily available should air monitoring indicate upgrade to Level C is required

Level C

- Same as Modified Level D with the addition of:
- Full face or half mask NIOSH approved APR with organic vapour cartridges

Level B or A work is not anticipated.

Action levels for organic vapor concentrations that may trigger a change in personal protection are provided in Table 4.1. Personnel may upgrade to a higher level of protection if they so choose, however they may not downgrade their level of personal protection without approval of the SSC/SSO. Any torn or damaged PPE must be replaced.

Protective equipment must be removed within the work area. No soiled protective equipment will be allowed outside the immediate work area. No food, drink or tobacco will be allowed in the work area. Eating and smoking will be allowed only outside the work area after personnel have proceeded through decontamination procedures outlined in Section 6.

Working hours will be limited to daylight hours unless artificial sources of light are provided. Air temperature and wind chill/humidex factors will be monitored. Workers will use a "buddy system" to watch for symptoms of hypothermia or hyperthermia. If such symptoms are observed the victim will undergo decontamination and be provided with appropriate first aid or medical treatment.

All contractors will have a fire extinguisher and a first aid kit including eye wash when on-site.

Table 4.1 Action Levels for Air Quality Monitoring in the Work Area

PID Instrument Reading	Action to be Taken and Required Levels of Protection
5 ppm and <19.5% O_2	Level D and Modified Level D
5 to 25 ppm and <19.5% O_2	Level C

Table 4.2 Levels of Protection for Hazardous or Contaminated Situations and Personal Protection Equipment

Level	Equipment[1]	Protection Provided	Should be Used When:	Limiting Criteria
A	RECOMMENDED: • Pressure-demand, full facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA • Fully-encapsulating, chemical-resistant suit • Inner chemical-resistant gloves • Chemical-resistant safety boots/shoes • Two-way radio communications OPTIONAL: • Cooling unit • Coveralls • Long cotton underwear • Hard hat • Disposable gloves and boot covers	The highest available level of respiratory, skin, and eye protection	• The chemical substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either; • measured (or potential for) high concentration of atmospheric vapors, gases or particulates; or • site operations and work functions involving a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the intact skin • Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible • Operations must be conducted in confined, poorly ventilated areas until the absence of conditions requiring Level A protection is determined	• Fully-encapsulating suit material must be compatible with the substances involved
B	RECOMMENDED: • Pressure-demand, full-facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA • Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit) • Inner and outer chemical-resistant gloves • Chemical-resistant safety boots/shoes • Hard hat • Two-way radio communications OPTIONAL: • Coveralls • Disposable boot covers • Face shield • Long cotton underwear	The same level of respiratory protection but less skin protection than Level A. It is the minimum level recommended for initial site entries until the hazards have been further identified	• The type and atmosphere concentration of substances have been identified and require a high level of respiratory protection, but less skin protection. This involves atmospheres: • with IDLH[2] concentrations of specific substances that do not represent a severe skin hazard; or • that do not meet the criteria for use of air-purifying respirators • Atmosphere contains less than 19.5 percent oxygen • Presence of incompletely identified vapors or gases is indicated by direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the intact skin	• Use only when the vapor or gases present are not suspected of containing high concentrations of chemicals that are harmful to skin or capable of being absorbed through the intact skin • Use only when it is highly unlikely that the work being done will generate either high concentrations of vapors, gases or particulates or splashes of material that will affect exposed skin

Level	Equipment[1]	Protection Provided	Should be Used When:	Limiting Criteria
C	RECOMMENDED: • Full-facepiece, air-purifying, canister-equipped respirator • Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit) • Inner and outer chemical-resistant gloves • Chemical-resistant safety boots/shoes • Hard hat • Two-way radio communications OPTIONAL: • Coveralls • Disposable boot covers • Escape mask • Long cotton underwear	The same level of skin protection as Level B, but a lower level of respiratory protection	• The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin • The types of air contaminants have been identified, concentrations measured, and a canister is available that can remove the contaminant • All criteria for the use of air-purifying respirators are met	• PID reading of 5ppm above background to 25ppm above background • Atmospheric concentrations of chemicals must not exceed IDLH levels • The atmosphere must contain at least 19.5 percent oxygen
D	RECOMMENDED: • Coveralls • Safety boots/shoes • Safety glasses or chemical splash goggles • Hard hat OPTIONAL: • Gloves • Escape mask • Face shield	No respiratory protection. Minimal skin protection	• The atmosphere contains no known hazard • Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals	• PID reading of background to 5ppm above background • The atmosphere must contain at least 19.5 percent oxygen

Source: NIOSH/OSHA/USCG/EPA Manual 85-115; pp. 8-14, 8-15.

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[1] Radiation detection film badges may be required for any of the levels specified. These will be furnished on an as-needed basis.

[2] IDLH - Immediate danger to life and health.

5. CONTAMINANT MONITORING

5.1. Site Ambient Air Monitoring

Site ambient air monitoring will be conducted on a real time basis using a PID organic vapor meter. During intrusive operations, site ambient air readings will be taken periodically within the work area to determine the appropriate level of worker protection.

Instrument readings will be recorded in a field notebook. Battery/charge level for each instrument will be checked at the beginning and end of each working day. Periodic instrument calibration will be conducted and daily instrument performance (span) checks will be recorded in a field notebook.

5.2. Community Air Monitoring

Based on previous work conducted at the facility, well drilling and groundwater sampling work will not generate significant organic vapor or particulate levels in the air. Therefore, real time monitoring for volatile organics will be measured using a PID only in the immediate work area and not outside the work area.

5.2.1 Vapor Emission Response Plan

If work area air levels exceed 5 ppm, work will be stopped and levels will be monitored until they drop below 5 ppm at which time work can be resumed.

6. DECONTAMINATION

6.1. Personal Decontamination

A decontamination station will be established outside the Exclusion Zone. Personnel working in the Exclusion Zone must perform the proper decontamination procedures before entering any support or clean areas.

The establishment of a decontamination area provides an area where personnel can remove known or potential contaminants from their personal protective equipment. The decontamination area will be designed to minimize the exposure of uncontaminated personnel or equipment to contamination. The decontamination area will consist of the following facilities:

- boot wash
- glove wash
- DOT 17H drum for disposable items

As workers enter the decontamination area, disposable boots and Tyvek coveralls will be removed and placed in a 17H drum. The worker then proceeds to a boot wash station that will consist of two washtubs. The first washtub will contain a detergent solution and scrub brush, the second will contain potable rinse water. The worker will scrub his/her boots in each washtub before carrying out further decontamination.

Outer gloves are washed in two separate buckets using the same procedure used in the decontamination of boots. Personnel will then decontaminate respiratory equipment, instruments and dispose of inner gloves to complete the decontamination process. Wash and rinse waters will be replaced as necessary to maintain adequate decontamination capacity.

All equipment and solutions used for decontamination will be decontaminated and/or properly disposed. The drums will be sealed when full or at the end of each work day.

Rest periods and lunch breaks will take place within the support area or off-site. Plant safety rules will be followed by all personnel entering the KANTHAL-GLOBAR facility. Field personnel entering the facility will require complete decontamination as previously described. If any worker becomes ill or injured while working within the Exclusion Zone the decontamination procedure can be modified depending on the seriousness of the illness or injury to facilitate medical treatment. First aid treatment will be administered in the Support Zone or at the plant until medical assistance arrives if needed.

6.2. Equipment Decontamination

If necessary, decontamination of grossly contaminated excavating equipment will take place prior to demobilization of equipment from the site. A decontamination pad will be constructed at a secure location of the facility. The pad will consist of 6 mil heavy plastic sheeting attached to 2 inch by 6 inch boards. The plastic will be protected from damage by boards and plywood. The pad will be fitted with a sump and submersible pump and a portable steam cleaner will be used to decontaminate the drilling equipment.

During verification sampling, the outside of the sample jars and any sampling equipment will be thoroughly cleaned after each sample has been taken. The cleaning process will consist of physically removing accumulated material by wiping or scraping, a wash with soap solution followed by a double rinse with deionized water.

Decontamination effluent consisting of water and suspended matter will be containerized on-site in 55 gallon drums. Containers will be clearly labeled as "Liquid Decontamination Wastes". Solid wastes will be stored in 55 gallon drums and labeled as "Solid Decontamination Waste". Drums will be removed to a secure area where wastes generated will be temporarily stored pending the results of sampling to determine the most appropriate method of disposal.

7. CONTAINMENT OF CONTAMINATION

During any intrusive investigation there is the potential for the transfer of contaminants to previously uncontaminated areas. The potential pathways for the spread of contamination during investigation at the site include:

- particulates generated during drilling
- diffusion and/or volatilization of contaminants from drill cuttings and development/purge water
- contamination of clothing and field equipment

Good practice and common sense can significantly reduce contaminant release.

Particulates and diffusion and volatilization of contaminants into the air will be minimized by containing drill cuttings in drums, and by disposing groundwater to the sewer as it is generated.

Contaminated clothing will not be worn outside the Exclusion Zone. Discarded clothing will be stored in 55 gallon drums located outside the Exclusion Zone. Drums containing clothing and other wastes will be clearly labeled as to their contents and will be transferred to a secure area on the facility until the materials disposed. Drilling and sampling equipment will be decontaminated as discussed in Section 6.

8. EMERGENCY PROCEDURES

The BP SSC and/or the KANTHAL-GLOBAR PSO will brief the Project Manager and Site Safety Officer on safety hazards and procedures before commencing any work on the site.

The SSO will conduct a comprehensive briefing session with subcontractors and field personnel and thereafter hold daily briefing sessions prior to the start of work each day to discuss the work plan for that day and review any changes to the HSP. This briefing will include a discussion of emergency contacts, emergency exit routes from the site, directions to the closest hospital, and the location and proper use of emergency equipment. The SSO will communicate on a regular basis with the SSC to discuss work activities and whether modifications to the work plan or HSP may be required.

The potential for an emergency situation exists with every field operation. Emergencies may develop due to malfunction of test or construction equipment, failure of PPE, the presence of previously unknown hazardous or contaminated material, or health failure not associated with field operations. An emergency response may be required for any of the following occurrences:

- personal injury
- fire or explosion
- vehicle or equipment accident
- chemical spill or gas release

If a personal injury occurs to a worker the following steps will be taken:

- An initial assessment of the illness or injury will be made.
- If the injured/ill person can be moved, and if the injured/ill person was working in the Exclusion Zone the person must be decontaminated to the extent most practical based on the extent of the injury or illness. If necessary, paramedics or the hospital will be notified. If the person cannot be moved, first aid will be administered until medical aid arrives.

- Protective equipment will be removed from the person and they will be returned to the support area.
- First aid will be administered as required. Hazardous Chemical Information Sheets will be reviewed to assess whether symptoms could be related to chemical poisoning.
- If the worker requires hospitalization, a fellow worker will accompany the injured/ill worker to hospital to communicate details of the injury/illness to emergency staff.

In the event of fire or explosion, project workers will comply with the following procedures:

- Immediately evacuate area
- Assess extent of damage/injuries
- Contact appropriate agencies such as Fire Department, Police Department and Hospital
- Contact PSO and investigate accident and implement necessary emergency procedures and corrective actions.

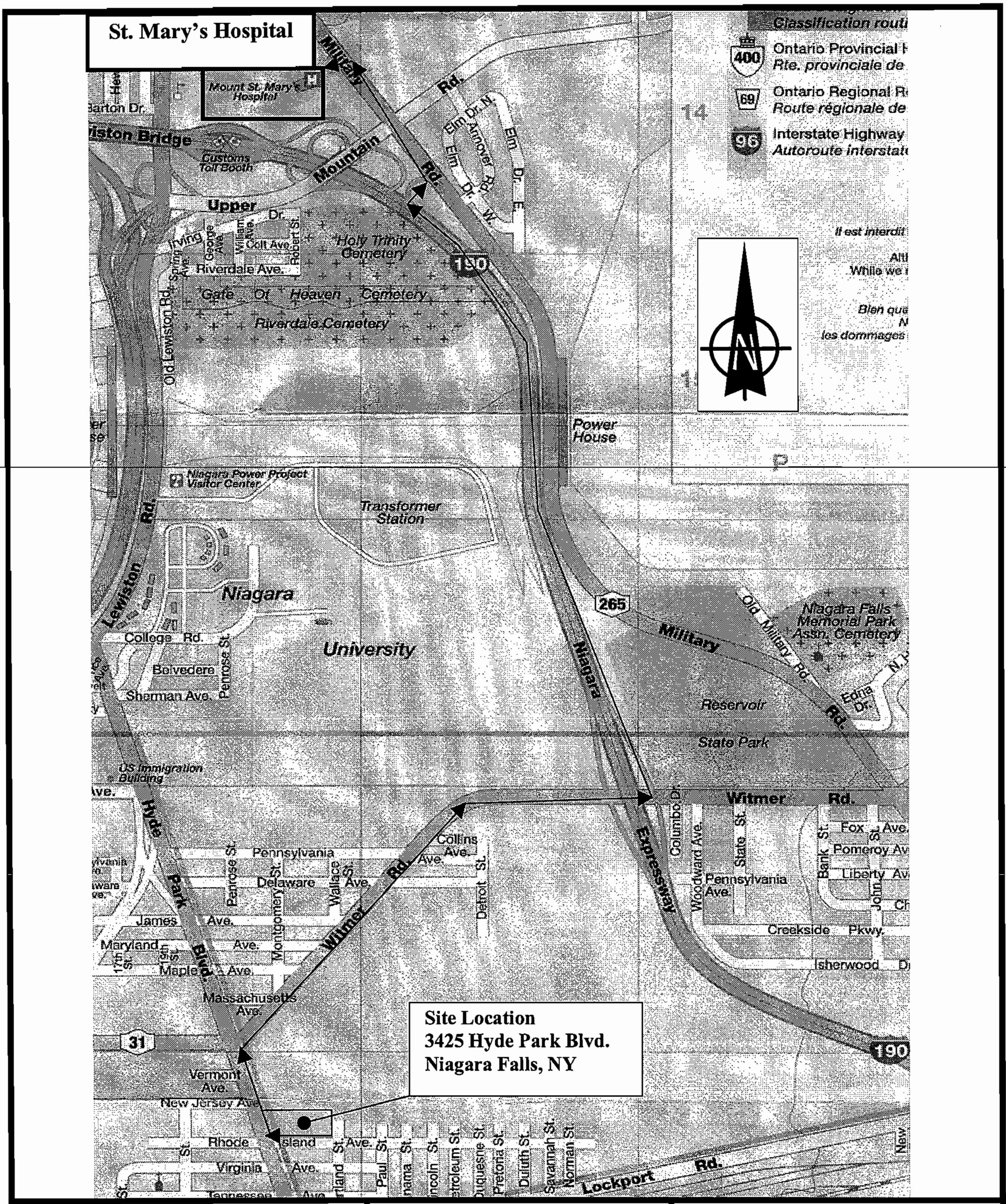
In the event of vehicle or equipment damage the incident will immediately be reported to the SSC or the SSO. The extent of personal injury will be assessed and the extent to which public health or property may be threatened will be evaluated and the appropriate authorities notified.

Chemical spills or gas releases will be monitored with air monitoring instruments. Action will be taken to contain the spill and the appropriate authorities will be notified. Depending on the nature of the spill and chemical involved, exposed workers will be provided with first aid and appropriate medical treatment if required. Table 8.1 contains an emergency contact list. Figure 8-1 provides directions to the nearest hospital. Appropriate emergency services and the local hospital will be notified of the work to be performed and advised of the potential chemicals that could be encountered in a medical emergency.

Table 8.1 Emergency Contacts

Local Resources	**Name/Address**	**Phone Number**
Fire Department Explosives Unit Ambulance	Niagara Fire Department 520 Hyde Park Blvd. Niagara Falls, NY 14301	Dispatch Number: 911 (716) 285-1233
Hospital Emergency Room	Mt. St. Mary's Hospital 5300 Military Road Lewiston, NY 14092	(716) 297-4800 (gen) (716) 298-2325 (dir)
Poison Control Center	National Hotline Niagara Falls Medical Center	1-800-888-7655 (716) 278-4511
Airport	Niagara Falls International Airport	(716) 297-4494
Police	Niagara County Sheriff's Department	(716) 439-9393 911
DE&S Gerry Grisak	6850 Austin Center Blvd. Austin TX 78731	(512) 346-2000
DE&S	240 Duncan Mill Rd., Suite 103	(416) 447-9400 (bus)
Kristin Hanson (Project Mgr.) Michael Marcotte (SSO)	Toronto, ON M3B 1Z4	(905) 602-4184 (home) (416) 483-1230 (home)
DE&S Ken Raven (Alternate Project Mgr.) Rob Timlin (Alternate SSO)	265 Carling Avenue, Suite 208 Ottawa, ON K1S 2E1	(613) 232-2525 (bus) (613) 526-2763 (home) (613) 591-2419 (home)
The Carborundum Company	1625 Buffalo Avenue, P.O. Box 337 Niagara Falls, NY 14302	(716) 731-3221 (bus)
BP Nathan I. Bigman (SSC) Mr. Richard Frankoski (Alternate SSC)	4850 E 49th St., MBC3-149 Cleveland, OH 44125	011-972-9-741-4854 (bus) (216) 271-8035 (bus)
KANTHAL-GLOBAR Inc. Carl F. Horst (PSO)	P.O. Box 339 Niagara Falls, NY 14302-0339	(716) 286-7625 (bus) (716) 297-5888 (home)
Agency Contacts		
Niagara County Health Department	James Devald Human Resources Building Main Post Office Box 428 10th and East Falls Street Niagara Falls, NY 14302	(716) 439-7430 (gen) (716) 278-8797 (dir) (716) 439-1453 (dir)
New York State Department of Health	584 Delaware Avenue Buffalo, NY 14202	(716) 847-4500
New York State Department of Environmental Conservation	Michael Hinton 270 Michigan Avenue Buffalo, NY 14203-2999	(716) 851-7220
Directions to Hospital: Mt. St. Mary's Hospital		

- Proceed west on Rhode Island Ave. to Hyde Park Blvd. Turn right at Hyde Park Blvd. and proceed north approximately 0.25 miles to Witmer Road. Turn right at Witmer Road, proceed northeast (east) approximately 1.2 miles to Interstate 190/Niagara Expressway. Proceed north on I-190 approximately 1.5 miles, exit I-190 to State Highway/Route 265 (Military Road). Turn left on Route 265 and proceed north approximately 0.3 miles (past Upper Mountain Road) directly to Mt. St. Mary's Hospital. The hospital is on the left side (west) of Route 265. It is well marked and the most prominent building in that area. Take the first entrance, "EMERGENCY", from Route 265 into the hospital.



St. Mary's Hospital

Site Location
3425 Hyde Park Blvd.
Niagara Falls, NY

Duke Engineering & Services (Canada), Inc.
A Duke Energy Company

Figure 8-1

Site Location Map

File: 0013-002 H&Splan FIG 9_1

9. REFERENCES

1. URS, 1990. Engineering Investigation at Inactive Hazardous Waste Sites. Preliminary Site Assessment, Carborundum Company Globar Plant. Site No. 932036. Prepared for: New York State Department of Environmental Conservation. December 1990.

2. INTERA Inc., 1993. Report on the Preliminary Site Assessment of the Carborundum Company Electric Products Division, Hyde Park Facility, Town of Niagara, Niagara County, New York. Prepared for The Carborundum Company.

3. INTERA Inc., 1997. Remedial Investigation of the Carborundum Company Electric Products Division, Hyde Park Facility, Town of Niagara, Niagara County, New York. Prepared for The Carborundum Company.

4. DE&S, 1998. Phase II Remedial Investigation of the Former Carborundum Company – Electric Products Division, Hyde Park Facility, Town of Niagara, Niagara County, New York, Site NO. 932036. Prepared for BP America.

5. DE&S, 1998. Interim Remedial Measure Work Plan for the Former Carborundum Company – Electric Products Division, Hyde Park Facility, Town of Niagara, Niagara County, New York, Site No. 932036. Prepared for BP America.

6. DE&S, 1999. Execution of the Interim Remedial Measure for the Former Carborundum Company – Electric Products Division, Hyde Park Facility, Town of Niagara, Niagara County, New York – Site No. 932036. Prepared for BP America.

7. DE&S, 2000. Feasibility Study for the Remediation of the Former Carborundum Company – Electric Products Division, Hyde Park Facility, Town of Niagara, Niagara County, New York, Site No. 932036, January 2000.

HSP APPENDIX A

SUBCONTRACTOR SIGNATURE PAGE

Agreement to Read and Comply with Health and Safety Plan

The undersigned confirms that he/she has read the Health and Safety Plan (HSP) pertaining to the drilling and groundwater monitoring program at the former Carborundum Company Hyde Park Facility and understands the requirements for working on this project.

The undersigned agrees to work safely and comply with the HSP and all applicable OSHA requirements. The undersigned agrees that if he/she is unclear about any aspect of this HSP that his/her concerns will be directed immediately to the Site Safety Officer.

Print Name	Signature	Company	Date

HSP APPENDIX B

HAZARDOUS SUBSTANCE DATA SHEETS:

Trichoroethylene
Xylenes
Vinyl Chloride

TRICHLOROETHYLENE

MSDS Number: T4940 --- *Effective Date: 03/23/98*

---

1. Product Identification

Synonyms: Trichloroethene; TCE; acetylene trichloride; Ethinyl trichloride
CAS No.: 79-01-6
Molecular Weight: 131.39
Chemical Formula: C_2HCl_3
Product Codes:
J.T. Baker: 5376, 9454, 9458, 9464, 9473, 9474
Mallinckrodt: 8598, 8600, 8633

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2. Composition/Information on Ingredients

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 Ingredient                                CAS No          Percent   Hazardous
 ---------------------------------------   ------------    -------   ---------

 Trichloroethylene                         79-01-6          100%        Yes
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3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED OR INHALED. AFFECTS HEART, CENTRAL NERVOUS SYSTEM, LIVER AND KIDNEYS. CAUSES SEVERE SKIN IRRITATION. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.

J.T. Baker SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Cancer Causing)
Flammability Rating: 1 - Slight
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:
Vapors can irritate the respiratory tract. Causes depression of the central nervous system with symptoms of visual disturbances and mental confusion, incoordination, headache, nausea, euphoria, and dizziness. Inhalation of high concentrations could cause unconsciousness, heart effects, liver effects, kidney effects, and death.

Ingestion:
Cases irritation to gastrointestinal tract. May also cause effects similar to inhalation. May cause coughing, abdominal pain, diarrhea, dizziness, pulmonary edema, unconsciousness. Kidney failure can result in severe cases. Estimated fatal dose is 3-5 ml/kg.

Skin Contact:
Cause irritation, redness and pain. Can cause blistering. Continued skin contact has a defatting action and can produce rough, dry, red skin resulting in secondary infection.

Eye Contact:
Vapors may cause severe irritation with redness and pain. Splashes may cause eye damage.

Chronic Exposure:
Chronic exposures may cause liver, kidney, central nervous system, and peripheral nervous system effects. Workers chronically exposed may exhibit central nervous system depression, intolerance to alcohol, and increased cardiac output. This material is linked to mutagenic effects in humans. This material is also a suspect carcinogen.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders, cardiovascular disorders, impaired liver or kidney or respiratory function, or central or peripheral nervous system disorders may be more susceptible to the effects of the substance.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Call a physician.
Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
Do not administer adrenaline or epinephrine to a victim of chlorinated solvent poisoning.

5. Fire Fighting Measures

Fire:
Autoignition temperature: 420C (788F)
Flammable limits in air % by volume:
lel: 8; uel: 12.5
Explosion:
A strong ignition source, e. g., a welding torch, can produce ignition. Sealed containers may rupture when heated.
Fire Extinguishing Media:
Use water spray to keep fire exposed containers cool. If substance does ignite, use CO2, dry chemical or foam.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Combustion by-products include phosgene and hydrogen chloride gases. Structural firefighters' clothing provides only limited protection to the combustion products of this material.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

---

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Trichloroethylene:
-OSHA Permissible Exposure Limit (PEL):
100 ppm (TWA), 200 ppm (Ceiling),
300 ppm/5min/2hr (Max)

-ACGIH Threshold Limit Value (TLV):
50 ppm (TWA) 100 ppm (STEL);
listed as A5, not suspected as a human carcinogen.

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. This substance has poor warning properties.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. Neoprene is a recommended material for personal protective equipment.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Chloroform-like odor.
Solubility:
Practically insoluble in water. Readily miscible in organic solvents.
Specific Gravity:
1.47 @ 20C/4C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
87C (189F)
Melting Point:
-73C (-99F)
Vapor Density (Air=1):
4.5
Vapor Pressure (mm Hg):
57.8 @ 20C (68F)
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Will slowly decompose to hydrochloric acid when exposed to light and moisture.
Hazardous Decomposition Products:
May produce carbon monoxide, carbon dioxide, hydrogen chloride and phosgene when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong caustics and alkalis, strong oxidizers, chemically active metals, such as barium, lithium, sodium, magnesium, titanium and beryllium, liquid oxygen.
Conditions to Avoid:
Heat, flame, ignition sources, light, moisture, incompatibles

11. Toxicological Information

Toxicological Data:
Trichloroethylene: Oral rat LD50: 5650 mg/kg; investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
This material has been linked to mutagenic effects in humans.

--------\Cancer Lists\--

	---NTP Carcinogen---		
Ingredient	Known	Anticipated	IARC Category
Trichloroethylene (79-01-6)	No	No	2A

12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released to water, this material is expected to quickly evaporate. This material has an experimentally-determined bioconcentration factor (BCF) of less than 100. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.
Environmental Toxicity:
The LC50/96-hour values for fish are between 10 and 100 mg/l. This material is expected to be slightly toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: TRICHLOROETHYLENE
Hazard Class: 6.1
UN/NA: UN1710
Packing Group: III
Information reported for product/size: 5GL

International (Water, I.M.O.)

Proper Shipping Name: TRICHLOROETHYLENE
Hazard Class: 6.1
UN/NA: UN1710
Packing Group: III
Information reported for product/size: 5GL

International (Air, I.C.A.O.)

Proper Shipping Name: TRICHLOROETHYLENE
Hazard Class: 6.1
UN/NA: UN1710
Packing Group: III
Information reported for product/size: 5GL

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15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Trichloroethylene (79-01-6)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

		--Canada--		
Ingredient	Korea	DSL	NDSL	Phil.
Trichloroethylene (79-01-6)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------------

	-SARA 302-		------SARA 313------	
Ingredient	RQ	TPQ	List	Chemical Catg.
Trichloroethylene (79-01-6)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------------

		-RCRA-	-TSCA-
Ingredient	CERCLA	261.33	8(d)
Trichloroethylene (79-01-6)	100	U228	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No

SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No

Reactivity: No (Pure / Liquid)

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: No information found.
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **2** Flammability: **1** Reactivity: **0**
Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED OR INHALED. AFFECTS HEART, CENTRAL NERVOUS SYSTEM, LIVER AND KIDNEYS. CAUSES SEVERE SKIN IRRITATION. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe vapor.

Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep away from heat and flame.

Label First Aid:

If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician. Note to physician: Do not administer adrenaline or epinephrine to a victim of chlorinated solvent poisoning.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 3, 16.

Disclaimer:

****

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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

XYLENES

MSDS Number: X2000 --- *Effective Date: 09/08/97*

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1. Product Identification

Synonyms: Dimethyl benzene, xylol, methyltoluene
CAS No.: 1330-20-7
Molecular Weight: 106.17
Chemical Formula: C6H4(CH3)2
Product Codes:
J.T. Baker: 5377, 5810, 5813, 9483, 9489, 9490, 9493, 9494, 9499, 9516, X516
Mallinckrodt: 8664, 8668, 8671, 8672, 8685, 8802

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2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
m-Xylene	108-38-3	40 - 65%	No
o-Xylene	95-47-6	15 - 20%	No
p-Xylene	106-42-3	< 20%	No
Ethyl Benzene	100-41-4	15 - 25%	Yes

---

3. Hazards Identification

Emergency Overview

DANGER! HARMFUL OR FATAL IF SWALLOWED. VAPOR HARMFUL. AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES

SEVERE EYE IRRITATION. CAUSES IRRITATION TO SKIN AND RESPIRATORY TRACT. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. CHRONIC EXPOSURE CAN CAUSE ADVERSE LIVER, KIDNEY, AND BLOOD EFFECTS. FLAMMABLE LIQUID AND VAPOR.

J.T. Baker SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 0 - None
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
Inhalation of vapors may be irritating to the nose and throat. Inhalation of high concentrations may result in nausea, vomiting, headache, ringing in the ears, and severe breathing difficulties which may be delayed in onset. Substernal pain, cough, and hoarseness are also reported. High vapor concentrations are anesthetic and central nervous system depressants.

Ingestion:
Ingestion causes burning sensation in mouth and stomach, nausea, vomiting and salivation. Minute amounts aspirated into the lungs can produce a severe hemorrhagic pneumonitis with severe pulmonary injury or death.

Skin Contact:
Skin contact results in loss of natural oils and often results in a characteristic dermatitis. May be absorbed through the skin.

Eye Contact:
Vapors cause eye irritation. Splashes cause severe irritation, possible corneal burns and eye damage.

Chronic Exposure:
Chronic inhalation can cause headache, loss of appetite, nervousness and pale skin. Repeated or prolonged skin contact may cause a skin rash. Repeated exposure of the eyes to high concentrations of vapor may cause reversible eye damage. Repeated exposure can damage bone marrow, causing low blood cell count. May damage the liver and kidneys.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems, or impaired liver, kidney, blood, or respiratory function may be more susceptible to the effects of the substance.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician immediately.
Ingestion:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately.
Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Flash point: 29C (84F) CC
Autoignition temperature: 464C (867F)
Flammable limits in air % by volume:
lel: 1.0; uel: 7.0
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire. Sealed containers may rupture when heated. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Vapors can flow along surfaces to distant ignition source and flash back.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB(tm) solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Do Not attempt to clean empty containers since residue is difficult to remove. Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, sparks, flame, static electricity or other sources of ignition: they may explode and cause injury or death.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
100 ppm (TWA) xylene
100 ppm (TWA) ethylbenzene
-ACGIH Threshold Limit Value (TLV):
100 ppm (TWA) 150 ppm (STEL) xylene
Carcinogen Category (xylene): A4
100 ppm (TWA) 125 ppm (STEL) ethyl benzene
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its

source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details. Use explosion-proof equipment.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, a half-face organic vapor respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

The following physical data is for xylene.

Appearance:

Clear, colorless liquid.

Odor:

Characteristic odor.

Solubility:

Insoluble in water.

Specific Gravity:

0.86 @ 20C/4C

pH:

Not applicable.

% Volatiles by volume @ 21C (70F):

100

Boiling Point:

137 - 140C (279 - 284F)

Melting Point:

-25C (-13F)

Vapor Density (Air=1):

3.7

Vapor Pressure (mm Hg):

8 @ 20C (68F)

Evaporation Rate (BuAc=1):

0.7

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Involvement in a fire causes formation of carbon monoxide and unidentified organic components.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizing agents and strong acids.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Toxicological Data:
Xylene: oral rat LD50: 4300 mg/kg; inhalation rat LC50: 5000 ppm/4H; skin rabbit LD50: > 1700 mg/kg; Irritation eye rabbit: 87 mg mild (Std. Draize); irritation skin rabbit 500 mg/24 moderate (Std. Draize); investigated as a tumorigen, mutagen, reproductive effector.
Ethyl benzene: oral rat LD50: 3500 mg/kg; skin rabbit LD50: 17800 uL/kg; investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
May cause teratogenic effects.

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--------\Cancer Lists\------------------------------------------------------

                                        ---NTP Carcinogen---
Ingredient                              Known    Anticipated    IARC Category
------------------------------------    -----    -----------    -------------
m-Xylene (108-38-3)                      No         No                3
o-Xylene (95-47-6)                       No         No                3
p-Xylene (106-42-3)                      No         No                3
Ethyl Benzene (100-41-4)                 No         No              None
```

12. Ecological Information

Environmental Fate:
Following data for xylene: When released into the soil, this material may evaporate to a moderate extent. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material may biodegrade to a moderate extent. When released into water, this material may evaporate to a moderate extent. When released into water, this material may biodegrade to a moderate extent. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life of less than 1 day. This material is not expected to significantly bioaccumulate. (mixed xylenes: octanol / water partition coefficient 3.1 - 3.2; bioconcentration factor = 1.3, eels)
Environmental Toxicity:
For xylene: This material is expected to be slightly toxic to aquatic life. The LC50/96-hour values for fish are between 10 and 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: XYLENES
Hazard Class: 3
UN/NA: UN1307
Packing Group: III
Information reported for product/size: 398LB

International (Water, I.M.O.)

Proper Shipping Name: XYLENES
Hazard Class: 3.3
UN/NA: UN1307
Packing Group: III
Information reported for product/size: 398LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
m-Xylene (108-38-3)	Yes	Yes	Yes	Yes
o-Xylene (95-47-6)	Yes	Yes	Yes	Yes
p-Xylene (106-42-3)	Yes	Yes	Yes	Yes
Ethyl Benzene (100-41-4)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

		--Canada--		
Ingredient	Korea	DSL	NDSL	Phil.
m-Xylene (108-38-3)	Yes	Yes	No	Yes
o-Xylene (95-47-6)	Yes	Yes	No	Yes
p-Xylene (106-42-3)	Yes	Yes	No	Yes
Ethyl Benzene (100-41-4)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------------

	-SARA 302-		------SARA 313------	
Ingredient	RQ	TPQ	List	Chemical Catg.
m-Xylene (108-38-3)	No	No	Yes	No
o-Xylene (95-47-6)	No	No	Yes	No
p-Xylene (106-42-3)	No	No	Yes	No
Ethyl Benzene (100-41-4)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------------

		-RCRA-	-TSCA-
Ingredient	CERCLA	261.33	8(d)
m-Xylene (108-38-3)	1000	No	No

o-Xylene (95-47-6)	1000	No	No
p-Xylene (106-42-3)	100	No	Yes
Ethyl Benzene (100-41-4)	1000	No	No

```
Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: Yes Pressure: No
Reactivity: No          (Mixture / Liquid)
```

Australian Hazchem Code: 3[Y]
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **2** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
DANGER! HARMFUL OR FATAL IF SWALLOWED. VAPOR HARMFUL. AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES SEVERE EYE IRRITATION. CAUSES IRRITATION TO SKIN AND RESPIRATORY TRACT. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. CHRONIC EXPOSURE CAN CAUSE ADVERSE LIVER, KIDNEY, AND BLOOD EFFECTS. FLAMMABLE LIQUID AND VAPOR.
Label Precautions:
Keep away from heat, sparks and flame.
Avoid contact with eyes, skin and clothing.
Keep container closed.
Use only with adequate ventilation.
Avoid breathing vapor.
Wash thoroughly after handling.
Label First Aid:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all

cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

Disclaimer:

****

****

Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

Material Safety Data Sheet

VINYL CHLORIDE MONOMER

May 29, 1992

PHONE NUMBERS
Emergency: (918) 661-8118
General MSDS Information: (918) 661-8327
~~For Additional MSDSs: (918) 661-5952~~

PHILLIPS 66 COMPANY
A Division of Phillips Petroleum Company
Bartlesville, Oklahoma 74004

A. Product Identification

Synonyms:	Chlorethene; Chloroethene; Chloroethylene
Chemical Name:	Vinyl chloride
Chemical Family:	Vinyl halide
Chemical Formula:	C_2H_3Cl
CAS Reg. No.:	75-01-4
Product No.:	000308

Product and/or Components Entered on EPA's TSCA Inventory: YES

This product is in U.S. commerce, and is listed in the Toxic Substances Control Act (TSCA) Inventory of Chemicals; hence, it may be subject to applicable TSCA provisions and restrictions.

B. Components

Ingredients	CAS Number	% By Wt.	OSHA PEL	ACGIH TLV
Vinyl chloride	75-01-4	100	1 ppm*	5 ppm

* STEL = 5 ppm

C. Personal Protection Information

Ventilation:	Use adequate ventilation to control exposure below recommended levels, local exhaust ventilation is recommended.
Respiratory Protection:	Refer to OSHA 1910.1017(g)4 for appropriate respirator protection for the concentrations measured. Unknown atmospheric concentrations of vinyl chloride or above 3,600ppm-open-circuit, self-contained breathing apparatus, pressure demand type, with full facepiece is required; not

over 1000 ppm-Type C, supplied air respirator, continuous flow-type, with full or half facepiece, helmet or hood is required.

Eye Protection: Use chemical goggles. For splash protection, use face shield with chemical goggles.

Skin Protection: Use full-body, long-sleeved garments impervious to the material. Use gloves impervious to the material being used (ie. - North Silvershield, Nitrile).

NOTE: Personal protection information shown in Section C is based upon general information as to normal uses and conditions. Where special or unusual uses or conditions exist, it is suggested that the expert assistance of an industrial hygienist or other qualified professional be sought.

D. Handling and Storage Precautions

Do not get in eyes, on skin or on clothing. Do breathe vapors, mist, fumes or dust. Wear protective equipment and/or garments described in Section C if exposure conditions warrant. Wash thoroughly after handling. Launder contaminated clothing before reuse. Use only with adequate ventilation. Do not get liquified gas into eyes, on skin, or on clothing. May cause freeze burns upon direct contact.

Store in tightly closed container. Store in well-ventilated area. Keep away from heat, sparks and flame. Bond and ground during transfer.

E. Reactivity Data

Stability: Stable
Conditions to Avoid: Not Applicable
Incompatibility (Materials to Avoid): Oxygen and strong oxidizing agents

Hazardous Polymerization: Will Occur
Conditions to Avoid: Contact with air, sunlight or heat. Metals such as copper and aluminum.
Hazardous Decomposition Products: Hydrogen chloride gas, carbon oxides and possibly trace amounts of phosgene, vinyl chloride, or HCl.

F. Health Hazard Data

Recommended Exposure Limits:

See Section B.

Acute Effects of Overexposure:

Eye: Vapors may produce moderate irritation. Escaping compressed gas or liquid may produce immediate pain, freeze burns and eye damage.

Skin: Vapors may produce mild to moderate irritation. Contact with escaping compressed gas or liquid may result in freeze burns.

Inhalation: Exposure to high vapor concentrations may produce central nervous system effects, such as dizziness, headache, nausea, dulled vision and drowsiness. Very high concentrations may cause lung irritation, heart beat irregularities, liver and kidney damage, decreased blood clotting, unconsciousness and death.

Ingestion: Toxic if swallowed. May cause nausea, vomiting, diarrhea and abdominal pain.

Subchronic and Chronic Effects of Overexposure:

Vinyl chloride is a confirmed human carcinogen. Exposure to vinyl chloride may result in cancer of the liver, brain, nervous system, lung, biliary tract, and blood system.

Prolonged exposure of humans to high concentrations may result in: degeneration of the ends of the bones of the hands, feet and pelvis; thickening, swelling, and decreased elasticity of the skin; problems with blood flow to the hands; joint and muscle pain; and changes in the liver's structure. Symptoms such as numbness in the fingers, decreased reflexes, weakness, and tingling of the extremeties have also been reported and may be due to toxic effects of vinyl chloride on the peripheral nerves and/or impaired circulation. In some studies, long term exposure of rats to extremely high vapor concentrations has caused nerve and kidney damage.

Stimulation of the immune system and decreased ability of the blood to clot have been reported in humans. Low to moderate levels of exposure in mice has also resulted in immune system stimulation, and in some but not all studies, impaired blood clotting.

Decreased sex drive in men, and irregular menstrual periods in women, have been reported in persons exposed over a long period of time to vinyl chloride at levels which caused adverse effects in the mother, could cause miscarriages, decreased birth weight, and delayed skeletal development of the offspring. Adverse effects on sperm and testes have been shown in animals exposed to vinyl chloride. Three studies involving the dominant lethal assay were negative, as reported by the Agency for Toxic Substances and Disease Registry.

Other Health Effects:

Laboratory tests have shown that vinyl chloride can alter genetic material.

Health Hazard Categories:

	Animal	Human		Animal	Human
Known Carcinogen	X	X	Toxic	X	
Suspect Carcinogen			Corrosive		
Mutagen	X		Irritant		
Teratogen			Target Organ Toxin	X	X
Allergic Sensitizer			Specify - Freeze Burn Hazard; Reproductive Toxin-Organ/function; Liver, Kidney and Nerve Toxin; Immune System Toxin		
Highly Toxic					

First Aid and Emergency Procedures:

NOTE:	For freeze burns, immediately flush effected area with tap water for at least fifteen minutes, seek immediate medical attention.
Eye:	Flush eyes with running water for at least fifteen minutes. If irritation or adverse symptoms develop, seek medical attention.
Skin:	Wash skin with soap and water for at least fifteen minutes. If irritation or adverse symptoms develop, seek medical attention.
Inhalation:	Remove from exposure. If breathing is difficult, give oxygen. If breathing ceases, administer artificial respiration followed by oxygen. Seek immediate medical attention.
Ingestion:	Immediately induce vomiting only if subject is conscious. Seek immediate medical attention.

G. Physical Data

Appearance:	Colorless gas
Odor:	Sweet
Boiling Point:	Not Established
Vapor Pressure:	Not Established
Vapor Density (Air = 1):	2.2
Solubility in Water:	0.11 g/110g @ 77F (25C)
Specific Gravity (H2O = 1):	0.97 @ 9F (-13C)
Percent Volatile by Volume:	100
Evaporation Rate (Butyl Acetate = 1):	Not Established
Viscosity:	Not Established

H. Fire and Explosion Data

Flash Point (Method Used):	-108F (-78C)
Flammable Limits (% by Volume in Air):	LEL - 3.6 UEL - 33.0
Fire Extinguishing Media:	Dry chemical, foam or carbon dioxide (CO2)
Special Fire Fighting Procedures:	Evacuate area of all unnecessary personnel. Shut off source, if possible. Use NIOSH/MSHA approved self-contained breathing apparatus and other protective equipment and/or garments described in Section C if exposure conditions warrant. Use gloves impervious to the material being used. Water fog or spray may be used to cool exposed equipment and containers. Heated containers may rupture violently and suddenly without warning due to vessel over-pressure (BLEVE). Fragmentation of the container should be anticipated. If flame is against the container, withdraw immediately on hearing a

rising sound, if venting increases in volume or intensity, or if there is discoloration of the tank due to fire.

Fire and Explosion Hazards: Toxic and corrosive fumes of hydrogen chloride may be formed when burned.

I. Spill, Leak and Disposal Procedures

Precautions Required if Material is Released or Spilled:
Evacuate area of all unneccessary personnel. Wear protective equipment and/or garments described in Section C if exposure conditions warrant. Shut off source, if possible. Protect from ignition. Keep out of water sources and sewers. Ventilate area thoroughly.

Waste Disposal (Insure Conformity with all Applicable Disposal Regulations):
Incinerate or otherwise manage in a RCRA permitted waste management facility.

J. DOT Transportation

Shipping Name: Vinyl chloride, inhibited
Hazard Class: 2.1 (Flammable gas)
ID Number: UN 1086
Packing Group: Not Applicable
Marking: Vinyl chloride, inhibited, UN 1086, RQ*
Label: Flammable gas
Placard: Flammable gas/1086
Hazardous Substance/RQ: Vinyl chloride/1#
Shipping Description: Vinyl chloride, inhibited, 2.1 (Flammable gas), UN 1086, RQ*
Packaging References: 49 CFR 173.304, 173.306, 173.314, 173.315

* Enter the letters "RQ" as shown if the hazardous substance is present in a quantity, on one package, which equals or exceeds the reportable quantity (RQ) shown for the hazardous substance.

K. RCRA Classification - Unadulterated Product as a Waste

Ignitable (D001)

Prior to disposal, consult your environmental contact to determine if TCLP (Toxicity Characteristic Leaching Procedure, EPA Test Method 1311) is required. Reference 40 CFR Part 261.

L. Protection Required for Work on Contaminated Equipment

Contact immediate supervisor for specific instructions before work is initiated. Wear protective equipment and/or garments described in Section C if exposure conditions warrant.

M. Hazard Classification

_X_ This product meets the following hazard definition(s) as defined by the Occupational Safety and Health Hazard Communication Standard (29 CFR Section 1910.1200):

___ Combustible Liquid
___ Compressed Gas
_X_ Flammable Gas
___ Flammable Liquid
___ Flammable Solid
___ Flammable Aerosol
___ Explosive
_X_ Health Hazard (Section F)
___ Organic Peroxide
___ Oxidizer
___ Pyrophoric
___ Unstable
___ Water Reactive

___ Based on information presently available, this product does not meet any of the hazard definitions of 29 CFR Section 1910.1200.

N. Additional Comments

SARA 313

This product contains the following chemical or chemicals subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372. (See Section B).

Vinyl chloride

APPENDIX C
Quality Assurance Project Plan

Duke Engineering
& Services (Canada), Inc.℠
A Duke Energy Company

240 Duncan Mill Road, Suite 103
Toronto, Ontario M3B 1Z4

Tel : (416) 447-9400
Fax: (416) 447-9405

Quality Assurance Project Plan for Groundwater Monitoring Program of the Former Carborundum Company - Electric Products Division Hyde Park Facility, Town of Niagara, Niagara County, New York, Site No. 932036

Prepared For:

BP
4850 E 49th St, MBC3-149
Cleveland, Ohio
44125

Prepared By:

Duke Engineering & Services, Inc.

TM0013-001

August, 1995
revised September, 2000

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1 INTRODUCTION

1.1 PURPOSE AND SCOPE

This Quality Assurance Project Plan (QAPP) defines and describes the responsibilities and mechanisms by which DE&S and its affiliates assure that the activities they perform with respect to the field investigations at the former Carborundum Company Hyde Park facility (the facility), the data generated as a result of the remedial investigation and the report that is prepared are of sound technical and scientific quality, legally defensible and are in accordance with contract requirements. This QAPP was implemented as part of the work plan to undertake the Remedial Investigation/Feasibility Study (RI/FS) of the former Carborundum Company facility.

This QAPP has been adapted from the QAPP prepared and approved for the RI/FS at the site dated August 1995. This document was tailored to address issues associated with activities that will be conducted during the Groundwater Monitoring Program.

The QAPP details the program objectives, the project team organization and responsibilities, the technical aspects of the field investigation, sampling protocols, instrument calibrations, sample custody, analytical procedures, and data reduction, validation and reporting. QA/QC procedures will be carried out in accordance with DE&S's own Corporate Quality Assurance Methods using scientifically acceptable and industry proven techniques, and in accordance with USEPA and NYSDEC regulations and guidelines.

Field activities including drilling methods, monitor well installation procedures and soil sampling are described in Section 3. QA procedures are defined and described in Section 4. Sampling protocols for groundwater and soil including cleaning protocols are described in Section 5. Calibration of field and analytical instruments is discussed in Section 6. Sample custody is described in Section 7. Section 8 describes analytical quantitation limits and laboratory QA/QC. Data reduction, validation and reporting techniques are described in Section 9. A detailed description of the laboratory QA/QC procedures are appended to this QAPP.

2 GROUNDWATER MONITORING PROGRAM

2.1 FIELD INVESTIGATION

Groundwater monitoring program field investigations will include:

- borehole and groundwater monitor well installation
- groundwater sampling, and
- sewer effluent sampling.

2.1.1 Groundwater Sampling Program

The purpose of the groundwater sampling program is to investigate groundwater conditions at the upgradient property boundary, on the property; and off site downgradient from the property.

2.1.1.1 Rationale for Sampling Locations

Groundwater monitor wells will be completed as well couplets. One shallow monitoring well will be installed in the Pleistocene overburden above the Lockport Dolomite and a deeper monitoring well will be installed into the upper section of the Lockport Dolomite. Each well will be installed in separate boreholes to ensure the integrity of the borehole seal and to prevent leakage between wells. Monitor well locations are numbered from MW16 to MW19, which is a continuation of previous well numbering.

Monitor well MW16 is located in the north portion of the property in the vicinity of the former solvent storage cage. It will allow for the assessment of any impact to groundwater from a small area of soil contaminated with vinyl chloride at a depth of 24 ft. MW17 will be installed just east of the building between MW7 and MW10 to evaluate contaminant distributions and vertical gradients along the flow path of the groundwater plume. MW18 will be installed south of the brick storage shed to evaluate potential impact to groundwater from contaminated soils remaining at depth in Area 2A. MW19 will be installed near the east property boundary to evaluate potential impacts from contaminated soils remaining on the east property boundary.

In addition to assessing groundwater quality, monitor wells will be used to measure equilibrium water levels so that both horizontal and vertical hydraulic gradients can be determined. This information will provide an estimate of groundwater flow directions and when combined with hydraulic conductivity measurements, aquifer cross sectional area, porosity and water quality, will allow estimates of average linear groundwater velocity, volumetric groundwater flux and contaminant mass flux onto and off the property.

2.1.1.2 Shallow Monitor Well Installation

During the drilling of the monitor wells, an exclusion zone will be established around the drilling rig with caution tape. Unauthorized individuals will not be allowed to enter the exclusion zone. The drilling contractor will place 6 mil plastic sheeting over the ground surface at each well location to minimize contamination of surface soils. A four foot by eight foot sheet of 5/8 in thick plywood will be placed over the plastic as a working surface and an appropriately sized hole will be cut into the plywood to accommodate down-hole tools.

Continuous soil sampling will be conducted at one of two wells constituting each pair using a split spoon sampler following ASTM-D-1586 standards. The stratigraphy of each split spoon sample will be logged in the field by a geologist for color and texture. Soil sampling for laboratory analysis is not planned because contaminated soils have been removed from the site. However, each split spoon sample will be inspected as follows:

a. Each split spoon sample will be visually inspected and scanned with an HNu-PID or equivalent. If this method detects specific areas of contamination, then a discrete sample will be taken for headspace screening from the area registering the highest HNu-PID reading.

b. If headspace screening and/or visual and olfactory evidence indicates that contamination is present, then a sample will be collected for laboratory VOC constituent analysis.

Hollow stem augering will be completed to a depth of 20 feet. If refusal is encountered prior to 20 feet, then the bottom of the well casing will be set 3 feet above the refusal depth after first sealing the auger hole with 2 feet of bentonite capped with 1 foot of sand. A monitor well consisting of 2 in I.D. schedule 40 flush jointed PVC riser pipe with a 5 ft long screen will be installed inside the hollow stem auger. The monitor well will be capped and will be finished with a locking cap and a flush-mounted protective cover at ground surface.

Coarse, clean, silica sand will be emplaced between the augers and the well casing to approximately 1 foot above the screened interval as the augers are removed. The top of the sand pack will be measured with a tape to ensure that it is completed above the screen. A bentonite seal 2 feet in thickness will be placed above the sand pack. A grout consisting of 3-5 percent bentonite and Portland cement will be placed into the annulus above the bentonite seal.

2.1.1.3 Deep Monitor Well Installations

Deep monitor wells will be installed into the upper 15 feet of the Lockport Dolomite at each couplet location. Boreholes for 2 inch diameter monitor wells will be advanced using 4.25 inch I.D. hollow stem augers to the top of bedrock. A temporary 4 inch I.D. steel casing with a spin bit will be advanced into the top of bedrock. An HQ-sized core barrel and drill rods fitted with a diamond bit will be used to complete the borehole into bedrock using air rotary methods. The air compressor will be equipped with a filter to prevent introduction of contaminants into the borehole. The air rotary method was chosen to eliminate the use of water in the drilling process. The disadvantages to using water are:

- water can be forced into the formation during drilling and considerable development is required prior to geochemical sampling to ensure that all drilling fluid has been removed;

- large volumes of drilling fluid and formation groundwater produced during well development can present disposal problems;

- the distribution, handling, storage and disposal of large volumes of water during winter drilling conditions can present problems of freezing.

Ambient air sampling will be performed in accordance with the HSP, during air rotary drilling, to ensure that excessive volatilization does not occur.

Drill cores will be logged by a geologist for lithology, color, texture, fracture density and evidence of contamination. Cores will be stored in labelled core boxes and retained by BP.

Installation of deep bedrock monitor wells will follow the same installation procedure as described for the shallow overburden monitor wells except that a 10 foot long screen will be installed in the hole to optimize the intersection of fractures and groundwater in the upper portion of the Lockport Dolomite. A sand pack will extend to approximately 1 foot above the top of the screen. A bentonite seal 2 feet in thickness will be placed above the sand pack and the hole will be completed with a bentonite/Portland cement grout to surface. The well will be protected with locking cap and a flush-mounted protective cover at ground surface.

2.1.1.4 Well Development

Each well will be developed by means of a bailer, surging or pumping. Development will be conducted for a maximum of three hours until turbidity reaches 50 nephelometric units (NTUs) and temperature, pH and conductivity stabilize. Previous experience from the site suggests that the turbidity in the overburden wells and possibly in one or more of the bedrock wells will not reach 50 nephelometric after 3 hours of well development. If groundwater in the well exceeds 50 NTUs after three hours of developing, but temperature, pH and conductivity measurements have stabilized, the well will be considered developed.

2.1.1.5 Groundwater Sampling

Each monitor well will be sampled after the wells have been developed according to the Work Plan. Each well will be equipped with a dedicated hand inertial pump which will consist of a delrin foot valve attached to a high density polyethylene riser tube.

Sampling will occur following the purging of 3-5 borehole volumes of water from the well. A borehole volume will be calculated as the volume of the standing water in the well and the water contained within the sandpack. During purging, groundwater will be monitored for pH, temperature, conductivity and turbidity. In addition, observations of the discharge water will be made for color, odor and turbidity. As well, samples will be inspected for the occurrence of non-aqueous phase liquids. During transfer of the sample from the pump to the sample bottle, care will be taken to avoid any unnecessary agitation which may result in loss of volatile organic compounds. Weather conditions at the time of sampling will be recorded. All observations will be recorded in a field notebook.

2.1.1.6 Groundwater Analysis

Groundwater samples will be analyzed for the COCs listed in Table 2.1. COCs in groundwater include the following specific volatile organic compounds (VOCs): vinyl chloride, trichloroethene, 1,2-dichloroethene and benzene. Samples will be collected unfiltered and without headspace in 40ml clean laboratory prepared, pre-labeled bottles. Preservation will consist of maintaining sample temperature at 4°C.

Samples will be submitted to Severn Trent Laboratories, Inc. (STL). STL is a contract laboratory for NYSDEC and uses NYSDEC analytical methods and protocols. Samples will be stored in refrigerated coolers, sealed and delivered to the laboratory within 48 hours of collection. All samples will be entered on a chain-of-custody record. This record will be initiated by the laboratory and will accompany the shipment of clean sample bottles. The laboratory will relinquish custody of the bottles to DE&S field personnel who will complete the records for each sample taken. The custody record will be signed off by field personnel on delivery of the samples to the laboratory. A summary of specifications for sampling including container type, sample volume, preservation requirements and maximum holding times are provided in Table 5-1 in the Groundwater Monitoring Work Plan. A summary of groundwater sampling and analytical protocols is given in Table 5-2 in the Groundwater Monitoring Work Plan. Further details on sampling are provided in a separate Work Plan.

Table 2-1 Contaminants of Concern

GROUNDWATER

VOCs

- vinyl chloride
- trichloroethene
- 1,2-dichloroethene
- benzene
- 1,1-dichloroethane

SOIL[1]

VOCs

- 1,2-dichloroethene
- trichloroethene
- vinyl chloride
- toluene
- acetone
- ethyl benzene
- xylenes

PAHs

- naphthalene
- acenaphthalene
- fluorene
- phenanthrene
- anthracene
- pyrene
- benzo(a)anthracene
- chrysene
- benzo(b)fluoranthene
- benzo(k)fluoranthene
- benzo(a)pyrene
- indeno(1,2,3-cd)pyrene

---

[1] Following the IRM, on-site soils are no longer a concern.

2.1.1.7 Monitor Well Identification and Water Level Monitoring

Monitor well locations will be plotted on a site plan map and distances to landmarks on the property will be measured and recorded. The well identification number will be written with permanent marker on the outside of the protective steel casing or flush mounted cap and on the inside of the lid of the protective casing or flush mounted cap.

Monitor wells will be surveyed vertically to National Geodetic Vertical Datum by a licensed surveyor. Elevations will be taken at ground surface at the perimeter of the sloping concrete drainage pad, and to the top of the flush mount surface casing. The distance from the top of the flush mounted surface casing to the inside PVC well casing will be measured with a tape measure. Water levels will be read relative to the top of the inside PVC well casing. Water levels in the monitor wells will be measured using an electric water level tape to within ±0.01 inches. Water levels will be recorded upon completion of the well, immediately prior to and during hydraulic testing, before groundwater sampling and at least 48 hours after completion of groundwater sampling. To prevent cross-contamination, after each measurement and prior to lowering the tape into another well, the water level tape (the metal probe and first 3 feet of tape) will be decontaminated utilizing the following procedures:

- paper towel wipe
- non-phosphate detergent wash
- deionized water rinse
- paper towel wipe

2.1.1.8 Decontamination Procedures

Decontamination of drilling equipment will take place on a decontamination pad constructed at a secure location within the facility. The pad will consist of 6 mil heavy plastic sheeting attached to 2 inch by 6 inch boards. The plastic will be protected from damage by boards and plywood. The pad will be fitted with a sump and submersible pump. Decontamination of equipment will consist of removing accumulated solids by scraping and brushing followed by steam cleaning. A portable steam cleaner will be used to decontaminate the drilling assembly and all downhole materials including augers, temporary casing, drill rods and core barrels. Equipment will be moved to the pad for decontamination before drilling commences and after the completion of each pair of monitor wells. Each individual well pair will be drilled utilizing separate downhole tools. If this is not possible then all downhole equipment will be decontaminated between individual wells. All the downhole drilling equipment required to complete both the shallow and deep boreholes will be decontaminated before utilization at the subsequent well pair installations.

Decontamination effluent consisting of water and suspended matter will be pumped from the sump and containerized. Containers will be clearly labelled as "Liquid Purging/Decontamination Wastes". Solid wastes will be stored in 55 gallon drums and labelled as "Solid Drilling/Decontamination Waste". Drums will be moved to a secure area where wastes generated during drilling, well development and purging will be temporarily stored pending the results of sampling by Carborundum Company to determine the most appropriate method of disposal.

2.1.2 Sewer Effluent Sampling

2.1.2.1 Rationale for Sampling Locations

An inspection and sampling of sewer effluent will be conducted in three locations along Rhode Island Avenue. Two samples will be collected from the locations immediately south of the site. One sample will be collected from an upgradient location approximately 2 blocks east of the eastern property boundary.

3 QAPP DEFINITIONS AND QA PROCEDURES

3.1 INTRODUCTION

Quality assurance and quality control are the procedures used during sampling, sample analysis and data reduction to assure sample representativeness and validity of analytical results.

Quality control represents the set of standard operating procedures (SOPs) which provide supporting evidence that the parameters measured in a given set of samples are representative of actual conditions, and include both field and laboratory procedures. Field related procedures include groundwater and soil sampling protocols, the use of replicate samples and blanks, chain-of-custody, instrument calibration and cleanup protocols. Laboratory related procedures include analytical methods, the use of replicates, blanks and spikes, and instrument calibration.

Quality assurance represents the set of procedures which provide an assessment of the qualitative and quantitative reliability of data. The key parameters in assessing data are:

- precision
- accuracy
- representativeness
- completeness and
- comparability

3.1.1 Precision

Precision is the measure of reproducibility between one or more analyses of the same sample or duplicate or replicate samples.

Precision of an analytical method is carried out by submitting "blind" replicate samples to the laboratory or by analyzing matrix spike and matrix spike duplicate samples.

"Blind" replicate samples are pairs of samples taken from the same sample location in the field submitted to the laboratory and identified as separate samples. The laboratory is not aware that the samples are replicates. Field replicate samples will be taken once in every ten samples for groundwater and once in every five samples for soils.

In addition to "blind" replicates, the laboratory will prepare replicate pairs of spiked samples known as matrix spike and matrix spike duplicates. The advantages of matrix spike samples is that the precision analysis can be conducted for each target compound once the matrix has been spiked with the target compounds. Matrix spike and matrix spike duplicate will be analyzed at a frequency of every ten groundwater samples and every five soil samples.

Precision is often reported as relative percent difference (RPD) according to the following equation:

$$\text{RPD} = \frac{(X_1 - X_2)}{(X_1 + X_2)/2} \times 100$$

where X_1 and X_2 represent the analytical results of a target compound in each field replicate or the laboratory prepared matrix spike and matrix spike duplicate.

3.1.2 Accuracy

Accuracy is a measure of how well an analytical result average of analytical results agrees with a "true" value, and is measured as a percentage of the "true" value.

The accuracy of any analytical method is determined by comparing the measured concentration of a "known" sample with the "known" sample concentration.

The "known" sample will consist of a laboratory prepared spike of target compound added to a matrix consisting of a field sample and correcting for analytes known to be present in the sample. Accuracy is measured as percent recovery of "known" concentration. If recoveries exceed acceptable criteria then analytical data for that batch of samples are considered inaccurate. The analyst must determine the cause of the problem and take corrective action by means of the following:

- recalibration of the instrument
- reanalysis of the matrix spike
- reanalysis of the samples in the batch

3.1.3 Representativeness

Representativeness is the degree to which data representing a single sample location within a population can be compared with data from many sample locations within the same population.

The degree to which a sample taken from one location in the sampled medium is representative of a large portion of the same sampled medium is dependent on the degree of homogeneity of the sampled medium, and the degree of homogeneity of the sample taken from the sampled medium. The degree of homogeneity of the sampled medium cannot be controlled by the sampler and is dependent on the natural distribution of materials in the medium and the distribution of contaminants in the medium. The degree of homogeneity of the sample itself is controlled by the appropriateness of the sampling protocols and the degree to which the sampler follows the protocols.

In the laboratory, the analyst must ensure that the aliquot extracted from the sample is representative of the sample within the sample container: this can be done by mixing the sample prior to extracting the aliquot. Representativeness cannot be quantified.

3.1.4 Completeness

Completeness is a measure of the amount of valid data that is obtained compared to the amount of valid data that is required to fulfill the objectives of an investigation.

Completeness can be applied to the assessment of analytical work using the following equation:

$$\%\ \text{completeness} = \frac{\text{number of acceptable analyses}}{\text{number of attempted analyses}} \times 100\%$$

Completeness can also be applied to the assessment of the data package submitted by the laboratory undertaking the analytical work which is reviewed by the QA officer. A complete data package would include the following:

- Chain-of-custody forms
- Case narratives and sample/analysis summary forms
- QA/QC summaries and supporting documentation
- Relevant calibration data and supporting documentation
- Instrument and method performance data
- Documentation to show laboratory's ability to attain contract specified method detection limits
- All data report forms including final concentration calculations
- All raw data used in the identification and quantitation of project target list compounds.

3.1.5 Comparability

Comparability is a measure of the confidence with which one set of data can be compared with another. In this project, there will be no requirement to compare data sets, so that this parameter will not be considered further.

4 SAMPLING PROCEDURES

4.1 GROUNDWATER SAMPLING

Groundwater sampling will take place after monitor wells have been installed and developed following the methods outlined in Section 3.0.

The water standing in a well prior to sampling may not be representative of in-situ groundwater quality. Therefore, prior to sampling, the standing water in the well and in the filter pack must be removed so that stagnant water will be replaced by formation water.

All wells are protected with standpipe covers or locking steel wellhead covers. Initially, the covers are unlocked and carefully opened to avoid the entry of foreign materials into the well. If needed, the exterior and interior of the exposed riser pipe of the monitoring wells will be wiped carefully with tissue paper and deionized water.

New, latex rubber gloves will be worn by field personnel during sampling at each of the monitoring wells. Measures will also be taken to prevent surface soils from coming into contact with the purging equipment. To facilitate this, plastic sheeting will be used on the ground in the immediate vicinity area of each well.

Field personnel will maintain a field log book to record the details of the purging activities. Information such as: well number, water levels prior to purging, pumping rates, purged volumes and general field observations will be recorded in the log book.

Groundwater sampling will consist of the following activities:

- measurement of static water level
- monitor well purging
- sample collection

4.1.1 Measurement of Static Water Level

Static water levels will be measured with an electric water level measuring tape consisting of a plastic-coated tape calibrated in inches and a stainless steel probe. The probe and the entire tape will be decontaminated prior to inserting into the first monitoring well to prevent introducing any contamination into the well. Thereafter, the stainless steel probe and the lower three feet of the tape will be decontaminated prior to inserting into subsequent wells to prevent cross contamination. Decontamination procedures are described in Section 5.3.

The volume of static water to be purged will be calculated as the volume of standing water in the well plus the saturated portion of the sandpack and will be calculated as follows:

$$V = r^2h\,(0.0519) + (R-r)^2Ln\,(0.0519)$$

where

V = volume of water to be purged in gallons

= 3.14

r = inside radius of monitor well casing in inches

h = height of standing water in the well in feet

R = Radius of sand pack in inches

L = length of saturated portion of sand pack in feet

n = estimated porosity of sand pack

0.0519 = conversion factor which accounts for the conversion of casing/sand pack radius from inches to feet and the conversion of cubic feet to gallons with units of gallons/in^2 ft

4.1.2 Monitor Well Purging

Monitor wells will be purged of between 3-5 well volumes prior to groundwater sampling using inertial hand pumps dedicated to each monitor well. During purging, temperature, pH, and conductivity will be monitored, and water will be observed for color and odor. Water will be purged from the upper part of the water column in the well to ensure removal of stagnant water.

4.1.3 Sample Collection

Samples will be collected from dedicated hand inertial pumps which consist of a delrin foot valve and polyethylene riser pipe. Field samplers will wear new latex rubber gloves at each sample location. Samples will be collected in clean laboratory prepared sample bottles by direct discharge into the bottle from the pump discharge tube taking care that the discharge tube does not touch the sample bottle.

Sampling for VOCs will be undertaken using extreme care to avoid agitating the sample and losing VOCs through volatilization. General characteristics of the groundwater such as color, presence of non-aqueous phase liquids, odor and turbidity will be recorded and weather conditions, including air temperature, wind conditions and precipitation, will also be recorded. Field samplers will complete a sample record log for each sample as shown in Figure 4.1.

Temperature, pH, dissolved oxygen (DO), ferrous iron, ORP and conductivity will be measured prior to taking the sample. Procedures for measuring field parameters are described below. Instrument calibration is discussed in Section 5.

Table 5-1 in the Groundwater Monitoring Workplan summarizes field sampling requirements for groundwater samples while Table 5-2 in the Groundwater Monitoring Work Plan summarizes analytical methods and QA/QC requirements.

Figure 4-1 DE&S Sample Record Log

SAMPLE ID:	SAMPLE MATRIX:	
DATE:	TIME:	WEATHER:
WELL/MANHOLE ID:	TYPE OF WELL:	WATER LEVEL:
SAMPLING METHOD:		
SAMPLE VOLUME:	CONTAINER TYPE:	
SAMPLE DESCRIPTION:		
FIELD PARAMETERS:		
pH:	ORP:	CONDUCTIVITY:
TEMPERATURE:	DO:	Fe^{2+}:
FIELD INSTRUMENTS DECON PROCEDURE:		
STORAGE LOCATION:		
DELIVERY METHOD:	LABORATORY:	
TYPE OF ANALYSES REQUIRED:		
GENERAL COMMENTS:		

4.1.3.1 Procedure for Field pH Measurement

Field pH measurements will be conducted using a Beckman or equivalent pH meter and the following procedure:

Following the pH electrode calibration, place the pH electrode in an open beaker containing sample. Constantly stir the solution very slowly with the electrode to ensure that the glass bulb is in contact with fresh solution during measurement.

The pH measurement should be taken as soon as possible after electrode calibration to minimize the effects of significant electrode drift and to obtain a solution pH before any significant CO_2-outgassing has a chance to affect solution conditions. It is not necessary to wait until a stable pH is obtained as this may represent the outgassed solution condition. A reasonable pH measurement should be taken within several minutes of the electrode being placed in the beaker.

4.1.3.2 Procedure for Field Conductivity Measurement and Temperature

Field conductivity measurements will be conducted using a Yellow Springs Instrument (YSI) or equivalent conductivity meter. The meter and probe will be checked for accuracy before starting sample measurements.

The electrical conductivity measurement is made by immersing the conductivity probe in the sample, selecting the appropriate measurement scale, and recording the stable reading. Care should be taken to ensure that the metal electrodes in the probe are fully immersed and that air bubbles are not trapped in the access ports of the probe. Temperature is measured with a thermometer as soon as possible after retrieving fluid from the well. The final electrical conductivity and temperature of the sample are recorded on the sample record log sheet.

4.1.3.3 Procedure for Field Dissolved Oxygen Measurement

DO concentrations will be measured using a YSI Model 55 Handheld Dissolved Oxygen System or a similar meter with a 25 foot probe cable. The probe will be lowered into each well immediately after purging. The probe will be agitated through the water at a rate of 1 ft/second while measuring DO concentration.

4.1.3.4 Procedure for Field ORP Measurement

ORP will be measured using an Orion 290A pH-Concentration Meter fitted with an ORP probe or a similar meter. The ORP probe will be inserted into a flow-through cell and measurements will be collected at each well following purging.

All probes used for collecting direct field measurements will be decontaminated using the following procedures:

- paper towel wipe
- non-phosphate detergent wash
- deionized water rinse
- paper towel wipe

4.1.3.5 Procedure for Field Ferrous Iron Measurement

A field analysis will be conducted for ferrous iron (Iron [II]). The analysis of this parameter must be done immediately because ferrous iron is not stable and cannot be measured accurately in a laboratory due to shipping delays. Field analysis of Iron II will be performed using a Hach Model IR-18C color disc method with 1, 10 Phenanthroline. The color disc method uses a continuous-gradient color wheel for color matching. Typical accuracy is ±10%. This method has a detection range of 0-10 mg/L. The field sample collected for determining ferrous iron concentration must be sediment free; therefore, each sample should be collected prior to purging each well.

4.2 *SOIL SAMPLING*

Soil sampling will be conducted following ASTM D-1586 standards using a CME 55 or equivalent drill rig equipped with 4.25 inch I.D. hollow stem augers and a 2 inch diameter 24 inch long split spoon sampler attached to AW size drill rods. The split spoon will be advanced using a 140 pound hammer at 6 inch intervals and the blow counts will be recorded.

Samples will be screened immediately with an HNu PID organic vapor meter. The sample will be stratigraphically logged, and transferred to a clean 16oz glass jar. Drilling equipment will be steam cleaned and split spoons will be cleaned after each sample according to the protocol described in Section 4.3.

A monitor well will be installed following the completion of selected boreholes as described in Section 2. Drill cuttings will be drummed and temporarily stored in a secure area on site and disposed of in accordance with applicable regulations.

4.3 *DECONTAMINATION*

Drilling, sampling and testing methods have been selected to prevent the possibility of cross-contamination.

Decontamination of drilling equipment will take place on a decontamination pad constructed at a secure location within the facility. The pad will consist of 6 mil heavy plastic sheeting attached to 2 inch by 6 inch boards. The plastic will be protected from damage by boards and plywood. The pad will be fitted with a sump and submersible pump.

A portable steam cleaner will be used to decontaminate the drilling assembly and all downhole materials including augers, temporary casing, drill rods and core barrels. Equipment will be moved to the pad for decontamination before drilling commences and after the completion of each pair of monitor wells. A sufficient number of augers and rods will be decontaminated at one time to allow the completion of both boreholes at each couplet location.

Split spoon samplers will be cleaned by washing in a detergent solution and rinsing with deionized water. The water level tape will be cleaned as follows:

- paper towel wipe
- non-phosphate detergent wash
- deionized water rinse
- paper towel wipe

Decontamination effluent consisting of water and suspended matter will be containerized. Containers will be clearly labelled as "Liquid Purging/Decontamination Wastes". Solid wastes will be stored in 55 gallon drums and labelled as "Solid Drilling/Decontamination Waste". Containers will be moved to a secure area where wastes generated during drilling, well development and purging will be temporarily stored pending the results of sampling by BP to determine the most appropriate method of disposal.

5 INSTRUMENT CALIBRATION

All field and laboratory instruments requiring calibration will be calibrated as per the manufacturers specifications by personnel properly trained in carrying out these procedures. Calibration procedures will be documented in appropriate field and laboratory log books for future reference.

5.1 FIELD INSTRUMENTS

5.1.1 pH Meter

The meter will be standardized using a pH 7.00 buffer and then calibrated with a pH 10 buffer prior to sampling at each well. The range of buffer solutions to be used (i.e., pH 7 and 10) for calibration depends on the approximate pH of the sample during the standardization measurement. Buffer solutions should bracket the expected pH of the sample. Previous sampling during the PSA indicate that pH at the site ranges from approximately 6.95 to 8.34. The electrode will be calibrated to the manufacturer's specifications. During pH probe calibration, the buffers will be kept at the same temperature as the groundwater.

5.1.2 Conductivity Meter

The conductivity meter and probe should be checked for accuracy before starting sample measurements. A standard of salt solution is available with the meter with a known electrical conductivity value. The equipment error will be noted and if the error is greater than several percent of the known standard then either the batteries in the meter require replacement or the probe requires cleaning. As routine procedure, the exposed metal electrodes in the PVC probe should be cleaned prior to the sampling round.

5.1.3 Dissolved Oxygen Probe

Dissolved oxygen will be measured with a YSI Model 55 Handheld Dissolved Oxygen System or similar instrument. The instrument will be maintained and calibrated according to the manufacturer's instructions.

5.1.4 Ferrous Iron Test

Ferrous iron will be measured in the field using a Hach Model IR-18C color disc for color matching. The color disc and the two sample test tubes will be kept clean and free of scratches to ensure results are as accurate as possible. The ferrous iron test kit does not require calibration.

5.1.5 Temperature

Thermometers/probes used for temperature measurements will be calibrated and maintained according to the manufacturer's instructions.

5.1.6 Turbidity

The instrument to measure turbidity will be calibrated with the appropriate reference standards. It will be calibrated prior to use and after every 10 sample measurements.

5.1.7 PID Meter

The PID meter will be calibrated using an isobutylene standard at ambient temperature according to the manufacturer's instructions. Calibration will be carried out at the beginning of each working day.

5.2 LABORATORY INSTRUMENTATION

Laboratory instrumentation calibration is described in the laboratory protocol discussed in Appendix B.

6 SAMPLE CUSTODY

Sample custody involves the identification and tracking of samples to ensure the integrity of the samples and to minimize loss of and damage to samples during transport. Sample custody will involve:

- field custody
- transport to the laboratory
- laboratory custody
- documentation

6.1 FIELD CUSTODY

Sample bottles will be received from the laboratory as certifiably clean in sealed insulated coolers. Each batch of clean sample bottles will be picked up at the laboratory by INTERA project field personnel and the transfer of sample bottles will be signed off on an accompanying chain-of-custody record. Sample custody in the field will be the responsibility of the field sampler who will record all sampling information into a field notebook and onto a sample record log. The log entry will include a sample identification number, sample location, date and time of sample, the required analyses, preservation techniques and other information relevant to the sample as discussed in Sections 2 and 4.

Sample bottles will be labeled with adhesive labels and identified using waterproof ink with the following information: company name, site identification, sample identification number, date and time of sample, required analyses, preservatives added, signature of sampler. This information will be cross referenced to the field sample log. Samples will be immediately transferred to a cooler.

The chain-of-custody record will be completed in duplicate by the field sampler for each shipment of samples to the laboratory. The sample cooler will be sealed with preprinted adhesive-backed custody seals across the cooler lid on two sides. Custody seals will be signed and dated by the field sampler.

The chain-of-custody record accompanies each cooler. A copy is kept by the field sampler and retained for the Project Manager. The chain-of-custody record is signed during transfer by those individuals giving up custody and those receiving the samples. Other information on the chain-of-custody record includes the date and time of sample transfer.

6.2 TRANSPORT TO THE LABORATORY

Samples will be transported to the laboratory by project field personnel involved with the sampling and packing of samples.

6.3 LABORATORY CUSTODY

Samples will be received at the laboratory by the sample receiver who accepts custody of samples from the project field person. The laboratory sample receiver will sign the chain-of-custody record. The receiver will first check the custody seals on the sample container and open the cooler to inspect the condition of samples and to ensure that bottles are intact. He/she will then comment on the integrity of the seals on the chain-of-custody record before returning a copy to the project field personnel.

The sample receiver will then proceed to log the samples into the laboratory chain-of-custody system by completing an analytical receipt form (ARF) for each sample. The ARF will accompany each sample through each step of the laboratory analysis.

6.4 DOCUMENTATION

6.4.1 Sample Identification

Samples will be identified using a 12 digit alpha-numeric code with the following format: 001300-10-G001. The first four digits identify the project number. The next two digits identify the calendar year (i.e., 00=2000). The next digits, separated by dashes, indicate the month of the sampling (i.e., 10=October). The letter indicates the sample type (G - groundwater; E – sewer effluent) and the last three digits identify the sequential sample number. Continuous, sequential sample numbers will be used throughout the long-term groundwater monitoring program.

6.4.2 Field Log Books

All aspects of the field program will be recorded in a waterproof field log book with numbered pages. All entries will be made in waterproof ink and entries will be dated and signed. Under no circumstances will pages be removed from the log book.

Any corrections to entries will be made by striking a single ruled line through the entry so that the original entry will still be legible, and the corrected entry is added adjacent to the correction. The correction will be initialled and dated and a footnote explaining the reason for the correction will be provided.

6.4.3 Laboratory Log Book

A laboratory log book will also be maintained by the analytical laboratory to document sample processing, preparation techniques and instrumentation methods as well as results and time, date, and name of the person performing the analyses.

7 EVALUATION OF DATA

7.1 ANALYTICAL QUANTITATION LIMITS AND LABORATORY QA/QC

Analytical protocols and methods are summarized in Section 2. A list of the compounds and elements to be analyzed in groundwater and soil have been provided in Table 2.1. Contract required quantitation limits are provided in Table 7.1.

7.2 DATA USEABILITY

The following five attributes can be used to define the quality and therefore the usability of environmental data (Nielsen 1991):

- precision
- accuracy
- completeness
- representativeness and
- comparability

The first three attributes precision, accuracy and completeness, are relevant to this project and are defined as follows.

7.2.1 Precision

Precision is a measure of the reproducibility of the data. Precision can be determined from replicate analyses of the same sample or analyses of samples submitted as duplicates. Precision is often reported as standard deviation, relative standard deviation or relative percent difference.

Standard Deviation

Standard deviation (SD) is expressed as:

$$SD = \sqrt{\sum_{i=1}^{N} \frac{\left(Xi - \overline{X}\right)^2}{N-1}}$$

where N = number of samples

Xi = concentration of i^{th} value

$\overline{X}$ = mean concentration = $\dfrac{\sum_{i=1}^{N} Xi}{N}$

For data that is normally distributed, X ± 1SD will include 68% of the data values and X ± 2 SD will account for 95% of the data values.

Relative Standard Deviation

The relative standard deviation (RSD) is used often to estimate the precision of replicate analyses and is expressed as:

$$\text{RSD} = \frac{SD \times 100}{\overline{X}}$$

Relative Percent Difference

The relative percent difference (RPD) is used to estimate the precision of analyses from duplicate samples and is expressed as:

$$\text{RPD} = \frac{X_1 - X_2}{\overline{X}} \times 100$$

where X_1 = concentration of first duplicate

X_2 = concentration of second duplicate

Table 7.1 Superfund Target Compound List (TCL) for Volatiles and Contract Required Quantitation Limits (CRQL)[*]

		Quantitation Limits[**]	
Compound No.	Compound Name	Low Water µg/L	Low Soil/Sediment[a] µg/Kg
1.	Chloromethane	10	10
2.	Bromomethane	10	10
3.	Vinyl chloride	2	10
4.	Chloroethane	5	10
5.	Methylene chloride	5	5
6.	Acetone	10	10
7.	Carbon Disulfide	5	5
8.	1,1-Dichloroethylene	5	5
9.	1,1-Dichloroethane	5	5
10.	1,2-Dichloroethylene(total)	5	5
11.	Chloroform	5	5
12.	1,2-Dichloroethane	0.6	5
13.	2-Butanone	10	10
14.	1,1,1-Trichloroethane	5	5
15.	Carbon tetrachloride	5	5
16.	Vinyl acetate	10	10
17.	Bromodichloromethane	5	5
18.	1,2-Dichloropropane	5	5
19.	cis-1,3-Dichloropropene	5	5
20.	Trichloroethene	5	5
21.	Dibromochloromethane	5	5
22.	1,1,2-Trichloroethane	5	5
23.	Benzene	1	5
24.	trans-1,3-Dichloropropene	5	5
25.	Bromoform	5	5
26.	4-Methyl-2-pentanone	10	10
27.	2-Hexanone	10	10
28.	Tetrachloroethene	5	5
29.	Toluene	5	5
30.	1,1,2,2-Tetrachloroethane	5	5
31.	Chlorobenzene	5	5
32.	Ethyl Benzene	5	5
33.	Styrene	5	5
34.	Total Xylenes	5	5

[a] Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 125 times the individual Low Soil/Sediment CRQL.

[*] Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

[**] Quantitation Limits listed for soil/sediment, calculated on dry weight basis, as required by the protocol, will be higher.

7.2.2 Accuracy

Accuracy is a measure of the closeness to the "true" value that an analytical value approaches. Accuracy is used to describe the percent recovery of: (i) a "spike" added to a sample of known value; or (ii) a standard reference material.

$$\% \text{ recovery}_{SS} = \frac{SS - S}{SA} \times 100$$

where SS = analyzed value of spiked sample

S = analyzed value of sample

SA = actual amount of spike added

$$\% \text{ recovery}_{SRM} = \frac{SRM_a}{SRM_t} \times 100$$

where SRM_a = analyzed value of standard reference material

SRM_t = true value of standard reference material

7.2.3 Completeness

Completeness is a measure of the amount of valid data that is obtained from a measurement system compared to the amount of data that is needed to provide confidence that conditions have been adequately assessed. Completeness is difficult to quantify and pertains to all aspects of an investigation including the field program as well as analytical work.

7.3 DATA ASSESSMENT

Data assessment will comply with NYSDEC ASP Category B deliverables for VOC data validation.

The project data validator will review all data generated during field and laboratory tasks. This will include:

- assessment of field work
- assessment of field sampling
- assessment of laboratory analytical results.

7.3.1 Assessment of Field Work

Field work, including drilling, monitor well installation and well development, will be assessed for completeness and adherence to the project work plan through a thorough review of field notes.

7.3.2 Assessment of Field Sampling

Field sampling will be assessed according to adherence to strict sampling and QA/QC protocols. Assessment will be made with respect to decontamination procedures during split spoon sampling, monitor well installation and groundwater sampling. Purging volumes will be reviewed to ensure that groundwater samples are representative. Completeness of the sampling program will be assessed by determining whether or not all samples were collected, and whether or not all samples were analyzed. Assessment will also be made with respect to preservation techniques, quality control samples, chain of custody and sample holding time.

7.3.3 Assessment of Laboratory Analytical Results

Analytical precision will be assessed as acceptable if the relative standard deviation or the relative percent difference of replicate or duplicate analyses lies below the upper control limit (UCL). The UCL is a critical value that represents the maximum allowable difference between replicate analyses or a single sample. The UCL for organics is calculated as:

$$\mathrm{UCL} = \overline{X_{RPD}} + 3SD_{RPD}$$

where $\overline{X}$ = the mean relative percent difference for matrix spike and matrix spike duplicate pairs

$\mathrm{SD_{RPD}}$ = the standard deviation of the relative percent difference

Where the RPD of any duplicate pairs of analyses exceeds the UCL, then the data are not acceptable.

Analytical accuracy is assessed as acceptable if the percent recoveries fall within upper and lower control limits defined as the mean of the percent recoveries plus or minus three standard deviations.

$$\mathrm{UCL} = \overline{Xr} + 3SD$$

$$\mathrm{LCL} = \overline{Xr} - 3SD$$

where $\overline{Xr}$ = mean of percent recoveries

If percent recoveries fall outside the control limits, the data is deemed out of control and unacceptable.

7.3.4 Data Validation Report

A report assessing the validity and useability of the data will be provided to NYSDEC with submission of the final report (see Section 8).

8 DATA REDUCTION, VALIDATION AND REPORTING

All data generated during this project will be evaluated to ensure that the work conducted complies with the work plan, HSP and QAPP, and is complete.

The Quality Assurance Policy for the laboratory contracted to undertake this work is provided in Appendix A.

8.1 DATA REDUCTION

The reduction of data into a format that will facilitate presentation in a final report will be conducted by means of a thorough review and assessment of all field and laboratory documentation associated with this project. Documents that will be reviewed will include:

- Field notebooks documenting all drilling, sampling and testing procedures
- Field sample logs
- Chain-of-custody forms
- Laboratory data packages including: calibration data, laboratory QA/QC, instrument and method performance, raw data, etc.

Where possible data will be reduced to tabular form.

8.2 DATA VALIDATION

Data validation will be carried out by an experienced data validator following methods acceptable to NYSDEC. The data validator will review the data package for completeness as defined in Section 3.1.4 and will assess the following information:

- laboratory QA/QC
- that data has been produced in a manner consistent with stated protocols

- that instrument tuning and calibration protocols have been followed
- that data reporting forms are complete
- that problems encountered during analysis and the steps taken to correct them are documented

8.3 DATA REPORTING

A data validation report will be prepared for the RI work program. The report will discuss the analysis of VOCs and PAHs in terms of the following validation items:

- traffic reports and laboratory narrative
- holding times
- surrogate recovery
- matrix spike and matrix spike duplicates
- blanks
- instrument tuning
- analyte identification
- tentatively identified compounds
- internal standards
- initial and continuing calibration
- field duplicates

Laboratory analytical data will be appended to the data validation report and qualifiers will be suffixed to the analytical result where appropriate.

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APPENDIX A

LABORATORY QA/QC FOR

SEVERN TRENT LABORATORIES, INC.

Quality Assurance Policy

It is STL's policy to:

- provide high quality, consistent, and objective environmental testing services that meet all federal, state, and municipal regulatory requirements.
- generate data that are scientifically sound, legally defensible, meet project objectives, and are appropriate for their intended use.
- provide STL clients with the highest level of professionalism and the best service practices in the industry.
- build continuous improvement mechanisms into all laboratory, administrative, and managerial activities.
- maintain a working environment that fosters open communication with both clients and staff.

Calibration Procedures

All equipment is tested upon receipt to establish its ability to meet the QC guidelines contained in the test method for which the instrumentation is to be used. This testing is documented in instrument run and maintenance logbooks. Once an instrument is placed in routine service, ongoing instrument calibration is demonstrated at the appropriate frequency as defined in the test method. Any instrument that is deemed to be malfunctioning is clearly marked and taken out of service. When the instrument is brought back into control, this is documented in the instrument maintenance log.

Document Control

Security and control of documents are necessary to ensure that confidential information is not distributed and that all current copies of a given document are from the latest applicable revision. Unambiguous identification of a controlled document is maintained by identification of the following items in the document header: Document Name, Document Number, Revision Number, Effective Date, Number of Pages. Controlled documents are authorized by the STL QA Department. Controlled documents are marked as such and records of their distribution are kept by the QA Department. Document control maybe achieved by either electronic or hardcopy distribution.

Changes to documents occur when a procedural change warrants a revision of the document. When an approved revision of a controlled document is ready for distribution, obsolete copies of the document are replaced with the current version of the document. The previous revision of the controlled document is archived by the QA Department.

Sample Preparation and Analytical Procedures

Sample preparation and analytical procedures are referenced in STL's Quality Assurance Plan and laboratory SOPs.

Most of the test methods performed at STL originate from test methods published by a regulatory agency such as the US EPA and other state and federal regulatory agencies.

STL maintains an SOP Table of Contents for both Method and Process SOPs. Method SOPs are maintained to describe a specific test method. Process SOPs are maintained to describe function and processes not related to a specific test method.

Method Verification

Method verification is required when a validated standard test method or a method modification is implemented. The level of activity required for method verification is dependent on the type of method being implemented, or on the level of method modification and its affect on a method's robustness. Method modification often takes advantage of a method's robustness, or the ability to make minor changes in a method without affecting the method's outcome.

Method Validation and Verification Activities

Before analyzing samples by a particular method, method validation and/or method verification must occur. A complete validation of the method is required for laboratory developed methods. While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

Data Reduction, Validation, and Reporting

Reduction

Data reduction involves the procedures used to convert raw data (instrument printouts) into reportable results. Reportable results can be retrieved from instrument direct readings or from calculations based on instrument output, readings or responses.

Equations used to calculate the concentration for each test parameter are presented in their respective methods. The basic calculations relate a known concentration to an instrumental, chemical, or physical measurement. The reporting units are based on the respective calibrations, which are defined in each analytical method.

All lab results (reduced data) are recorded by the chemist onto the laboratory data sheets. The laboratory chemist is also responsible for calculations of spike recoveries and precision for duplicate identification of blanks and QC data as well as accurate transcription of sample results and identifications.

Data Verification

All laboratory data entries and calculations are checked for errors and mistakes. The chemists and supervisors will check the laboratory data sheets against raw data to verify that the data makes sense, is analyzed within holding time, includes appropriate method reference, has proper units and reporting limits, and is associated with the correct STL sample ID number. The laboratory supervisor and senior chemist will also check the following records and documentation before turning in the laboratory data sheets to Data Management:

- Raw data entries for transcription accuracy
- 80 - 90% of all calculations randomly checked for mathematical errors including percent recoveries (%R), RPDs, dilution factors, final volumes, dry weight factors and sample volumes or weights

- Verify acceptability of initial and/or continuing calibration data
- Verify integrity of calibration
- Sample preparation logs and instrument or analytical logs to assure that samples were prepared and analyzed within prescribed holding times
- Cross check all records for completeness and for transcription errors associated with the sample number
- Verify all chain of custody records (if applicable) for completeness and acceptability (custody integrity of samples)

Once the laboratory data sheets are turned into Data Management, they are keyed into LIMS by the LIMS Operator. The laboratory data sheets and final report are filed in a Project folder with the COC, the PSIF, CPIF, the Sample Checklist, the invoice, the field sheets, etc. The data then goes through a proofing step by Data Management personnel.

Project Verification/Validation

The Project Manager/Client Services Representative is responsible for review of all project data before submission to the client. The Project Manager's review responsibilities include:

- Reviewing all identified (reported) QC checks (field and lab). Assuring all questionable data or any QC data outside control limits has been qualified
- Reviewing all header information
- Checking for overall project consistency and supporting documentation such as field records, COC, CPIF, PSIF, etc.
- Comparison of data with historical data or expected results (if possible)
- Checking for obvious anomalous values
- Checking for clerical errors transposed numbers and accurate data transfer.
- The Project Manager/Client Services Representative will then verify the final report with his/her signature.

Verification/Validation by the QA Department

Five percent of the file folders are then passed to the QA department for validation. The validation duties include:

- Verification that all quality control blanks meet criteria. If necessary, report associated data sets with appropriate data qualifiers
- Review of all other quality control data (spikes, duplicates, quality control check standards, quality control check samples, etc.) for acceptability
- Review of all surrogate and standard additions spike recoveries, and internal standard responses for acceptability
- Identification of any sample set or data that are unacceptable and initiate appropriate corrective action measures
- Verification of mass spectral interpretation (if applicable) and/or component identification
- Assignment of data qualifiers to all applicable data. Note: the reported value always precedes the data qualifier code

Reporting

Data is manually keyed in from the laboratory data by the LIMS operators. Corrective Action forms must be filled out by the chemist for any nonconformances. The original Corrective Action form is turned into the QA department and a copy is attached to the laboratory data sheet. The project managers generate the Case Narrative when necessary to report to the client any problems associated with samples.

All parties responsible for data review and verification are also responsible for providing data to LIMS Operators with accurate records (laboratory data sheets, workload sheets, QC data or batch sheets, and field sheets) for transcription.

The Data Management personnel are responsible for ensuring all laboratory data sheets, final reports, Case Narratives (if necessary), COC, PSIF, CPIF, sample checklists, etc. are combined in the project file folder in an orderly manner.

The minimum information that will be included on or as an attachment to final analytical reports:

- Laboratory name, address and phone number
- Client name and/or site name
- Laboratory certification numbers from various certification, state and accreditation agencies
- Client or field identification number
- Laboratory identification number for each sample (sample ID number)
- Method number used for each sample analysis
- Analytical result for each analysis
- Date of analysis
- Time of sample preparation/analysis if the holding is less than 48 hours
- Date and time of sample collection as reported on the Chain of Custody
- Identification of all subcontract laboratories providing analytical results in the report

Internal Quality Control Checks

Control samples are analyzed with each batch of samples to monitor laboratory performance in terms of accuracy, precision, sensitivity, selectivity, and interferences. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch. There are also a number of QC sample types that monitor field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Control Sample types and typical frequency of their application are outlined in Table below. Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. The table does not define STL's approach to application of QC samples for each regulatory program or test method.

Laboratory QC Sample Type	Use	Required Frequency
Laboratory Control Sample (Laboratory Fortified Blank)	Measures accuracy of method in blank matrix	1 per batch of 20 or less samples per matrix type per sample extraction or preparation method[1]
Method Blank	Measures method contribution to any source of contamination	1 per batch of 20 or less samples per matrix type per sample extraction or

		preparation method[1]
Field QC Sample Type	**Use**	**Typical Frequency**
Matrix Duplicate	Measures effect of site matrix on precision of method	Per 20 samples per matrix or per SAP/QAPP[1,2]
Matrix Spike	Measures effect of site matrix on accuracy of method	Per 20 samples per matrix or per SAP/QAPP[1]
Matrix Spike Duplicate	Measures effect of site matrix on precision of method	Per 20 samples per matrix or per SAP/QAPP[1,2]
Equipment Blank (Equipment Rinsate)	Measures field equipment contribution to any source of contamination	Per SAP/QAPP
Trip Blank	Measures shipping contribution to any source of contamination (Volatiles only)	Per Cooler

[1] Denotes an STL required frequency

[2] Either an MSD or an MD is required per 20 samples per matrix or per SAP/QAPP.

Performance Audits

The internal performance audit consists essentially of evaluating the accuracy of all data. A performance audit will consist of introducing blind performance evaluation samples to the laboratory from vendors approved by NIST (NELAC). Blind performance evaluation samples are required for each program (drinking water, clean water act, RCRA) twice annually.

The blind performance evaluation samples must be analyzed by the same methods and in the same manner afforded routine sample analyses. It is not acceptable to use "special" processing considerations for PE samples. Unless the method permits replicate analyses, the analyses at multiple dilutions and special data handling processes for PE samples are not permissible at STL.

Systems Audits

Facility systems audits are technical in nature and are conducted on an ongoing basis by the QA Manager or his/her designee at each facility. Systems audits cover all departments of the facility, both operational and support.

The audit report is issued by the QA Manager of the facility within 21 calendar days of the audit. The audit report is addressed to the Department Supervisor and/or Manager, and copied to the General Manager and Laboratory Director.

Written audit responses are required within 21 calendar days of audit report issue. The audit response follows the format of the audit report, and corrective actions and periods for their implementation are included for each deficiency. The audit response is directed to all individuals copied on the audit report. Where a corrective action requires longer than 21 days to complete, the target date for the corrective action implementation is stated and evidence of the corrective action is submitted to the QA Department in the agreed upon time frame.

Data Audits

Data audits are focussed to assess the level of method compliance, regulatory compliance, accuracy and completeness of test results and reports, documentation, and adherence to established QC criteria, laboratory SOPs, technical policy, and project specific QC criteria.

A data auditing frequency target of 5% has been established. The QA Department provides feedback and/or corrections and revisions to project reports where necessary. Data audits include spot-checking of manual integrations by QA personnel in order to determine that the manual integration is appropriate and documented according to STL policy.

Records of the data audits are kept, and the frequency of data audits is included in the monthly QA report. In performing data audits, it is essential that data be assessed in terms of differentiating between systematic and isolated errors. Upon noting anomalous data or occurrences in the data audits, the QA Department is responsible for seeking clarification from the appropriate personnel, ascertaining whether the error is systematic or an isolated error, and overseeing correction and/or revision of the project report if necessary. Errors found in client project reports are revised and the revision sent to the client. The QA Department is also responsible for assisting in the corrective action process where a data audit leads to identification of the need for permanent corrective action.

Where specific clients and regulatory programs require more frequent data auditing; the individual facility meets the data auditing frequency for that program.

Preventative Maintenance

All equipment is subject to rigorous checks upon its receipt, upgrade, or modification to establish that the equipment meets with the selectivity, accuracy, and precision required by the test method for which it is to be used. All manufacturer's operations and maintenance manuals are kept up to date and accessible for the use of the equipment operator. Documentation of equipment usage is maintained using analytical run and maintenance logbooks.

STL employs a system of preventative maintenance in order to ensure system up time, minimize corrective maintenance costs and ensure data validity. All routine maintenance is performed as recommended by the manufacturer and may be performed by an analyst, instrument specialist or outside technician. Maintenance logbooks are kept on all major pieces of equipment in which both routine and non-routine maintenance is recorded. Notation of the date and maintenance activity is recorded each time service procedures are performed. The return to analytical control following instrument repair is documented in the maintenance logbook. Maintenance logbooks are retained as QC records.

Maintenance contracts are held on specific pieces of equipment where outside service is efficient, cost-effective, and necessary for effective operation of the laboratory.

Data Assessment Procedures

In order to determine method performance characteristics, a method detection limit study and a precision and accuracy study will be conducted prior to the use of any method. STL's in-house control limits are determined on an annual basis for each method. Continuing performance is demonstrated through analysis of the LCS, MS and MSD.

Method Detection Limit Studies

Soil and water MDL studies must be completed for each method by an experienced chemist or technician. All GC instruments must have MDLs for both the primary and secondary column/detector. The procedure to be followed is documented in 40 CFR Part 136, App. B and STL-PN SOP 1004.

Reporting Limits

The STL reporting limits were developed from various client requests. Prior to establishing these reporting limits, STL reviewed in-house MDL studies and historical data and determined that such reporting limits were feasible and met clients' analytical needs. STL's reporting limits are not based on a particular factor applied to its MDLs. Analytical reports and QC reports supplied to clients contain STL's reporting limits **unless** the data pertains to a project requiring specific MDLs and PQLs.

Precision and Accuracy

Each chemist or technician must perform a one-time initial demonstration of precision and accuracy (P&A) or capability (IDOC). The procedure(s) to follow is documented in STL-PN SOP 1004. Matrix-specific P&A studies must be performed. All P&A studies must be turned in to the QA Department.

Precision and accuracy targets (control limits) are listed in the laboratory QAP, and must be generated from matrix spikes (MS) and matrix spike duplicates (MSD), or duplicates of environmental samples. Control limits are also generated from laboratory control samples (LCS).

Client DQOs

A client may require that the laboratory to test for a single analyte with specific DQOs for sensitivity, accuracy, and precision as follows: Reporting Limit of 10 ppm, accuracy ±25%, and RSD of less than 30%. The laboratory may opt to develop a method that meets these criteria and document through the Method blank results, MDL study, and LCS results that the method satisfies those objectives. In this case, both the method and the embedded QC criteria have been based on the client's DQOs.

In some cases, the data user needs more stringent sensitivity, accuracy, and/or precision than the laboratory can provide using a routine test method. In this case, it is appropriate that the laboratory provide documentation of the sensitivity, accuracy, and precision obtainable to the data user and let the data user determine whether to use the best available method offered by the laboratory, or determine whether method development or further research is required.

Corrective Actions

Corrective actions are taken when sample data is determined to be questionable, QC data is out of control, or deficiencies are cited during an audit. If a specified QC measure is determined to be out of a predetermined acceptance range (out of control), and the source or reason for the deviation is not identified and corrected, the sample data associated with the QC measure may not be useful or valid information. Some QC criteria (calibrations) have a direct effect on sample results. Others (blanks, duplicates, etc.) are indicators of possible contamination or improper protocol.

The purpose of a corrective action is to document and promptly address major and/or minor problems, and to develop a plan that will eliminate the potential for repetition of the problem. An ideal corrective action that is initiated as a result of an audit should eliminate any carryover from audit to audit.

A corrective action can be applied to a process or an individual. When applied to an individual, its purpose is to immediately correct the employee's perception of the standards that have caused the problem. Management realizes that the employee is many times not at fault, and that the problems are often caused by lack of training. However, the individual must fill out the Corrective Action/Out-Of-Control Events Form in order to demonstrate that the problem will be corrected. It is also used to demonstrate that the employee understands the problem or situation. The supervisor and the individual then sign the Corrective Action/Out-Of-Control Events Form to document the correction of the problem. The supervisor is responsible for training the other employees in the department so that this problem will not recur. It is also important that the Corrective Action/Out-Of-Control Events Form be held no longer than 5 days, once it is fully completed, before returning it to the QA Department.

Quality Assurance Reports to Management

A monthly QA report is prepared by QA Manager and forwarded to the Laboratory Director, the General Manager, and the Corporate QA Manager. The reports include statistical results that are used to assess the effectiveness of the Quality System. The format of the monthly report is shown below.

Monthly QA Report Format

1. Audits
   Internal systems audits performed.
   External systems audits performed.
   Data audits performed (in percent).
2. Revised Reports/Client Complaints
   Revised reports in percent.
   Total number of client complaints, reason, and resolution.
3. Certifications/Parameters Changes
4. Proficiency Testing
   Score for each PT as a percent.
   Note repeat failures and/or significant problems.
5. Miscellaneous QA and Operational Issues
   Narrative outlining improvements, regulatory compliance issues, general concerns, and assistance required from Corporate QA.

A Corporate QA Monthly Report containing a compilation of the Facility QA reports statistics, information on progress of the Corporate QA program, and a narrative outlining significant occurrences and/or concerns is prepared by the Corporate QA Manager and forwarded to the Chief Operating Officer.