Department of Environmental Conservation

Division of Environmental Remediation

Record of Decision

Frontier Chemical Royal Avenue Site
Operable Unit No. 1

City of Niagara Falls, Niagara County, New York

Site Number 9-32-110

March 2006

New York State Department of Environmental Conservation
GEORGE E. PATAKI, *Governor*   DENISE M. SHEEHAN, *Commissioner*

DECLARATION STATEMENT - RECORD OF DECISION

Frontier Chemical Royal Avenue Inactive Hazardous Waste Disposal Site
Operable Unit No. 1
City of Niagara Falls, Niagara County, New York
Site No. 9-32-110

Statement of Purpose and Basis

The Record of Decision (ROD) presents the selected remedy for Operable Unit #1 of the Frontier Chemical Royal Avenue site, a Class 2 inactive hazardous waste disposal site. The selected remedial program was chosen in accordance with the New York State Environmental Conservation Law and is not inconsistent with the National Oil and Hazardous Substances Pollution Contingency Plan of March 8, 1990 (40CFR300), as amended.

This decision is based on the Administrative Record of the New York State Department of Environmental Conservation (NYSDEC) for Operable Unit #1 of the Frontier Chemical Royal Avenue inactive hazardous waste disposal site, and the public's input to the Proposed Remedial Action Plan (PRAP) presented by the NYSDEC. A listing of the documents included as a part of the Administrative Record is included in Appendix B of the ROD.

Assessment of the Site

Actual or threatened releases of hazardous waste constituents from this site, if not addressed by implementing the response action selected in this ROD, presents a current or potential significant threat to public health and/or the environment.

Description of Selected Remedy

Based on the results of the Remedial Investigation and Feasibility Study (RI/FS) for the Frontier Chemical Royal Avenue site and the criteria identified for evaluation of alternatives, the NYSDEC has selected the removal and treatment of soil contaminant "source areas" with groundwater control and treatment. The components of the remedy are as follows:

A remedial design program would be implemented to provide the details necessary for the construction, operation, maintenance, and monitoring of the remedial program.

- A remedial design program would be implemented to provide the details necessary for the construction, operation, maintenance, and monitoring of the remedial program.
- Removal of existing site buildings, above grade structures, and demolition debris from the site.
- Excavation and off-site treatment/disposal of contaminated soil source areas (generally defined as soils with total VOCs+MCT > 100ppm).

- The backfill of soil removal areas with clean soil or other suitable material.
- Completion of a clean soil or asphalt pavement cover over areas of site which do not have concrete or asphalt pavement.
- Improved storm water collection with permitted discharge to the Niagara Falls Water Board sewer system.
- Site groundwater controlled/treated in one of two ways: either an agreement with the Niagara Falls Water Board for use of Water Board utilities to provide site groundwater control/treatment; or, a groundwater control/treatment system constructed on site, with permitted discharge of effluent to the Water Board's sewer system.
- Development of a site management plan to address residual contamination and any use restrictions.
- Imposition of an institutional control in the form of an environmental easement.
- Periodic certification of the institutional and engineering controls.
- Operation of components of the remedy until remedial objectives have been achieved, or until a NYSDEC/NYSDOH determination that continued operation is not feasible.
- A long term groundwater monitoring program to evaluate effectiveness of the cover and groundwater control/treatment system.

New York State Department of Health Acceptance

The New York State Department of Health (NYSDOH) concurs that the remedy selected for this site is protective of human health.

Declaration

The selected remedy is protective of human health and the environment, complies with State and Federal requirements that are legally applicable or relevant and appropriate to the remedial action to the extent practicable, and is cost effective. This remedy utilizes permanent solutions and alternative treatment or resource recovery technologies, to the maximum extent practicable, and satisfies the preference for remedies that reduce toxicity, mobility, or volume as a principal element.

MAR 24 2006

Date

Dale A. Desnoyers, Director
Division of Environmental Remediation

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FRONTIER CHEMICAL ROYAL AVENUE
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March 2006

SECTION 1: SUMMARY OF THE RECORD OF DECISION

The New York State Department of Environmental Conservation (NYSDEC), in consultation with the New York State Department of Health (NYSDOH), has selected this remedy for Operable Unit No. 1 of the Frontier Chemical Royal Avenue site. The presence of hazardous waste has created significant threats to human health and the environment that are addressed by this remedy. As more fully described in Sections 3 and 5 of this document, on-site disposal and other releases during waste treatment and storage activities have resulted in the disposal of hazardous wastes, including VOCs and SVOCs. These wastes have contaminated the soils and groundwater at the site and have resulted in:

- a significant threat to human health associated with potential direct exposure to contaminated site soils and groundwater;
- a significant environmental threat associated with the impacts of contaminants to regional bedrock groundwater and the Niagara River.

To eliminate or mitigate these threats, the NYSDEC has selected the following remedy:

- A remedial design program would be implemented to provide the details necessary for the construction, operation, maintenance, and monitoring of the remedial program.
- Removal of existing site buildings, above grade structures, and demolition debris from the site.
- Excavation and off-site treatment/disposal of contaminated soil source areas (generally defined as soils with total VOCs>100ppm).
- The backfill of soil removal areas with clean soil or other suitable material.
- Completion of a clean soil or asphalt pavement cover over areas of site which do not have concrete or asphalt pavement.
- Improved storm water collection with permitted discharge to the Niagara Falls Water Board sewer system.
- Site groundwater controlled/treated in one of two ways: either an agreement with the Niagara Falls Water Board for use of Water Board utilities to provide site groundwater control/treatment; or, a site

groundwater control/treatment system constructed on site, with permitted discharge of effluent to the Water Board's sewer system.

- Development of a site management plan to address residual contamination and any use restrictions.

- Imposition of an institutional control in the form of an environmental easement.

- Annual certification of the institutional and engineering controls.

- Operation of components of the remedy until remedial objectives have been achieved, or until a NYSDEC/NYSDOH determination that continued operation is not feasible.

- A long term monitoring program to evaluate effectiveness of cover and groundwater control/treatment system.

The selected remedy, discussed in detail in Section 8, is intended to attain the remediation goals identified for this site in Section 6. The remedy must conform with officially promulgated standards and criteria that are directly applicable, or that are relevant and appropriate. The selection of a remedy must also take into consideration guidance, as appropriate. Standards, criteria, and guidance are hereafter called SCGs.

SECTION 2: SITE LOCATION AND DESCRIPTION

The Frontier Chemical Royal Avenue site is approximately 9 acres in size and is located on the northwestern corner of the intersection of Royal Avenue and 47th Street in Niagara Falls (see Figure 1). A residential neighborhood is approximately ½ mile west of the site. The Frontier Chemical site is in the heavily industrialized area of Niagara Falls bounded on the north by Niagara Falls Blvd., on the south by the Niagara River, and on the west by Hyde Park Blvd. Numerous other inactive hazardous waste sites are within 1 mile of the site. These include several Occidental Chemical waste and plant sites, as well as DuPont Chemical, Olin Chemical, and the Solvent Chemical sites.

The majority of the buildings on the site have been demolished, although some smaller buildings and structures remain. The site is completely fenced and the majority of the surface of the site covered by either concrete or blacktop. Several large areas of demolition debris also occupy areas on the surface of the site.

Operable Unit (OU) No. 1, which is the subject of this document, consists of the overburden soils, as well as overburden and upper (defined in Section 5.1.1 as the A-zone and B-zone) bedrock groundwater. An operable unit represents a portion of the site remedy that for technical or administrative reasons can be addressed separately to eliminate or mitigate a release, threat of release or exposure pathway resulting from the site contamination. The remaining operable unit for the this site is Operable Unit No. 2, and is defined as the deeper (defined in Section 5.1.1 as the C-zone and lower) bedrock groundwater.

SECTION 3: SITE HISTORY

3.1: Operational/Disposal History

The Frontier Chemical Waste Process Corporation operated a permitted waste treatment, storage, and disposal (TSD) facility at the Royal Avenue site from 1974 to December 1992. While operating, this facility treated or stored approximately 25,000 tons of chemical wastes per year. Figure 2 shows the TSD facility layout in 1984. Several major spills were documented during site operations, and in December 1992, following documented releases of hazardous waste from numerous drums, the site was ordered closed by the NYSDEC.

3.2: Remedial History

Several investigations of the site have been performed between 1981-1990. These investigations were primarily focused on identifying areas of groundwater contamination, and were required under terms of the facility's operating permit. In 1992, the bankruptcy of the company's management firm ended the company's preliminary plans to implement corrective actions to address the identified groundwater contamination.

Following closure of the facility in December 1992, an emergency removal action was initiated by the US Environmental Protection Agency (EPA) to remove the stored hazardous wastes from the site. During 1993-1994, under a voluntary agreement with the EPA, a group of potentially responsible parties (PRPs) removed over 4,000 drums of waste from the site. In a subsequent agreement with the EPA, a second phase was conducted by the PRPs during 1994-1995 which resulted in the removal of wastes from the 45 storage tanks on the property.

In 1995, the NYSDEC listed the site as a Class 2 site in the Registry of Inactive Hazardous Waste Disposal Sites in New York State. A Class 2 site is a site where hazardous waste presents a significant threat to the public health or the environment and action is required.

In January 2001 the site was referred to the NYSDEC for action using State Superfund monies. In the summer of 2001, a work plan was prepared to perform a Supplemental Remedial Investigation (Supplemental RI) and Feasibility Study (FS) of the site. The Supplemental RI was completed in 2002, and the Feasibility Study was completed in 2004.

SECTION 4: ENFORCEMENT STATUS

Potentially Responsible Parties (PRPs) are those who may be legally liable for contamination at a site. This may include past or present owners and operators, waste generators, and haulers.

As a result of previous litigation resulting from the drum and tank removal actions, several hundred PRPs have been identified. These PRPs, as well as the current property owner- "5335 River Road, Inc.", may be legally liable for contamination at the site.

The PRPs declined to implement the RI/FS at the site when requested by the NYSDEC. After the remedy is selected, the PRPs will again be contacted to assume responsibility for the remedial program. If an agreement cannot be reached with the PRPs, the NYSDEC will evaluate the site for further action under the State Superfund. The PRPs are subject to legal actions by the state for recovery of all response costs the state has incurred.

SECTION 5: SITE CONTAMINATION

A remedial investigation/feasibility study (RI/FS) has been conducted to evaluate the alternatives for addressing the significant threats to human health and the environment.

5.1: Summary of the Remedial Investigation

The purpose of the RI was to define the nature and extent of any contamination resulting from previous activities at the site. The RI consisted of data collected from the previous site investigations (conducted from 1981-1990), as well as data collected from the Supplemental RI (conducted between October 2001 and July 2002). The field activities and findings of the investigations are described in detail in the November 2002 Supplemental RI report.

The following is a summary of major site activities conducted from 1981-1990:

- 1982: To define site geology and groundwater flow direction, a hydrogeologic investigation was performed which included the installation of 8 groundwater monitoring wells.

- 1984-1985: To assess groundwater quality, a hydrogeologic investigation was conducted which included the installation and sampling of 9 additional groundwater monitoring wells.

- 1987-1988: A soil and groundwater investigation was performed which included the installation and sampling of 17 additional groundwater monitoring wells. The investigation included the organic vapor screening of soils from 28 overburden boreholes to access contaminant source areas.

- 1989-1990: A groundwater investigation was performed which included the installation and sampling of 42 additional groundwater monitoring wells.

- 1991-1992: An Interim Remedial Measures (IRM) Design Report was developed by Frontier Chemical Waste Process, Inc. and submitted to the NYSDEC. The proposed IRM included the installation of a new bedrock groundwater pumping well to reduce groundwater contaminant migration, with the use of existing chemical treatment processes to treat the captured groundwater prior to discharge to adjacent Niagara FallsWater Board sewers. The IRM was never implemented by Frontier.

The following activities were conducted during the Supplemental RI conducted during 2001-2002:

- Record search of historical site information;

- Evaluation of previous investigation data and reports to identify and focus Supplemental RI scope of work;

- Excavation of 4 test pits to verify reported site utility connections along Royal Avenue;

- Collection and analysis of soil samples taken from 26 soil borings installed as part of hydrogeologic investigations;

- Installation of 11 new (replacement) groundwater monitoring wells and 11 new piezometers; and

- Sampling of 69 new and existing groundwater monitoring wells and piezometers;

To determine whether the soil and groundwater contain contamination at levels of concern, data from the investigation were compared to the following SCGs:

- Groundwater, drinking water, and surface water SCGs are based on NYSDEC "Ambient Water Quality Standards and Guidance Values" and Part 5 of the New York State Sanitary Code.

- Soil SCGs are based on the NYSDEC "Technical and Administrative Guidance Memorandum (TAGM) 4046; Determination of Soil Cleanup Objectives and Cleanup Levels".

Based on the RI results, in comparison to the SCGs and potential public health and environmental exposure routes, certain media and areas of the site require remediation. These are summarized below. More complete information can be found in the 2002 Supplemental RI report.

5.1.1: Site Geology and Hydrogeology

Geology

The surface of the site is mostly covered by either asphalt or concrete. Up to 2 feet of fill material (generally gravel with some cinder, glass, wood, slag, bricks, etc.) overlies an overburden mostly comprised of a silty-clay, with some discontinuous seams of silty sand and clay. The total depth of the overburden is 14 to 17 feet.

The bedrock immediately beneath the overburden is Lockport Dolomite. Distinct horizontal fracture systems have been characterized during the RI. The upper 35 feet of bedrock has been characterized as follows: the A-zone is identified as the fracture system consisting of the upper several feet of weathered bedrock; the B-zone is identified as the fracture system approximately 8-10 feet below the A-zone; and the C-zone is identified as the fracture system approximately 20 feet below the B-zone. While no previous Frontier Chemical investigations have targeted bedrock beneath the C-zone, numerous deeper bedrock fracture systems have been confirmed and described at other locations within the region. The bedrock A-zone, B-zone, and C-zone are described in greater detail in the Site Hydrogeology discussion.

Regional Hydrogeology

Regionally, bedrock groundwater is recharged by water from the upper Niagara River (above the Falls), transmitted through fractures in the rock, and discharged to the lower Niagara River (at the gorge downstream from the falls). There are two man-made structures which exert a significant influence on the flow of bedrock groundwater in the region: the New York Power Authority (NYPA) conduits and the Falls Street Tunnel. These structures and their effects on regional groundwater are discussed below.

NYPA Conduits

The NYPA conduits are two parallel reinforced concrete lined tunnels which were installed within the upper bedrock to convey upper Niagara River water to the Robert Moses power generating station in Lewiston, NY. They are each approximately 65 feet wide by 46 feet high and run 4 miles in length in a south (river intake end) to north (power plant location) direction. The conduits pass approximately 1/4 mile to the west of the Frontier Chemical site (see Figure 1 for location).

The NYPA conduits were constructed with a series of continuous drains along the outside of the concrete walls and floors. These drains are connected to the inside of the conduits at two locations and were designed to regulate the bedrock groundwater height around the exterior of the conduits. Given the length and depth of the NYPA conduits, the drain systems intersect and influence a significant portion of the upper bedrock groundwater in the Niagara Falls area. The drain systems essentially create a preferential pathway for upper bedrock groundwater, and the result is a groundwater "sink" along the length of the conduits. It has been estimated that the conduits influence on the bedrock groundwater extends approximately 3,000 - 4,000 feet to the east and west of the alignment.

The NYPA conduits pass under the unlined bedrock Falls Street Tunnel (described in detail below) near Royal Avenue. A significant amount of bedrock groundwater transmitted along the NYPA conduit drain system discharges upward into the Falls Street Tunnel at this crossing. A 2003 estimate performed on behalf of NYPA calculated a discharge of approximately 6.5 million gallons of bedrock groundwater per day into the Falls Street Tunnel from the NYPA conduit drain system.

Falls Street Tunnel

The Falls Street Tunnel (FST) is an unlined bedrock sewer tunnel which passes along the south side of the Frontier Chemical site. It runs east to west for approximately 3.5 miles from 56th Street to the Niagara Gorge (see Figure 3). The FST is approximately 7 feet wide by 6 feet high (in the vicinity of Royal Ave.) and it intersects the site B-zone bedrock fracture system. The FST has drop shafts constructed at all major street intersections. These drop shafts are brick lined within the overburden and unlined within the bedrock.

Other Local Sewers

In the local vicinity of the site, there are several sewers which either influence site hydrogeology or play a role in the collection and discharge of local groundwater and storm water. The major Water Board sewers and corresponding flow paths are shown in Figure 3. As discussed above, the FST is a major sewer which runs under Royal Avenue along the south side of the site. Running parallel, and also located beneath Royal Avenue just south of the FST, is the South Side Interceptor. In addition, the New Road Tunnel runs along the eastern side of the site under 47th street. The South Side Interceptor and the New Road Tunnel are discussed in detail below.

South Side Interceptor

The FST was originally constructed as a combined storm and sanitary sewer. However, most of the waters from east of 47th Street were diverted after 1972, when the concrete lined South Side Interceptor (SSI) sanitary sewer was constructed. The SSI is located slightly south of the FST and runs from near 47th street and Royal Avenue to its discharge point at the Water Board's waste water treatment plant (WWTP). The SSI sewer serves various industrial waste dischargers with connections between its origin and its termination at the WWTP. Regulating weirs constructed in the FST just west of 47th street (and adjacent to the Royal Avenue site) and at 38th street (about ½ mile to the west) divert normal FST flows to the SSI. High water flows within the FST (such as those accompanying significant storm events) result in an "over topping" of the diversion weirs, and allow flow to continue along the FST to the west instead of being by diverted to the SSI.

New Road Tunnel

The New Road Tunnel is an unlined bedrock sewer tunnel which passes along the eastern side of the site. It runs from north to south under 47th street, and discharges to the FST. The New Road tunnel is approximately 6 feet wide by 5 feet high, and like the FST, the tunnel intersects the site B-zone bedrock fracture system.

Site Hydrogeology

Depth to groundwater within the overburden ranges from about 2 to 10 feet below ground surface. There is a horizontal overburden groundwater gradient to the southeast, with a localized overburden "sink" (inwardly directed groundwater depression) in the south-central portion of the site. A downward vertical groundwater gradient exists between the overburden and the top of the bedrock.

Within the upper 35 feet of bedrock, 3 distinct horizontal fracture zones have been identified. The A-zone consists of the highly weathered upper 3 to 5 feet of bedrock. The B-zone is a fracture system which is up to 2 feet thick and is located approximately 8 to 10 feet below the A-zone. A downward vertical groundwater gradient exists from the A-zone to the B-zone. The C-zone is a fracture system approximately 20 feet below the B-zone. Although the C-zone has not been fully characterized, a slight upward vertical groundwater gradient has been calculated from the C-zone to the B-zone. The bedrock between the three defined horizontal fracture zones contain some vertical fractures which provide some groundwater communication between the zones.

The FST and the New Road Tunnel run along the south and east sides of the site, respectively. As both of these tunnels intersect the bedrock B-zone fracture system, site bedrock groundwater from the B-zone directly infiltrates into these tunnels. This infiltration in turn promotes a downward groundwater gradient from the site overburden and upper weathered bedrock into the B-zone. The construction of the drop shafts to the FST also promotes overburden groundwater drainage to the bedrock. The influence of these tunnels may also impart an upward groundwater gradient from the lower C-zone fracture system toward the B-zone. The effect of the Falls Street tunnel as an upper bedrock groundwater interceptor has been well documented in numerous hydrogeologic studies of the area. The location, depth, and hydraulic influence of the tunnels has effectively intercepted site overburden and upper bedrock groundwater and prevented it from migrating beyond the Royal Avenue and 47th street tunnel alignments.

At the Frontier Chemical site, groundwater within the bedrock C-zone and some of the lower bedrock fracture systems are also likely influenced by the NYPA conduit drain system. Site groundwater flow within some of these lower bedrock fracture zones is most likely toward the NYPA conduits. Since significant amounts of conduit water discharges into the Falls Street Tunnel, it appears likely that at least some of the C-zone and lower site bedrock groundwater is discharged to the FST.

5.1.2 Niagara Falls Water Board Treatment of Waste Water and Storm Water Flows

The Water Board's WWTP ordinarily treats all discharges into the sanitary and storm water sewers. Treated waters from the WWTP are discharged to the lower Niagara River via the Adams Tailrace Tunnel (see Figure 3). However, during extended storm events or during those with very intense precipitation, the storage capacities of the utilities may be exceeded, resulting in the discharge of untreated waters directly to the lower Niagara River. The major components of the Water Board's storm water management system are discussed below.

Routine Handling and Treatment of Stormwater

Under normal weather conditions, all water entering the FST is ultimately discharged to the WWTP for treatment. Flows in the FST to the east of 38^{th} street (including industrial waste water discharge and contributions from the new road tunnel) are diverted to the SSI, which transmits flow directly to the WWTP. Flow in the FST downstream of a diversion weir at 38^{th} street (storm water, groundwater infiltration, etc.) is discharged to the South Gorge Interceptor, which conveys the flow along the river gorge to the Gorge Pumping station, where it is pumped to the WWTP for treatment.

Handling and Treatment during Significant Storm Water Events

During significant storm events, flows within the FST can bypass the SSI diversion weir and continue down the FST to the South Gorge Interceptor. During such storm events, flows in the South Gorge Interceptor may exceed the capacity of the pumping station. When the storm water holding capacities of the South Gorge Interceptor and FST are exceeded, flows are discharged without treatment to the Lower Niagara River via one or more permitted combined sewer overflow outfalls.

5.1.3: Nature of Contamination

As described in the Supplemental RI report, many soil and groundwater samples were collected to characterize the nature and extent of contamination. Figure 4 depicts a site base map with locations of soil and groundwater samples indicated. The main categories of contaminants that exceed their SCGs are volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs). The VOCs of concern include (but are not limited to) such compounds as acetone, trichloroethane, trichloroethene, dichloroethane, dichloroethene, tetrachloroethene, trichlorobenzene, dichlorobenzene, benzene, chlorobenzene, toluene, xylene, vinyl chloride, etc. The SVOCs of concern include (but are not limited to) such compounds as monochlorotoluene, phenol, trichlorophenol, dichlorophenol, etc.

5.1.4: Extent of Contamination

This section describes the findings of the investigation for all environmental media that were investigated. Chemical concentrations are reported in parts per billion (ppb) for water and parts per million (ppm) for soil. For comparison purposes, where applicable, SCGs are provided for each medium.

Table 1 summarizes the degree of contamination for the contaminants of concern in subsurface soils and compares the data with the soil SCGs for the site. Tables 2, 3, 4, and 5 summarize the degree of contamination for the contaminants of concern in the site overburden, A-zone bedrock, B-zone bedrock, and C-zone bedrock groundwaters, respectively, and provides comparisons with groundwater SCGs for the site. The following are the media which were investigated and a summary of the findings of the investigation.

Surface Soil

The majority of the site is currently covered with either concrete or asphalt pavement. As such, surface soil samples were not collected as part of the Supplemental RI sampling program.

Subsurface Soil

Volatile organic contamination is widespread in overburden soils in the central and south-central portions of the site. Figure 5 is a two-dimensional depiction of monchlorotoluene (MCT) and total VOCs (without MCT) concentrations within subsurface soils. MCT is a tentatively identified compound which can be identified in VOC and SVOC sample analysis. MCT is present in very high concentrations at the site, and is also considered a contaminant of concern at several other hazardous waste sites in the Niagara Falls area. There appears to be an overburden source area of MCT in the south-western quadrant of the site, with MCT concentrations detected as high as 7,884 ppm. There is an equally large area of soil with very high concentrations of total VOCs (as high as 2,089 ppm) in the central and southern portion of the site.

It should be noted that VOC concentrations within the source areas vary with depth, and maximum VOC concentrations were detected at depths from 3 and 13 feet below ground surface. The heterogeneous nature of the overburden contributes to the vertical and horizontal distribution of contaminants in the source areas. The extremely high concentrations of VOCs and MCT detected within overburden soils suggest that non-aqueous phase liquid (NAPL) exists within the soil matrix. Since many of the VOCs are more dense than water, it is also likely that dense NAPLs (i.e. DNAPL) are more prevalent near the bottom of the overburden soils, on or near the surface of the bedrock.

Toxicity Characteristic Leaching Procedure (TCLP) analysis, which indicates whether a media must be treated as a hazardous waste, was performed on soil samples from 3 boreholes located within the central part of the site. One of the soil samples in this area exceeded the regulatory limit for trichloroethene (2.32 ppm vs. criteria of 0.5 ppm). Given the magnitude of organic contaminant concentrations in soils at other site locations, it is likely that there is a significant area of subsurface soil which would also exceed TCLP criteria, and therefore be considered hazardous waste.

Groundwater

Site groundwater has been contaminated from previous spills and releases during waste storage, treatment and disposal activities. As a large percentage of the overburden soils have been contaminated by various VOCs and SVOCs, associated overburden groundwater has been similarly effected. Due to the influence of the adjacent unlined bedrock tunnels on the overburden groundwater (drawing it downward into the fractured bedrock aquifer), the majority of site contamination (both dissolved phase and NAPL) has likely migrated downward into the fractured bedrock. Groundwater impacts to each zone are discussed below. As discussed in Section 5.1.1, the location and influence of the Falls Street and New Road Tunnels has effectively intercepted the lateral movement of overburden and upper bedrock groundwater and prevented it from migrating off site beyond the Royal Avenue and 47th Street tunnel alignments. The effects of the Falls Street Tunnel (and the NYPA Conduits) on upper bedrock groundwater in the area has been well documented. USGS studies (1987 and 1991) and the 1992 "Niagara Falls Regional Groundwater Assessment" (performed jointly on behalf of DuPont, Olin, and Occidental) fully detail the effects summarized in Section 5.1.1.

Overburden Groundwater

Very high concentrations of VOCs are distributed over a large area of the site from the center to the southwestern corner. A sample of DNAPL containing mostly MCT was taken during a 1988 sampling event from overburden well BH-4B, located in the southwestern quadrant of the site, immediately down gradient of a former sludge settler lagoon. The highest concentrations of VOCs within overburden groundwater were detected in the center of the site. MCT was detected at 264,000 ppb at BH87-4B(R) and total VOCs (not including MCT) were detected at 394,300 ppb at PZ-01-4. Table 2 lists contaminants of concern in the overburden groundwater and Figures 6 and 7 present a conceptual view of total VOCs and MCT concentrations.

Bedrock Groundwater

The nature and extent of bedrock groundwater contamination is discussed below. As discussed in Section 2, Operable Unit No. 1 includes only the upper portion of the bedrock groundwater (i.e. A-zone and B-zone). The limited data related to Operable Unit No. 2 (i.e. deeper bedrock groundwater- C-zone and below) has been included in this discussion since an attempt was made to obtain C-zone bedrock groundwater quality data in the RI. Tables 3, 4, and 5 list contaminants of concern in the bedrock groundwater and Figures 6 and 7 present a conceptual view of total VOCs and MCT concentrations detected in the various upper bedrock zones.

A-zone Bedrock Groundwater

The distribution of groundwater contamination within the A-zone is widespread throughout the center, southern and southwestern portions of the site (see Figures 6 and 7). The highest concentrations of VOCs within the A-zone groundwater unit are located in the same proximity as the overburden groundwater VOC highs. MCT was detected at 42,900 ppb at MW88-3A(R) and total VOCs (without MCT) were detected at up to 354,064 ppb at MW-88-8A.

B-Zone Bedrock Groundwater

B-zone groundwater contamination is generally less widespread than the A-zone. The influence of the Falls Street Tunnel is apparent as the highest concentrations of VOCs and MCT are present along the southern side of the site near Royal Avenue (see Figures 6 and 7). MCT was detected at 47,400 ppb at MW-11 and total VOCs (without MCT) were detected at 93,271 ppb, also at MW-11. Samples of DNAPL were obtained in 1988 from B-zone fracture wells MW-11 and MW-87-1A. The DNAPL from MW-11 contained mostly MCT, di-chlorobenzenes, tri-chlorobenzenes, tetrachloroethene, and trichloroethene. The DNAPL from MW-87-1A was almost entirely MCT.

C-Zone Bedrock Groundwater

Three groundwater monitoring wells were installed in the C-zone as part of the previous investigations. One of the three wells was damaged and therefore was not sampled during the Supplemental RI. One of the two remaining C-zone bedrock wells sampled (near the eastern site boundary) in the Supplemental RI did not contain VOCs at detectable concentrations. The other well (in the south-central area) contained concentrations of MCT at 4,410 ppb and total VOCs (without MCT) at 3,590 ppb. This south central site location corresponded to an area of very high B-zone contaminant concentrations. It is therefore likely that there is also extensive C-zone groundwater contamination present in the southern portion of the site. However, the magnitude and extent of C-zone contamination cannot be assessed without additional groundwater investigations. Appropriate investigations of Operable Unit No. 2 will be necessary to characterize the nature and extent of deeper bedrock groundwater contamination.

5.2: Interim Remedial Measures

An interim remedial measure (IRM) is conducted at a site when a source of contamination or exposure pathway can be effectively addressed before completion of the RI/FS. There were no IRMs performed at this site during the RI/FS. A previous removal action was initiated by the US EPA and is discussed in Section 3.2.

5.3: Summary of Human Exposure Pathways:

This section describes the types of human exposures that may present added health risks to persons at or around the site. A more detailed discussion of the human exposure pathways can be found in Section 7 of the November 2002 Supplemental RI report.

An exposure pathway describes the means by which an individual may be exposed to contaminants originating from a site. An exposure pathway has five elements: [1] a contaminant source, [2] contaminant release and transport mechanisms, [3] a point of exposure, [4] a route of exposure, and [5] a receptor population.

The source of contamination is the location where contaminants were released to the environment (any waste disposal area or point of discharge). Contaminant release and transport mechanisms carry contaminants from the source to a point where people may be exposed. The exposure point is a location where actual or potential human contact with a contaminated medium may occur. The route of exposure is the manner in which a contaminant actually enters or contacts the body (e.g., ingestion, inhalation, or direct contact). The receptor population is the people who are, or may be, exposed to contaminants at a point of exposure.

An exposure pathway is complete when all five elements of an exposure pathway exist. An exposure pathway is considered a potential pathway when one or more of the elements currently does not exist, but could in the future.

At this site, contamination exists in subsurface soils and groundwater, and in soil vapor. For a complete exposure pathway to occur, persons would have to come into contact with the contaminated soil or groundwater, or inhale organic vapors. Exposure to these media could occur through trespassing or utility maintenance activities in and around the site. Currently, the only potential pathways of exposure are for utility workers entering adjacent or on-site utilities and structures. These potential pathways are:

- Dermal (skin) contact with contaminated subsurface soils and groundwater; and

- Inhalation of organic vapors.

The site is located in an industrial area and is not readily accessible to the public or workers at adjacent businesses. All occupied structures in the area are served by public water. Completed pathways may occur in the future for utility workers or site workers during subsurface construction activities and routine work.

5.4: Summary of Environmental Impacts

This section summarizes the existing and potential future environmental impacts presented by the site. Environmental impacts include existing and potential future exposure pathways to fish and wildlife receptors, as well as damage to natural resources such as aquifers and wetlands.

Site contamination has impacted the groundwater resource in the bedrock. However, a City ordinance currently prohibits the use of groundwater for drinking water purposes.

Under certain wet weather conditions, the off-site migration of contaminants within the overburden and upper bedrock may be directly discharged to the lower Niagara River (which in turn flows into Lake Ontario). The potential exists for aquatic resources to be effected by site contaminants. Some organic contaminants may bio-accumulate in Niagara River or Lake Ontario aquatic resources.

SECTION 6: SUMMARY OF THE REMEDIATION GOALS

Goals for the remedial program have been established through the remedy selection process stated in 6 NYCRR Part 375-1.10. At a minimum, the remedy selected must eliminate or mitigate all significant threats to public health and/or the environment presented by the hazardous waste disposed at the site through the proper application of scientific and engineering principles.

The remediation goals for this site are to eliminate, reduce, or control to the extent practicable:

- exposures of persons at or around the site to VOCs and SVOCs in soils, groundwater, or air;
- the release of contaminants from soil into groundwater that may create exceedances of groundwater quality standards;
- the release of VOC vapors from soils or groundwater into ambient air within site structures or subsurface utilities; and
- the off-site migration of VOCs and SVOCs within the overburden groundwater and within the bedrock groundwater zones of concern.

Further, the remediation goals for the site include attaining to the extent practicable:

- ambient groundwater quality standards and
- NYSDEC TAGM 4046 Recommended Soil Cleanup Objectives

SECTION 7: SUMMARY OF THE EVALUATION OF ALTERNATIVES

The selected remedy must be protective of human health and the environment, be cost-effective, comply with other statutory requirements, and utilize permanent solutions, alternative technologies or resource recovery technologies to the maximum extent practicable. Potential remedial alternatives for the Frontier Chemical Royal Avenue Site were identified, screened and evaluated in the FS report which is available at the document repositories identified in Section 1.

The FS utilized a select, focused group of general response actions and remedial technologies for site soil and groundwater contamination. This focused approach was appropriate given the nature and extent of site contamination. Both the magnitude of site contamination (including the presence of NAPL) and the practical limitations posed by the fractured bedrock aquifer were taken into consideration. Appropriate guidance, including EPA's *"Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites"* and *"Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration"* were considered. Due to the composition of the overburden (silty-clay with discontinuous seams of silty sand), various in-situ technologies (such as vapor extraction and chemical oxidation) were deemed infeasible and screened out of consideration in the FS.

A summary of the remedial alternatives that were considered for this site are discussed below. The present worth represents the amount of money invested in the current year that would be sufficient to cover all present and future costs associated with the alternative. This enables the costs of remedial alternatives to be compared on a common basis. As a convention, a time frame of 30 years is used to evaluate present worth costs for alternatives with an indefinite duration. This does not imply that operation, maintenance, or monitoring would cease after 30 years if remediation goals are not achieved.

7.1: Description of Remedial Alternatives

The following potential remedies were considered to address the contaminated soils and groundwater at the site.

Alternative 1: No Action

The No Action Alternative is evaluated as a procedural requirement and as a basis for comparison. This alternative would leave the site in its present condition and would not provide any additional protection to human health or the environment.

Present Worth: *$0*
Capital Cost: *$0*
Annual OM&M:
(Years 1-5): *$0*
(Years 5-30): *$0*

Alternative 2: Institutional Controls

Institutional controls would be implemented to restrict site access and prevent human exposures to site contaminants within the soils and groundwater. Site access would be physically controlled by long term maintenance of the perimeter fence. An environmental easement would be implemented to prevent future site uses which may be incompatible with the site remedy. A site management plan would be developed to ensure that any future site use be limited to commercial or industrial uses and that any future construction include appropriate mitigation efforts to deal with contaminated site soils, soil vapors, and groundwater. An annual certification would be required from the property owner that the institutional controls are still in place and that nothing has occurred that would impair the ability of the controls to protect public health or the environment.

This alternative would also include an annual groundwater monitoring program to assess long term site contamination and the effectiveness of the institutional controls at achieving the remedial objectives. Overburden and bedrock groundwater samples would be collected and analyzed from selected existing wells. It is assumed that the number of wells included in the monitoring program would be reduced by approximately 50% after the fifth year of data collection.

The implementation of the environmental easement and development of an Operation, Monitoring, and Maintenance (OM&M) plan for the institutional controls could be completed and finalized in 3-6 months.

Present Worth: *$989,000*
Capital Cost: *$26,000*
Annual OM&M:
(Years 1-5): *$101,000*
(Years 5-30): *$50,000*

Alternative 3: Cover System with Control/Treatment of Overburden and Upper Bedrock Groundwater

This alternative would include the removal of above grade structures and debris, with placement of a clean soil or asphalt pavement cover over areas of the site which are not currently paved. It would also include the control/treatment of contaminated site groundwater by either employing the existing Water Board utilities or through the design and construction of an on-site groundwater control/treatment system. The objective of this alternative would be to eliminate potential human exposures to contaminated vapors, soils, and groundwater, and to effectively and reliably control and treat the contaminated overburden and upper bedrock groundwater.

The cover system would be accomplished by either placing at least a one foot layer of clean soil over the unpaved areas of the site (approximately 20% of the site), or by grading and paving those areas with asphalt. If clean soil was used as the cover material, a layer of geotextile material would be included in those areas below the clean soil for future "demarcation" of potentially contaminated soils. It is recognized this type of cover system would not completely prevent infiltration of precipitation into the site soils. Any surface depressions or below grade building foundations on the site would be filled with clean soil and properly graded, or filled with an appropriate sub-base layer and paved with asphalt. In order to construct and maintain the cover system, the existing demolition debris would be removed from the site. Additional storm water collection manholes and sewer lines would be installed on the site to facilitate proper drainage. The storm water collection system would be connected to one of the existing Niagara Falls Water Board sewers for discharge under a permit with the Water Board.

Overburden and upper bedrock groundwater would either be intercepted and treated utilizing existing Water Board utilities or through the design, construction, and operation of an on-site groundwater control/treatment system. Use of existing Water Board utilities for the long term collection and treatment of contaminated site groundwater would require an agreement with the Water Board and would include reasonable compensation for providing such services. If the Water Board were to undertake future modifications to the existing utilities which diminished their control/treatment effectiveness, or should the Water Board be unwilling to provide for the continued collection and treatment of contaminated site groundwater, then an on-site groundwater control/treatment system would be required.

An environmental easement would be implemented to prevent future site uses which may be incompatible with the site remedy. A site management plan would be developed to ensure that any future site use be limited to commercial or industrial uses and that any future construction include appropriate mitigation efforts to deal with contaminated site soils, soil vapors, and groundwater. A periodic certification would be required from the property owner that the institutional controls are still in place and that nothing has occurred that would impair the ability of the controls to protect public health or the environment.

This alternative would also include an annual groundwater monitoring program to assess long term site contamination and the effectiveness of the remedy at achieving the remedial objectives. Overburden and bedrock groundwater samples would be collected and analyzed from selected existing wells. It is assumed that the number of wells included in the monitoring program would be reduced by approximately 50% after the fifth year of data collection.

The design for this alternative would depend on the choice of groundwater control/treatment system and could be completed and finalized in 6-18 months. An on-site groundwater control/treatment system would likely require pre-design pump tests and groundwater treatability studies to determine effective groundwater control/treatment system parameters. The construction time to implement this alternative is estimated at approximately 6-12 months. Costs below include a range with the lower estimates assuming groundwater control/treatment utilizing existing Water Board utilities (but do not include Water Board charges for such services), and the upper estimates assuming the design, construction, an operation of an on-site groundwater control/treatment system.

Present Worth:	*$1,861,000 - $4,671,000*
Capital Cost:	*$873,000 - $2,635,000*
Annual OM&M:	
(Years 1-5):	*$101,000 - $169,000*
(Years 5-30):	*$50,000 - $118,000*

Alternative 4: Excavation and Treatment/Disposal of Soil "Source Areas" (Total VOCs+MCT >100ppm), Installation of a Cover System, with Overburden and Upper Bedrock Groundwater Control/Treatment

This alternative would remove the above grade structures and debris from the site as well as excavate and treat/dispose of the contaminated soils with total VOCs+MCT >100 ppm. Following removal of the contaminated soil >100 ppm, a clean soil or asphalt pavement cover would be completed over areas of the site which are not currently paved. This alternative would also include the control/treatment of contaminated site groundwater by either employing the existing Water Board utilities or thru the design and construction of an on-site groundwater control/treatment system. The objective of this alternative would be to reduce contaminant soil source areas, while effectively and reliably controlling the highly contaminated overburden and upper bedrock groundwater.

A pre-design soil investigation would be conducted to more accurately identify the lateral and vertical extent of soil "source areas". These areas would be excavated and treated/disposed at a permitted off site location. On-site de-watering of contaminated soils would be necessary for soils below the water table. Excavation waters would either be treated on-site with permitted discharge to the sewers, or would be sent off site for treatment and disposal. Soil excavation would use engineering controls to prevent potential on and off-site exposures to particulates and volatile organic vapors. In order to conduct the pre-design investigation and excavate the contaminant "source areas", all remaining structures and demolition debris would be removed from the site with proper disposal of the material at an off-site facility.

The removal of the soil contaminant source areas >100 ppm total VOCs+MCT would eliminate much of the potential future contaminant loadings to the bedrock. These areas likely contain NAPL and are the most highly contaminated overburden areas.

Similar to Alternative 3, a cover system would be constructed after removal of the soil contaminant "source areas". The cover system would include the placement of at least one foot of clean soil over the unpaved areas of the site (approximately 20% of the site), or by grading and paving those areas with asphalt. If clean soil was used as the cover material, a layer of geotextile material would be included in those areas below the clean soil for future "demarcation" of potentially contaminated soils. Any surface depressions or below grade building foundations on the site would be filled with clean soil and properly graded prior to being covered. Additional storm water collection manholes and sewer lines would be installed on the site to facilitate proper drainage. The storm water collection system would be connected to one of the existing Water Board sewers for discharge under a permit with the Water Board.

Site groundwater would be controlled and treated either utilizing the existing Water Board utilities, or by design, construction, and operation of an on-site groundwater control/treatment system. Either groundwater control/treatment option would require Water Board agreement and/or permits for discharge of either raw or treated site groundwater to the Water Board's sewer system.

An environmental easement would be implemented to prevent future site uses which may be incompatible with the site remedy. A site management plan would be developed to ensure that any future site use be limited to commercial or industrial uses and that any future construction include appropriate mitigation efforts to deal with contaminated site soils, soil vapors, and groundwater. A periodic certification would be required from the property owner that the institutional controls are still in place and that nothing has occurred that would impair the ability of the controls to protect public health or the environment.

This alternative would also include an annual groundwater monitoring program to assess long term site contamination and the effectiveness of the remedy at achieving the remedial objectives. Overburden and bedrock groundwater samples would be collected and analyzed from selected existing wells. It is assumed that the number of wells included in the monitoring program would be reduced by approximately 50% after the fifth year of data collection.

As with Alternative 3, the design for this alternative would depend on the choice of groundwater control/treatment system and could be completed and finalized in 6-18 months. Pump tests and treatability studies would likely be required if design of an on-site groundwater treatment system is necessary. In addition, a pre-design soil investigation would be required to further define the soil contaminant "source areas". Treatability studies may also be required for soil disposal. The construction time to implement this alternative is estimated at approximately 12-24 months. Costs below include a range with lower estimates assuming groundwater control/treatment utilizing existing Water Board utilities (but do not include Water Board charges for such services) and upper estimates assuming the design, construction, and operation of an on-site groundwater control/treatment system.

Present Worth: . . . . *$10,892,000 - $13,701,000*

Capital Cost: . . . . *$9,903,000 - $11,665,000*
Annual OM&M:
(Years 1-5): . . . . *$101,000 - $169,000*
(Years 5-30): . . . . *$50,000 - $118,000*

Alternative 5: Excavation and Treatment/Disposal of all Contaminated Soils with Upper Bedrock Groundwater Control/Treatment

This alternative would include the excavation and off-site treatment/disposal of all soils containing total VOCs greater than 10ppm. It would also include the control/treatment of the contaminated upper bedrock groundwater by either employing the existing Water Board utilities or thru the design, construction, and operation of an on-site groundwater control/treatment system. The objective of this alternative would be to eliminate contaminant soil source areas, while effectively controlling the highly contaminated upper bedrock groundwater.

On-site de-watering of contaminated soils would be necessary for soils below the water table. Excavation waters would either be treated on-site with permitted discharge to the sewers, or would be sent off site for treatment and disposal. Similar to Alternative 4, soil excavation would use engineering controls to prevent potential on and off-site exposures to particulates and volatile organic vapors. In order to gain access to all excavation areas, all remaining demolition debris would be removed from the site. Any remaining site buildings or structures located in the soil removal areas would be demolished with proper disposal of the material at an off-site facility.

The removal of the soil contaminant source areas >10 ppm total VOCs would eliminate most of the potential future contaminant loadings to the bedrock.

Upper bedrock groundwater would be controlled and treated either utilizing the existing Water Board utilities, or by design, construction, and operation of an on-site groundwater control/treatment. Either groundwater collection/treatment option would require Water Board agreement and/or permits for discharge of either raw or treated site groundwater to the Water Board's sewer system.

An environmental easement would be implemented to prevent future site uses which may be incompatible with the site remedy. A site management plan would be developed to ensure that any future site use be limited to commercial or industrial uses and that any future construction include appropriate mitigation efforts to deal with contaminated site soils, soil vapors, and groundwater. A periodic certification would be required from the property owner that the institutional controls are still in place and that nothing has occurred that would impair the ability of the controls to protect public health or the environment.

This alternative would also include an annual groundwater monitoring program to assess long term site contamination and the effectiveness of the remedy at achieving the remedial objectives. Overburden and bedrock groundwater samples would be collected and analyzed from selected existing wells. It is assumed that the number of wells included in the monitoring program would be reduced by approximately 50% after the fifth year of data collection.

As with Alternatives 3 and 4, the design for this alternative would depend on the choice of groundwater control/treatment system, and could be completed and finalized in 12-18 months. Pump tests and treatability studies would likely be required if design of an on-site groundwater treatment system is necessary. In addition, a pre-design soil investigation would be required to delineate the extent of the soil removal areas. Treatability studies may also be required for soil disposal. The construction time to implement this alternative is estimated at approximately 18-36 months. Costs below include a range with lower estimates assuming bedrock groundwater control/treatment utilizing existing Water Board utilities (but do not include Water Board charges for such services), and upper estimates assuming the design, construction, and operation of an on-site bedrock groundwater control/treatment system.

Present Worth: . . . . *$23,765,000 - $26,574,000*
Capital Cost: . . . . *$22,777,000 - $24,539,000*
Annual OM&M:
(Years 1-5): . . . . *$101,000 - $169,000*
(Years 5-30): . . . . *$50,000 - $118,000*

7.2 Evaluation of Remedial Alternatives

The criteria to which potential remedial alternatives are compared are defined in 6 NYCRR Part 375, which governs the remediation of inactive hazardous waste disposal sites in New York State. A detailed discussion of the evaluation criteria and comparative analysis is included in the FS report.

The first two evaluation criteria are termed "threshold criteria" and must be satisfied in order for an alternative to be considered for selection.

1. Protection of Human Health and the Environment. This criterion is an overall evaluation of each alternative's ability to protect public health and the environment.

2. Compliance with New York State Standards, Criteria, and Guidance (SCGs). Compliance with SCGs addresses whether a remedy will meet environmental laws, regulations, and other standards and criteria. In addition, this criterion includes the consideration of guidance which the NYSDEC has determined to be applicable on a case-specific basis.

The next five "primary balancing criteria" are used to compare the positive and negative aspects of each of the remedial strategies.

3. Short-term Effectiveness. The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation are evaluated. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives.

4. Long-term Effectiveness and Permanence. This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If wastes or treated residuals remain on-site after the selected remedy has been implemented, the following items are evaluated: 1) the magnitude of the remaining risks, 2) the adequacy of the engineering and/or institutional controls intended to limit the risk, and 3) the reliability of these controls.

5. Reduction of Toxicity, Mobility or Volume. Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility or volume of the wastes at the site.

6. Implementability. The technical and administrative feasibility of implementing each alternative are evaluated. Technical feasibility includes the difficulties associated with the construction of the remedy and the ability to monitor its effectiveness. For administrative feasibility, the availability of the necessary personnel and materials is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, institutional controls, and so forth.

7. Cost-Effectivness. Capital costs and operation, maintenance, and monitoring costs are estimated for each alternative and compared on a present worth basis. Although cost-effectiveness is the last balancing criterion evaluated, where two or more alternatives have met the requirements of the other criteria, it can be used as the basis for the final decision. The costs for each alternative are presented in Table 6.

This final criterion is considered a "modifying criterion" and is taken into account after evaluating those above. It is evaluated after public comments on the Proposed Remedial Action Plan have been received.

8. Community Acceptance - Concerns of the community regarding the RI/FS reports and the PRAP have been evaluated. The responsiveness summary (Appendix A) presents the public comments received and the manner in which the NYSDEC addressed the concerns raised. In general, the public comments received at the meeting were supportive of the selected. Several comments were received in writing relating to the need for soil contaminant "source area" remediation, and the selection of 100 ppm total VOCs+MCT as the cleanup criteria. Appendix A addresses these comments in detail.

SECTION 8: SUMMARY OF THE SELECTED REMEDY

Based on the Administrative Record (Appendix B) and the discussion presented below, the NYSDEC has selected Alternative 4, excavation and treatment/disposal of soil "source areas" (with Total VOCs+MCT>100ppm), installation of a cover system, with overburden and upper bedrock groundwater control/treatment as the remedy for Operable Unit No. 1 at this site. The elements of this remedy are described at the end of this section.

The selected remedy is based on the results of the RI and the evaluation of alternatives presented in the FS. Alternative 4 is being selected because, as described below, it satisfies the threshold criteria and provides the best balance of the primary balancing criteria described in Section 7.2. It will achieve the remediation goals for the site by: removing the remaining soil contaminant source areas from the site, preventing direct human contact with contaminated site soils, vapors, and groundwater by completing a cover system over the surface of the site; and ensure the long term control and treatment of contaminated site groundwater by either utilizing existing Water Board utilities (per an agreement with the Water Board), or by the design and construction of an on-site groundwater control/treatment system. Figure 8 is a conceptual representation of soil removal areas with groundwater control/treatment features.

Due to the extremely high concentrations of organic contaminants within the site groundwater, and the presence of DNAPL within the bedrock (which will serve as a continuing source of contamination and cannot be readily extracted from bedrock fractures), achievement of groundwater standards on site within a reasonable time frame is considered technically impracticable. As such, pursuant to U.S. Environmental Protection Agency guidance Evaluating the Technical impracticability of Ground-Water

Restoration, Interim Final, Directive 9234.2-25, September 1993, the NYSDEC has determined that the SCGs for bedrock groundwater will not be met.

Alternatives 3, 4, and 5 offer similar protection of human health and the environment, through either containment and/or soil source area removal and treatment. Alternative 1 does not offer any protection of human health and the environment, and Alternative 2 offers limited protection by means of site access restrictions.

None of the five alternatives achieves SCGs for both soil and groundwater. Alternative 5 is the only alternative that achieves soil SCGs, through excavation and off site treatment/disposal of all soils above SCGs. Alternative 4 will remove and treat some of the soil contaminant "source areas", however a large volume of contaminated soil above SCGs will remain. None of the alternatives achieve groundwater SCGs.

Because alternatives 3, 4, and 5 all satisfy the threshold criteria, the five balancing criteria are particularly important in selecting a final remedy for the site.

Alternatives 3, 4, and 5 all have short term impacts which could be controlled. Alternatives 4 and 5 require significant engineering controls in order to control releases of organic vapors during soil excavation activities. Erection of temporary containment structures are likely required to prevent releases of volatile organic contaminants during soil excavations and/or staging activities. Workers involved in excavations and/or contaminated soil handling activities associated with Alternatives 3, 4, and 5 require respiratory protection. Since Alternative 3 (containment) could be implemented the quickest, the time needed to achieve the remediation goals is generally be the shortest for alternative 3.

Alternative 5 offers the greatest long term effectiveness since this alternative removes/treats/disposes of all contaminated soils above SCGs. Alternative 4 offers more long term effectiveness than Alternative 3, since it involves the removal/treatment/disposal of the soil contaminant "source areas". However, while alternatives 4 and 5 remove either some or all of the contaminant source soils, such a removal does not result in the achievement of groundwater standards within a reasonable or predictable time frame. This is due to the presence of DNAPL within the bedrock, which will continue to serve as a source of future bedrock groundwater contamination. Alternatives 3 and 4 both offer long term effectiveness by providing a reliable means (a cover system) of preventing contact with contaminated soils. Alternative 4's effectiveness will be enhanced by the removal and treatment/disposal of soil contaminant source areas. Alternatives 3 and 4 also rely on a site management plan to ensure that any future site use or development adequately addressed the remaining soil and soil vapor contamination. Alternatives 3, 4, and 5 equally provide for long term control and treatment of contaminated site groundwater. Alternatives 1 and 2 offer little, if any, long term effectiveness for existing soil and groundwater contamination.

Alternative 5 offers the greatest reduction in contaminant volume. Alternative 4 will offer some reduction in soil contaminant volume by removing contaminant source areas. Alternatives 1, 2, and 3 do not offer any reduction of contamination within site soils. Alternatives 3, 4, and 5 all control groundwater contaminant mobility within the overburden and upper bedrock groundwater.

Alternatives 1 and 2 are easily implementable. Alternative 3 is also easily implementable, but requires some additional controls (e.g. minor dust and vapor suppression and monitoring) during construction of the cover system and/or the groundwater control/treatment system. Alternatives 4 and 5 are implementable, but require extensive engineering controls for the excavation and transport of the contaminated soils. Extensive pre-design soil sampling will need to be conducted to delineate the extent of the soil contaminant "source areas" in Alternatives 4 and 5. Treatability studies are also likely necessary for the off-site treatment/disposal of contaminated soils in Alternatives 4 and 5.

The cost of the alternatives varies significantly. Due to the costs of soil excavation and treatment/disposal, alternatives 4 and 5 cost substantially more than alternatives 1,2, or 3. The costs for removal and treatment of "source area" soils in Alternatives 4 and 5 depend upon the source area soil volume estimates determined in a pre-design sampling program. Alternatives 3, 4, and 5 all require groundwater control/treatment. Significant cost savings may be realized if an agreement were reached with the Water Board to provide long term site groundwater control/treatment. Such an agreement could eliminate the expenses associated with the design, construction, and operation of an on-site groundwater control/treatment system.

The estimated present worth cost to implement the selected remedy is estimated at between $10,892,000 - $13,701,000. The cost to construct the selected remedy is estimated at between $9,903,000 - $11,665,000 and the estimated average annual operation, maintenance, and monitoring costs for 30 years is estimated at between $50,000 - $169,000 (not including appropriate Niagara Falls Water Board charges). The significant range of costs is due to a lower cost estimate which assumes use of the existing Water Board utilities for groundwater control/treatment, and a higher cost estimate which assumes the construction and operation of an on site groundwater control/treatment system.

The elements of the selected remedy are as follows:

1. A remedial design program will be implemented to provide the details necessary for the construction, operation, maintenance, and monitoring of the remedial program.

2. Existing site buildings, above grade structures, and demolition debris will be removed from the site.

3. Contaminant source area soils (those containing total VOCs+MCT > 100ppm) will be excavated and treated/disposed off-site at an appropriate disposal facility.

4. Soil removal areas will be backfilled with clean soil or other suitable material.

5. The site surface will be covered through placement of clean soil or asphalt pavement over the unpaved portions of the site. If clean soil is used as the cover material, a layer of geotextile material will be included in those areas below the clean soil for future "demarcation" of potentially contaminated soils.

6. Appropriate storm sewers will be constructed to collect and discharge site storm water to the Niagara Falls Water Board's sewers under appropriate permit requirements.

7. Site groundwater will be controlled/treated in one of two ways. Either an agreement with the Niagara Falls Water Board will be reached which allows for site groundwater control/treatment utilizing City utilities, or a site groundwater control/treatment system will be constructed on site, with permitted discharge of effluent to the Water Board's sewer system.

8. Development of a site management plan to: (a) address contaminated soils that may be excavated from the site during future redevelopment. The plan will require soil characterization and, where applicable, disposal/reuse in accordance with NYSDEC regulations; (b) evaluate the potential for vapor intrusion for any buildings constructed on the site, including provisions for mitigation of any impacts; (c) identify any use restrictions; and (d) provide for the operation and maintenance of the components of the remedy.

9. Imposition of an institutional control in the form of an environmental easement that will (a) require compliance with the approved site management plan; (b) limit use and development of the property to commercial or industrial uses only; (c) restrict the use of groundwater as a source of potable water; and (d) require the property owner to complete and submit to the NYSDEC a periodic certification.

10. The property owner will provide periodic certification, prepared and submitted by a professional engineer or such other expert acceptable to the NYSDEC, until the NYSDEC notifies the property owner in writing that this certification is no longer needed. This submittal will contain certification that the institutional controls and engineering controls are still in place, allow the NYSDEC access to the site, and that nothing has occurred that will impair the ability of the control to protect public health or the environment, or constitute a violation or failure to comply with the site management plan.

11. The operation of the components of the remedy will continue until the remedial objectives have been achieved, or until the NYSDEC determines that continued operation is technically impracticable or not feasible.

12. Since the remedy results in untreated hazardous waste remaining at the site, a long term groundwater monitoring program will be instituted. This program will allow the effectiveness of the groundwater control/treatment system to be monitored and will be a component of the operation, maintenance, and monitoring for the site.

SECTION 9: <u>HIGHLIGHTS OF COMMUNITY PARTICIPATION</u>

As part of the remedial investigation process, a number of Citizen Participation activities were undertaken to inform and educate the public about conditions at the site and the potential remedial alternatives. The following public participation activities were conducted for the site:

- Repositories for documents pertaining to the site were established.
- A public contact list, which included nearby property owners, elected officials, local media and other interested parties, was established.
- A Fact Sheet was sent to the contact list in October 2001 to announce the start of the State's Supplemental Remedial Investigation and Feasibility Study at the site.
- A Fact Sheet was sent to the contact list in January 2006 to announce the PRAP and the date and time of the meeting to present the PRAP.
- A public meeting was held on February 7, 2006 to present and receive comment on the PRAP.

- A responsiveness summary (Appendix A) was prepared to address the comments received and during the public comment period for the PRAP.

TABLE 1
Nature and Extent of Subsurface[1] Soil Contamination
2001 Sampling

SOILS	Contaminants of Concern	Concentration Range Detected (ppm)[a]	SCG[b] (ppm)[a]	Frequency of Exceeding SCG
Volatile Organic Compounds (VOCs)	1,1,1 trichloroethane	0.002 - 510	0.8	5 of 31
	1,1 dichloroethane	0.002 - 45	0.2	5 of 31
	1,2,4 trichlorobenzene	0.002 - 140	3.4	8 of 31
	1,2 dichlorobenzene	0.002 - 680	7.9	8 of 31
	1,3 dichlorobenzene	0.002 - 210	1.6	11 of 31
	1,4 dichlorobenzene	0.002 - 430	8.5	8 of 31
	acetone	0.005 - 48	0.2	3 of 31
	benzene	0.003 - 9.8	0.06	4 of 31
	chlorobenzene	0.002 - 830	1.7	7 of 31
	tetrachloroethene	0.003 - 2700	1.4	9 of 31
	toluene	0.001 - 56	1.5	8 of 31
	trichloroethene	0.002 - 150	0.7	10 of 31
	xylenes (total)	0.001 - 40	1.2	4 of 31
Semivolatile Organic Compounds (SVOCs)	phenol	0.037 - 8.7	0.03	13 of 31
	benzo(a)anthracene	0.043 - 1.3	0.224	4 of 31
	benzo(a)pyrene	0.072 - 2.4	0.061	9 of 31
	chrysene	0.049 - 3	0.4	4 of 31
	dibenzo(a,h)anthracene	0.038 - 0.39	0.014	6 of 31
Tentatively Identified Compounds (TICs)	total monochlorotoluene	ND[c] - 7884	NA[d]	NA[d]
PCB/Pesticides	heptachlor epoxide	0.00027 - 0.22	0.02	3 of 31

Notes: [1]Only subsurface soil data available- surface soils were not sampled.
[a] ppm = parts per million, which is equivalent to milligrams per kilogram, mg/kg, in soil;
[b] SCG = standards, criteria, and guidance values;
[c]ND = non-detect
[d]NA = No SCG available for total MCT

TABLE 2
Nature and Extent of Overburden Groundwater Contamination
2001 Sampling

OVERBURDEN GW	Contaminants of Concern	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)[a]	Frequency of Exceeding SCG
Volatile Organic Compounds (VOCs)	1,1,1 trichloroethane	4 - 8500	5	11 of 29
	1,1 dichloroethane	2 - 7000	5	14 of 29
	1,2,4 trichlorobenzene	9 - 7600	5	7 of 29
	1,2 dichlorobenzene	2 - 69000	3	14 of 29
	1,2 dichloroethane	1 - 460	0.6	5 of 29
	1,3 dichlorobenzene	2 - 41000	3	12 of 29
	1,4 dichlorobenzene	2 - 43000	3	13 of 29
	acetone	6 - 5500	50	9 of 29
	benzene	2 -30000	1	9 of 29
	chlorobenzene	1 - 36000	5	13 of 29
	cis- 1,2 dichloroethene	1 - 120000	5	19 of 29
	methylene chloride	220 - 19000	5	6 of 29
	tetrachloroethene	3 - 74000	5	17 of 29
	toluene	2 - 6700	5	10 of 29
	trichloroethene	2 - 250000	5	21 of 29
	vinyl chloride	22 - 6300	2	12 of 29
	xylenes (total)	4 - 720	5	6 of 29
Semivolatile Organic Compounds (SVOCs)	phenol	6 - 4600	1[c]	7 of 12
	2,4 dichlorophenol	3 - 42	5	4 of 12
Tentatively Identified Compounds (TICs)	total monochlorotoluene	ND[d] - 135	NA[e]	NA[e]

Notes: [a] ppb = parts per billion, which is equivalent to micrograms per liter, ug/L, in water;
[b] SCG = standards, criteria, and guidance values;
[c]1 ppb= standard applies to sum of phenolic compounds (i.e. Total Phenols)
[d]ND = non-detect
[e]NA = No SCG available for total MCT

TABLE 3
Nature and Extent of A-Zone Bedrock Groundwater Contamination
2001 Sampling

Bedrock A-Zone GW	Contaminants of Concern	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)[a]	Frequency of Exceeding SCG
Volatile Organic Compounds (VOCs)	1,1,1 trichloroethane	47 - 18000	5	7 of 23
	1,1 dichloroethane	1 - 4300	5	12 of 23
	1,1 dichloroethene	5 - 1300	5	4 of 23
	1,2,4 trichlorobenzene	1 - 4200	5	7 of 23
	1,2 dichlorobenzene	1 - 61000	3	15 of 23
	1,2 dichloroethane	20 - 140	0.6	2 of 23
	1,3 dichlorobenzene	1 - 19000	3	14 of 23
	1,4 dichlorobenzene	2 - 26000	3	13 of 23
	acetone	13 - 3500	50	9 of 23
	benzene	4 -15000	1	15 of 23
	chlorobenzene	1 - 21000	5	16 of 23
	cis- 1,2 dichloroethene	2 - 270000	5	16 of 23
	methylene chloride	130 - 13000	5	7 of 23
	tetrachloroethene	2 - 47000	5	10 of 23
	toluene	1 - 3900	5	12 of 23
	trichloroethene	2 - 22000	5	17 of 23
	vinyl chloride	3 - 26000	2	8 of 23
	xylenes (total)	1 - 240	5	4 of 23
Semivolatile Organic Compounds (SVOCs)	phenol	1 - 4400	1[c]	13 of 18
	2,4 dichlorophenol	7 - 85	5	6 of 18
	2,4,6 trichlorophenol	1 - 64	1	5 of 18
Tentatively Identified Compounds (TICs)	total monochlorotoluene	ND[d] - 27600	NA[e]	NA[e]

Notes: [a] ppb = parts per billion, which is equivalent to micrograms per liter, ug/L, in water;
[b] SCG = standards, criteria, and guidance values;
[c]1 ppb= standard applies to sum of phenolic compounds (i.e. Total Phenols)
[d]ND = non-detect
[e]NA = No SCG available for total MCT

TABLE 4
Nature and Extent of B-Zone Bedrock Groundwater Contamination
2001 Sampling

Bedrock B-Zone GW	Contaminants of Concern	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)[a]	Frequency of Exceeding SCG
Volatile Organic Compounds (VOCs)	1,1,1 trichloroethane	4 - 10000	5	7 of 18
	1,1 dichloroethane	1 - 2800	5	10 of 18
	1,2,4 trichlorobenzene	1 - 1100	5	6 of 18
	1,2 dichlorobenzene	4 - 12000	3	12 of 18
	1,3 dichlorobenzene	4 - 8400	3	12 of 18
	1,4 dichlorobenzene	7 - 9600	3	12 of 18
	acetone	3 - 8700	50	6 of 18
	benzene	5 -5100	1	12 of 18
	chlorobenzene	1 - 13000	5	13 of 18
	cis- 1,2 dichloroethene	1 - 1600	5	13 of 18
	methylene chloride	11 - 8600	5	6 of 18
	tetrachloroethene	12 - 6000	5	10 of 18
	toluene	2 - 2500	5	8 of 18
	trichloroethene	3 - 10000	5	10 of 18
	vinyl chloride	28 - 400	2	8 of 18
	xylenes (total)	2 - 360	5	2 of 18
Semivolatile Organic Compounds (SVOCs)	phenol	7 - 11000	1[c]	8 of 14
	2,4,6 trichlorophenol	1 - 170	1	4 of 14
Tentatively Identified Compounds (TICs)	total monochlorotoluene	Nd[d] - 47000	NA[e]	NA[e]

Notes: [a] ppb = parts per billion, which is equivalent to micrograms per liter, ug/L, in water;
[b] SCG = standards, criteria, and guidance values;
[c]1 ppb= standard applies to sum of phenolic compounds (i.e. Total Phenols)
[d]ND = non-detect
[e]NA = No SCG available for total MCT

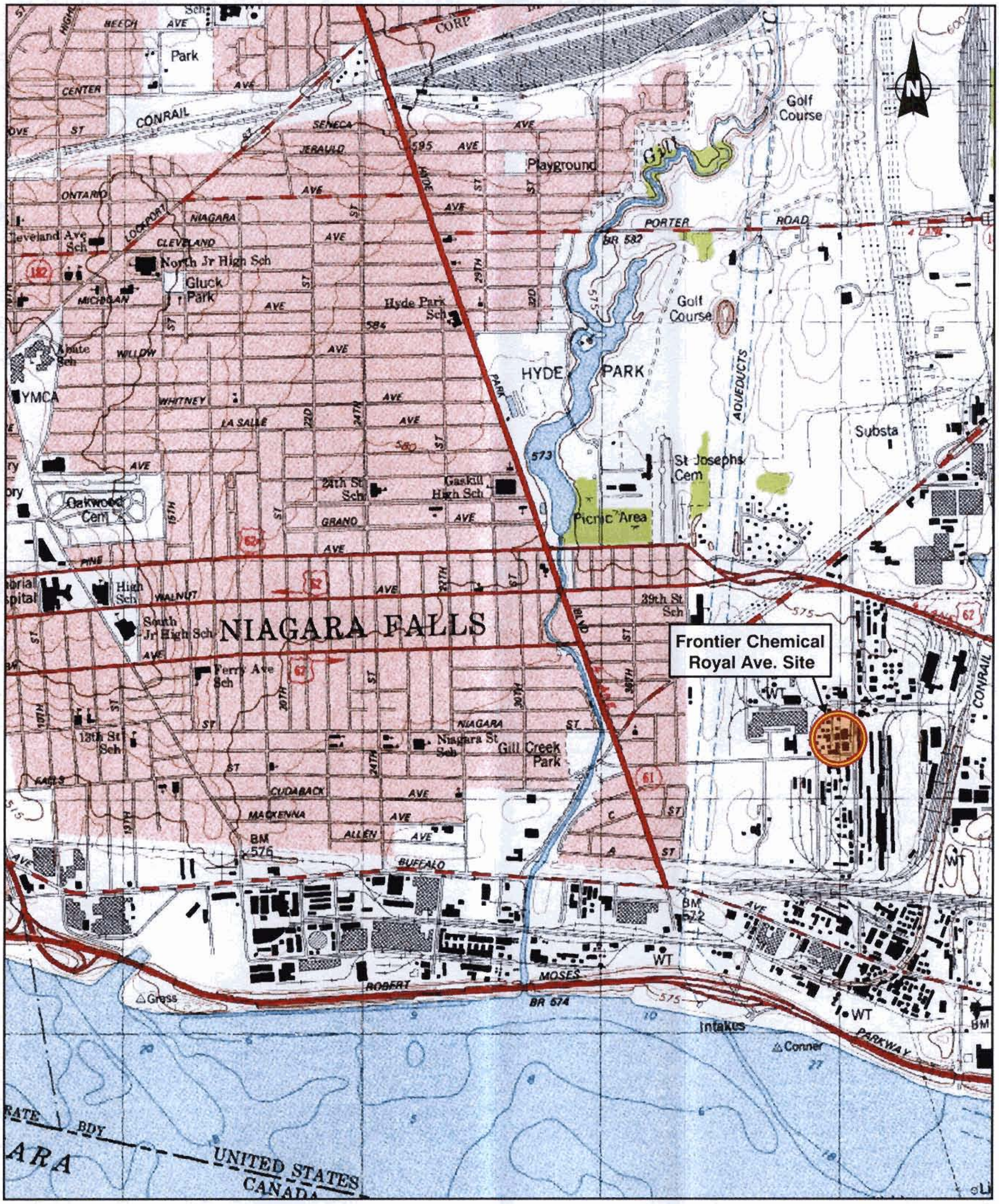
TABLE 5
Summary of C-Zone Bedrock Groundwater Contamination
2001 Sampling

Bedrock C-Zone GW	Contaminants of Concern	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)[a]	Frequency of Exceeding SCG
Volatile Organic Compounds (VOCs)	1,1,1 trichloroethane	ND[c] - 910	5	1 of 2
	1,1 dichloroethane	ND - 77	5	1 of 2
	1,2,4 trichlorobenzene	ND - 57	5	1 of 2
	1,2 dichlorobenzene	ND - 210	3	1 of 2
	1,3 dichlorobenzene	ND - 210	3	1 of 2
	1,4 dichlorobenzene	ND - 210	3	1 of 2
	benzene	4 -440	1	2 of 2
	chlorobenzene	ND - 680	5	1 of 2
	cis- 1,2 dichloroethene	ND - 11	5	1 of 2
	methylene chloride	ND - 100	5	1 of 2
	tetrachloroethene	ND - 95	5	1 of 2
	toluene	ND - 170	5	1 of 2
	trichloroethene	ND - 420	5	1 of 2
Semivolatile Organic Compounds (SVOCs)	phenol	ND - 31	1[d]	1 of 2
Tentatively Identified Compounds (TICs)	total monochlorotoluene	ND - 2600	NA[e]	NA[e]

Notes: [a] ppb = parts per billion, which is equivalent to micrograms per liter, ug/L, in water;
[b] SCG = standards, criteria, and guidance values;
[c]ND = non-detect
[d]1 ppb= standard applies to sum of phenolic compounds (i.e. Total Phenols)
[e]NA = No SCG available for total MCT

Table 6
Remedial Alternative Costs

Remedial Alternative	Capital Cost	Annual OM&M	Total Present Worth
1. No Action	$0	$0	$0
2. Institutional Controls	$26,000	$50,000 - $101,000	$989,000
3. Cover System/GW Control/Treatment	$873,000 - $2,635,000	$50,000 - $169,000	$1,861,000 - $4,671,000
4. Excavation/Treatment of Soil "Source Areas"(>100ppm)/Cover System/`GW Control/Treatment	$9,903,000 - $11,665,000	$50,000 - $169,000	$10,892,000 - $13,701,000
5. Excavation/Treatment of Contaminated Soils (>10ppm)/ GW Control/Treatment	$22,777,000 - $24,539,000	$50,000 - $169,000	$23,765,000 - $26,574,000

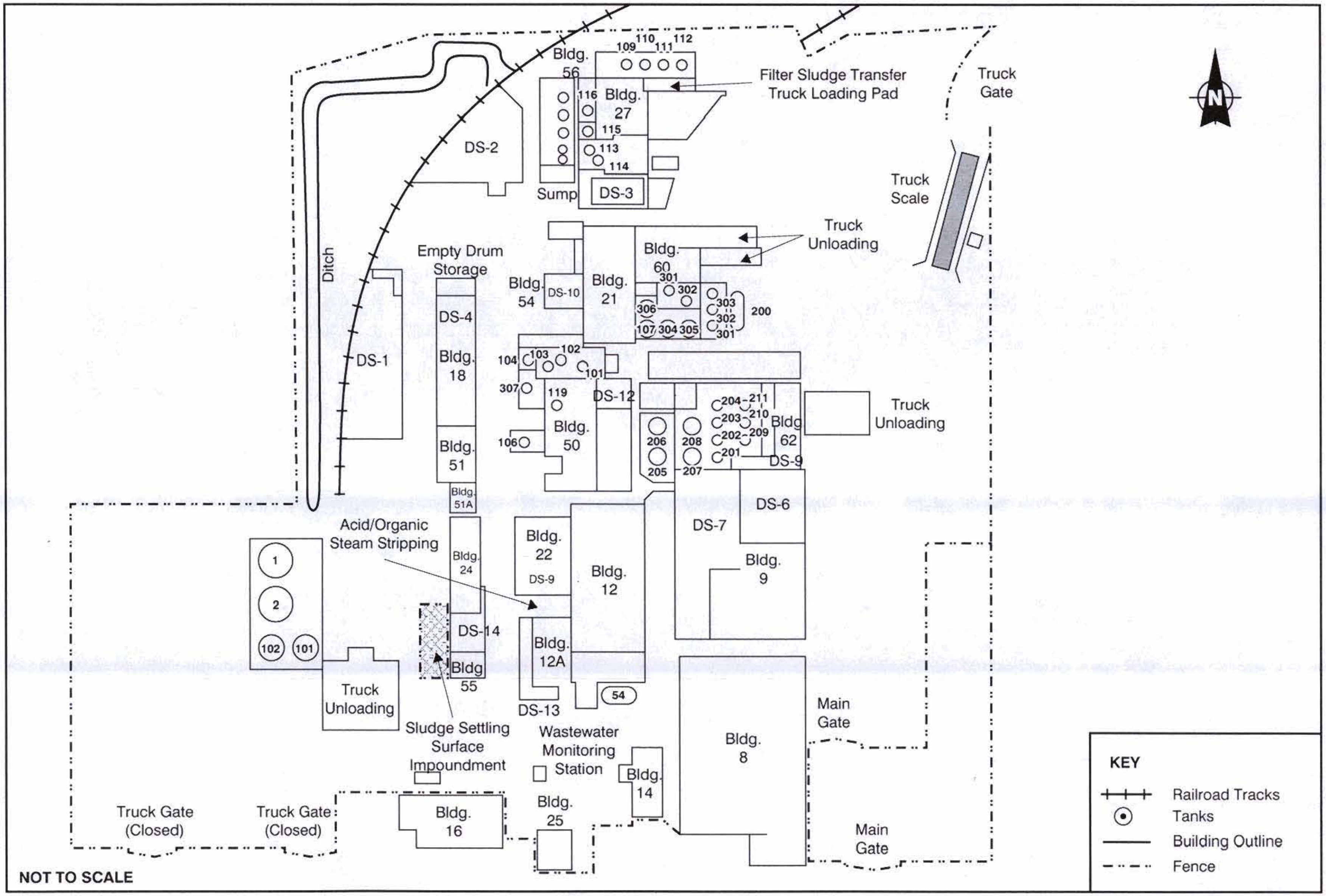


SOURCE: Niagara Falls Quadrangle, 7.5 Minute Series Topographic Map 1980.

SCALE

0 0.5 1 Mile

Figure 1 - SITE LOCATION MAP
Frontier Chemical Royal Avenue Site (#9-32-110)



SOURCE: Frontier Waste Process, Inc. historical drawings.

Figure 2 - 1984 Site Map - Frontier Chemical Royal Avenue Site (#9-32-110)

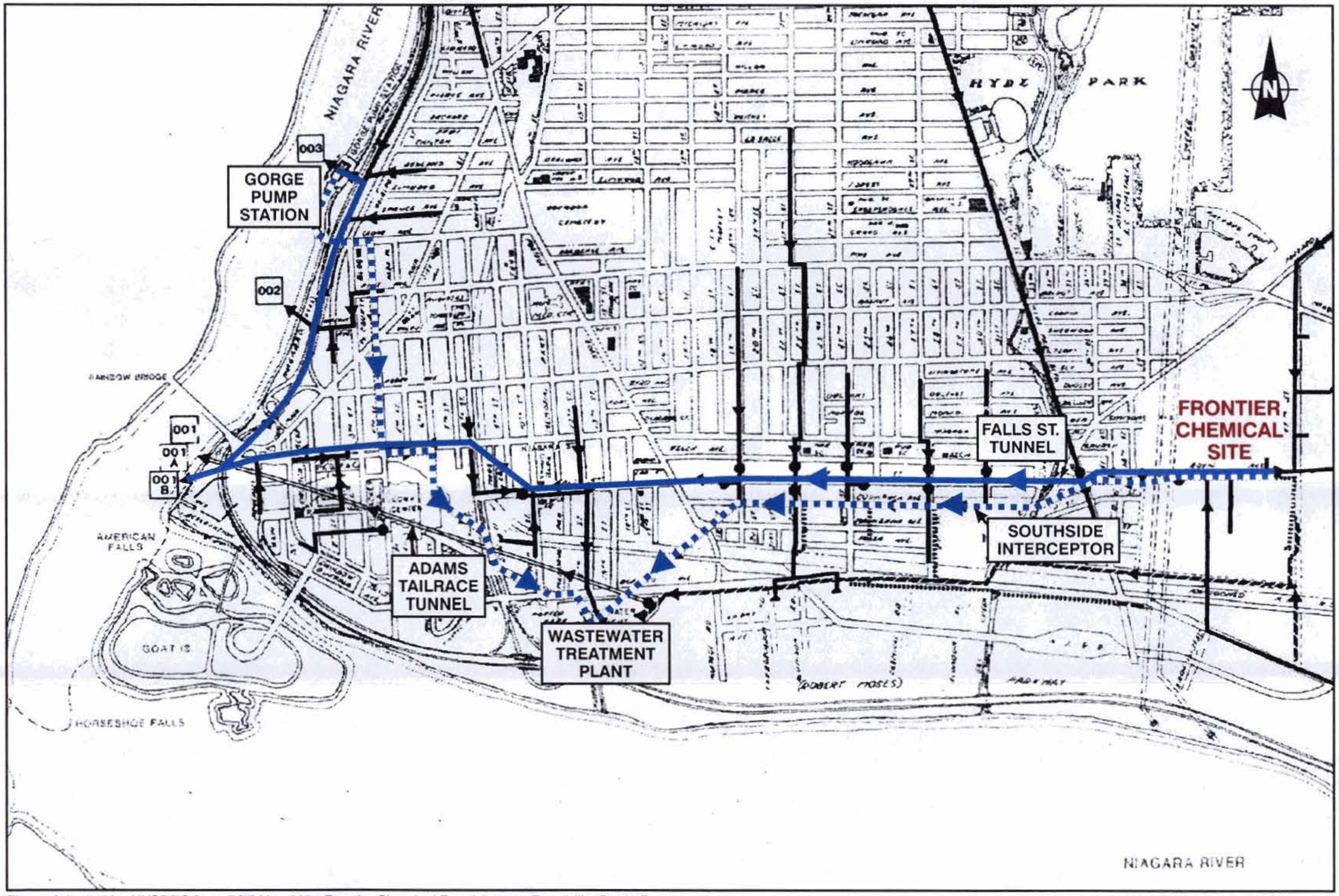
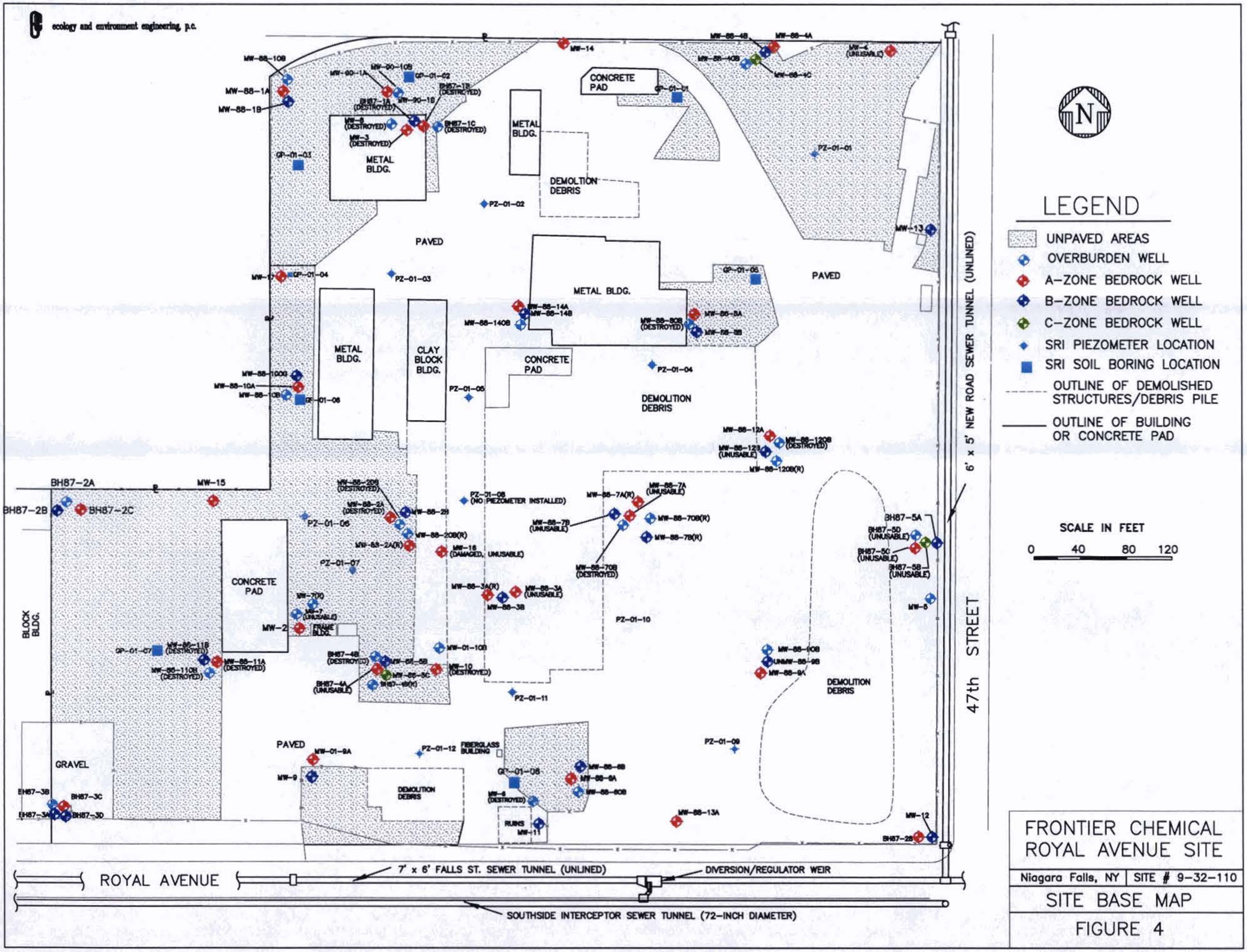


Figure Adapted by NYSDEC from E&E May 2004 Frontier Chemical Royal Avenue Feasibility Study Report

Figure 3 - Major Sewer Flows in the Vicinity of the Frontier Chemical Royal Avenue Site (#9-32-110)

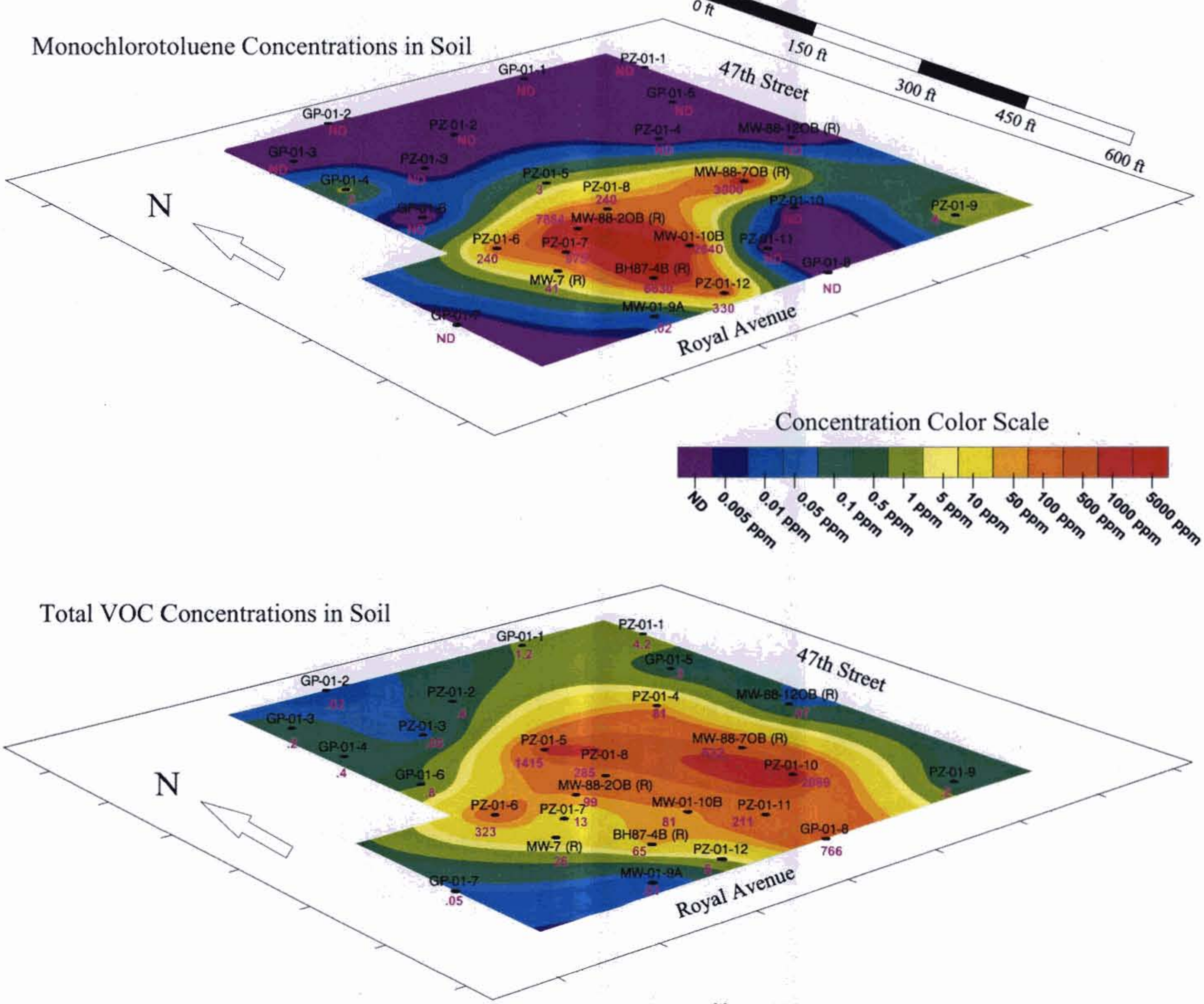


FRONTIER CHEMICAL ROYAL AVENUE SITE

Niagara Falls, NY | SITE # 9-32-110

SITE BASE MAP

FIGURE 4



Notes:
1. Figures adapted from E&E Nov. 2002 Supplemental RI Report.
2. Monochlorotoluene (MCT) is a tenatively identified compound.
3. Samples collected November 2001.
4. Distance scale is approximate.

ecology and environment engineering, p.c.

Figure 5 - Two-Dimensional Contour Plots of MCT and Total VOCs (minus MCT) in Soils
Frontier Chemical Royal Avenue Site (#9-32-110)

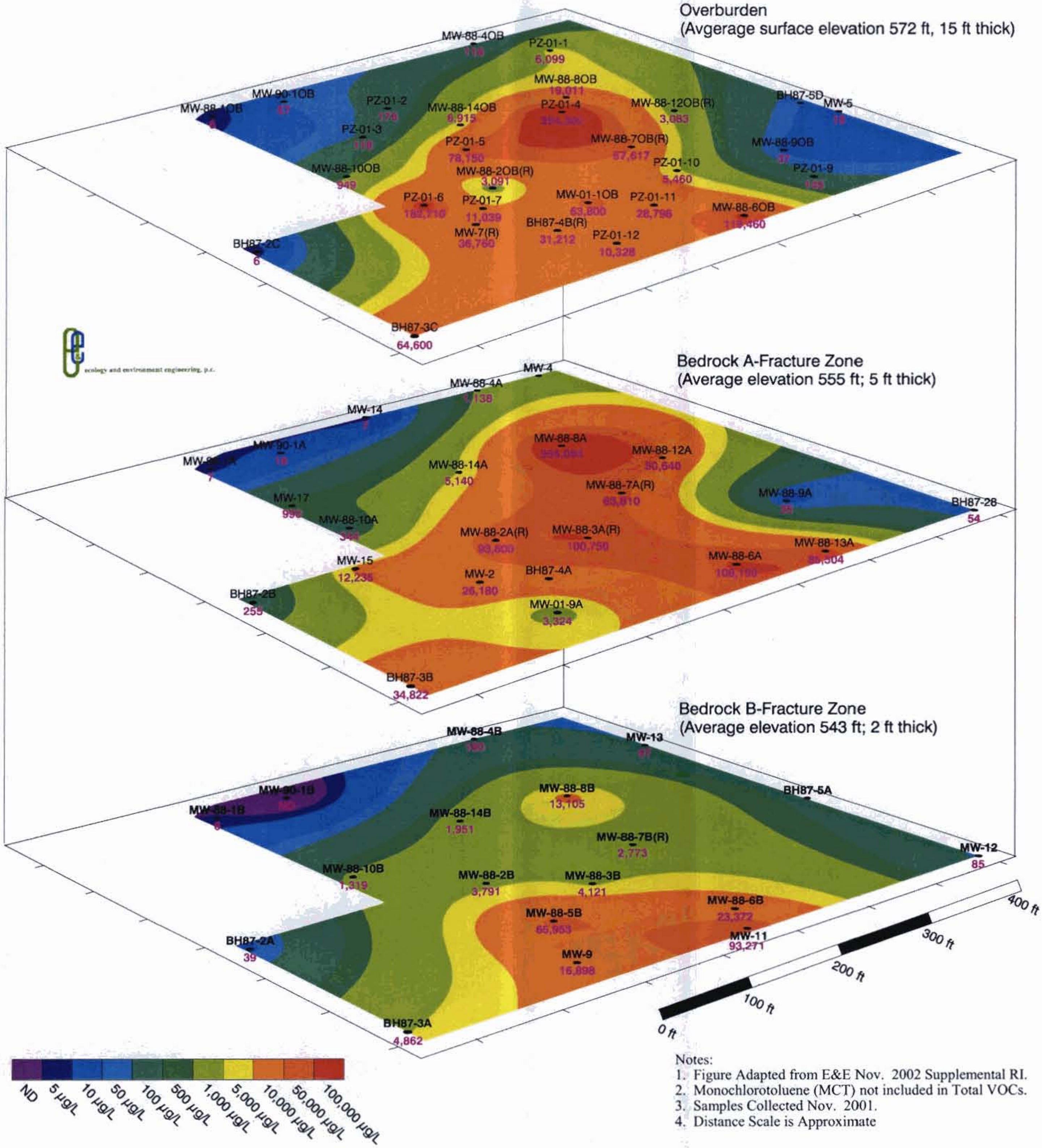
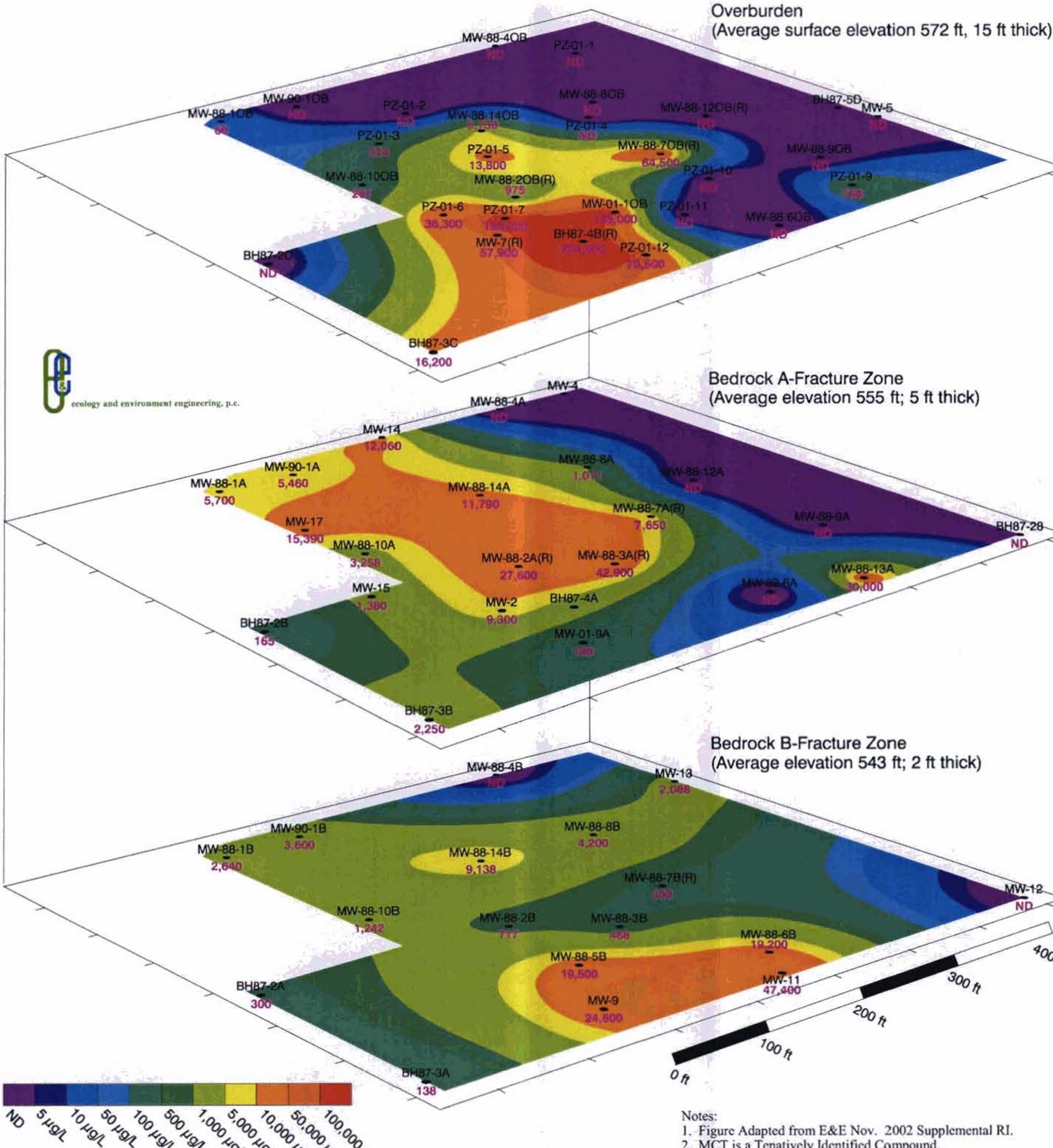
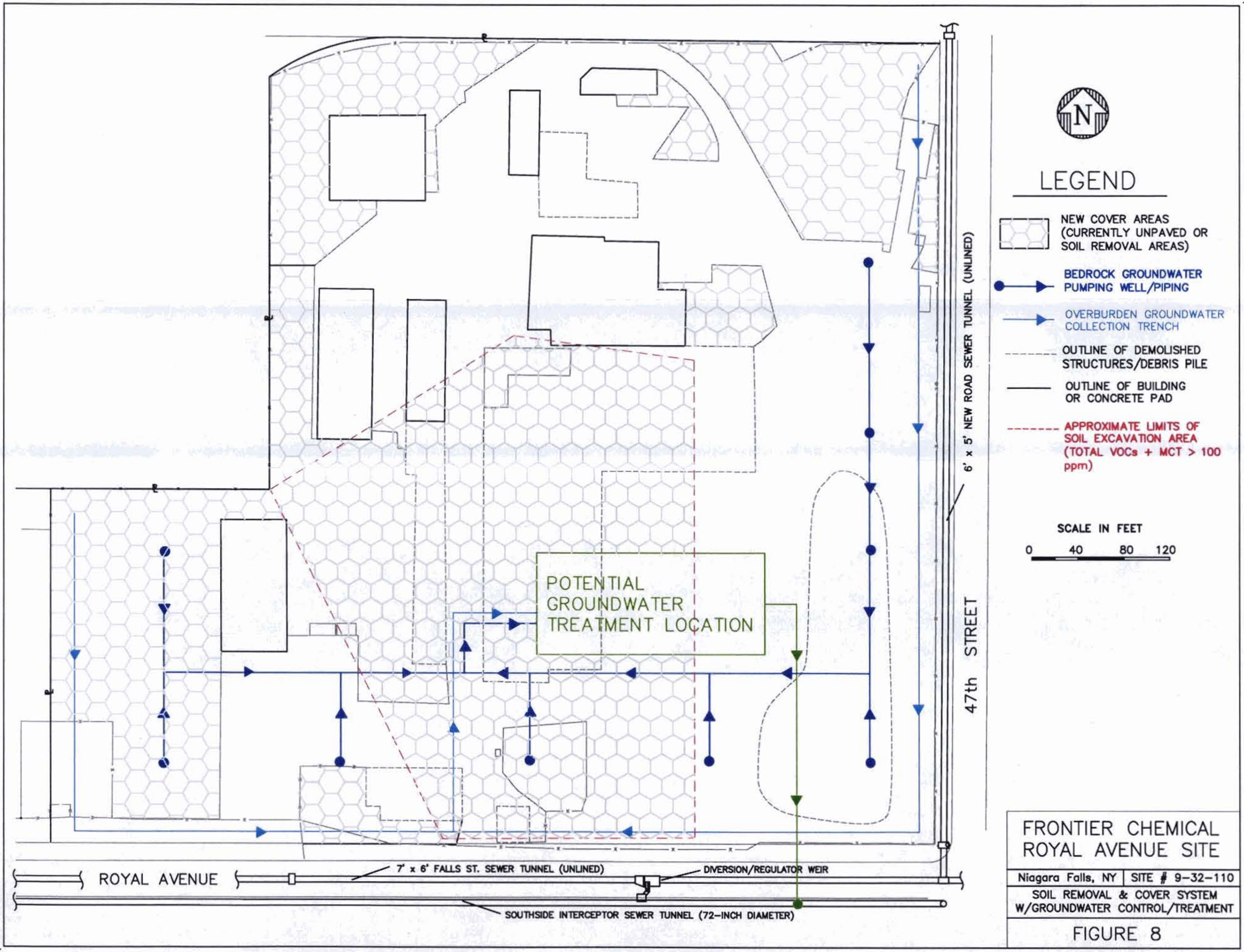


Figure 6 - Three Dimensional View of Total VOC Concentrations (Minus MCT) in Groundwater
Frontier Chemical Royal Avenue Site (#9-32-110)



Notes:
1. Figure Adapted from E&E Nov. 2002 Supplemental RI.
2. MCT is a Tenatively Identified Compound.
3. Samples Collected November 2001.
4. Distance Scale is Approximate.

Figure 7 - Three Dimensional View of Monochlorotoluene (MCT) Concentrations in Groundwater
Frontier Chemical Royal Avenue Site (#9-32-110)



LEGEND
NEW COVER AREAS (CURRENTLY UNPAVED OR SOIL REMOVAL AREAS)
BEDROCK GROUNDWATER PUMPING WELL/PIPING
OVERBURDEN GROUNDWATER COLLECTION TRENCH
OUTLINE OF DEMOLISHED STRUCTURES/DEBRIS PILE
OUTLINE OF BUILDING OR CONCRETE PAD
APPROXIMATE LIMITS OF SOIL EXCAVATION AREA (TOTAL VOCs + MCT > 100 ppm)
SCALE IN FEET
0 40 80 120
POTENTIAL GROUNDWATER TREATMENT LOCATION
6' x 5' NEW ROAD SEWER TUNNEL (UNLINED)
47th STREET
ROYAL AVENUE
7' x 6' FALLS ST. SEWER TUNNEL (UNLINED)
DIVERSION/REGULATOR WEIR
SOUTHSIDE INTERCEPTOR SEWER TUNNEL (72-INCH DIAMETER)
FRONTIER CHEMICAL ROYAL AVENUE SITE
Niagara Falls, NY
SITE # 9-32-110
SOIL REMOVAL & COVER SYSTEM W/GROUNDWATER CONTROL/TREATMENT
FIGURE 8

APPENDIX A

Responsiveness Summary

RESPONSIVENESS SUMMARY

Frontier Chemical Royal Avenue
Operable Unit No. 1
City of Niagara Falls, Niagara County, New York
Site No. 9-32-110

The Proposed Remedial Action Plan (PRAP) for the Frontier Chemical Royal Avenue site, was prepared by the New York State Department of Environmental Conservation (NYSDEC) in consultation with the New York State Department of Health (NYSDOH) and was issued to the document repositories on January 20, 2006. The PRAP outlined the remedial measure proposed for the contaminated soil and groundwater at the Frontier Chemical Royal Avenue (OU No. 1) site.

The release of the PRAP was announced by sending a notice to the public contact list, informing the public of the opportunity to comment on the proposed remedy.

A public meeting was held on February 7, 2006, which included a presentation of the Remedial Investigation (RI) and the Feasibility Study (FS) as well as a discussion of the proposed remedy. The meeting provided an opportunity for citizens to discuss their concerns, ask questions and comment on the proposed remedy. These comments have become part of the Administrative Record for this site. The public comment period for the PRAP ended on February 21, 2006.

This responsiveness summary responds to all questions and comments raised during the public comment period. The following are the comments received, with the NYSDEC's responses:

<u>PUBLIC MEETING QUESTIONS</u>

COMMENT: **How far back into the past is the NYSDEC going to go when identifying potentially responsible parties (PRPs) for this site?**

RESPONSE: The NYSDEC Division of Environmental Enforcement will contact PRP's for participation in the implementation of the Remedy after the Record of Decision (ROD) is released (in March 2006). Initially, it is likely that NYSDEC will utilize PRP data bases developed by the US EPA during Phase I and II of the removal action performed in the 1990s. The US EPA PRP list was developed using all available site records of waste generators and transporters which used the Frontier Chemical Royal Avenue facility.

COMMENT: **How many PRPs were contacted for this meeting?**

RESPONSE: A list of 10 primary PRPs contact names was provided by the NYSDEC Division of Environmental Enforcement. These contacts were added to the site's mailing list, and they received copies of the Fact Sheet announcing the public meeting. In addition, these parties were mailed copies of the PRAP.

COMMENT: **Is there a chance that site groundwater contamination could be traveling northward towards the Lewiston Power reservoir?**

RESPONSE: Deeper bedrock groundwater contaminants (bedrock C-zone and below) on site have not been characterized. Operable Unit No. 2 will address the deeper bedrock groundwater quality and migration. The deeper bedrock groundwater (below those zones influenced by the NYPA conduit drain system) may be transmitted to the north, since deeper regional bedrock groundwater does tend to travel in this direction.

COMMENT: **Are you aware that this site is linked to the Manhattan Project? The link is Harshaw Chemical, and they operated right across the street from this site, and at one time they were the largest radioactive production facilities in the free world.**

RESPONSE: According to the US Army Corps of Engineers (who perform radiological remediation projects on behalf of the US Department of Energy), the Harshaw site in Ohio performed work on the Manhattan Project. The NYSDEC is unaware of any former Harshaw facility near the former Frontier Chemical Royal Avenue site.

COMMENT: **Why is there no reference to any radiological testing done on this site? Why is this site not listed in the Atomic Energy Occupational Illness Act (AEOIA)? I hope this site will be put on the list before any further action is taken at the site.**

RESPONSE: Frontier Chemical Waste Process, Inc. was a permitted transportation, storage, and disposal facility for RCRA hazardous wastes. The facility was not permitted to accept radiological wastes. The NYSDEC has no reason to believe that radiological wastes were received by Frontier during site operations. However, the NYSDEC will include radiological screening of soils and groundwater during the subsequent OU #2 characterization and/or the OU#1 pre-design soil sampling efforts. Questions regarding the AEOIA should be directed to the US Department of Energy.

<u>WRITTEN COMMENTS RECEIVED</u>

A LETTER DATED FEBRUARY 2, 2006 REGARDING POTENTIAL FUTURE COST ALLOCATIONS WAS RECEIVED FROM FREDRIC S. JAKES OF SOLVENTS AND PETROLEUM SERVICE, INC.:

The PRP cost allocation formula should be based on volume of waste sent to the site, aka "Waste-In". This formula provides the PRP Steering Committee the best tool to achieve maximum PRP participation. Attachment #1 is a volumetric list of the top 17 generators using the site from 1987 to 1992. Attachments #2 and #3 are the generators who participated in the

Phase I (drums) and Phase II (tanks) actions. A comparison of these lists show the top four generators have not participated in either clean-up despite their contribution to the tank bottoms in Phase II and ground water contamination in the proposed Phase III. If the "Waste-In" formula is not used, the philosophy of "Cradle to Grave" is avoided making a mockery of the waste stewardship system. My letter of August 12, 1994 (Attachment #3) further shows the frustration of the Steering Committee with the EPA Phase II allocation scheme. The citizens of New York State will expect a logical allocation as some State agencies will be PRPs.

RESPONSE TO SOLVENTS AND PETROLEUM SERVICE, INC.:

Following the release of the Record of Decision (ROD), the NYSDEC will contact the PRPs identified from the previous USEPA removal actions (Phase I and Phase II) performed at the site. The NYSDEC will then begin negotiations with the PRPs on an Order on Consent to implement the ROD. Your specific request to use waste volumes for future cost allocations has been noted. It should be noted that future cost allocations under such an Order may be dependent upon any number of factors, including the number of Responsible Party participants.

A LETTER DATED FEBRUARY 16, 2006 REGARDING THE PROPOSED REMEDY WAS RECEIVED FROM RICHARD R. ROLL OF THE NIAGARA FALLS WATER BOARD:

The Niagara Falls Water Board (NFWB) has reviewed the January 2006 Proposed Remedial Action Plan, Frontier Chemical Royal Avenu, Operable Unit No. 1 (PRAP). The PRAP has been made available for public review and comment. The NFWB asks that this letter be included in the administrative record for this Site, and that the NYSDEC include these comments (and any NYSDEC responses) in the responsiveness summary included in the Record of Decision (ROD) for the site.

Background

As noted in the PRAP, the site is bounded by the Falls Street Tunnel (FST), the New Road Sewer Tunnel and the Royal Ave. combined sanitary/storm sewer (Royal Ave. Sewer). These sewers are owned by the NFWB and they ultimately discharge to the Niagara Falls Wastewater Treatment Plant (WWTP) which is owned and operated by the NFWB. Historically, the Site (when operational) had an outfall to the Royal Ave. sewer, and the owner/operators at the site had a Significant Industrial User (SIU) permit governing their discharges to the sewer. To the best of the NFWB's knowledge, there is no outfall discharge from the site to the Royal Ave. sewer at this time.

Specific Comments

Section 5.1.1

Based on the studies referenced in this section of the PRAP, the NFWB acknowledges the impact of the NYPA conduits, the FST and the New Road Tunnel on groundwater flow in the vicinity of the Site. In particular, the groundwater infiltration into the FST and the New Road Tunnel, which are located in the bedrock B-zone have, as acknowledged in the PRAP, played a critical role in preventing the lateral migration of Site impacted groundwater in A-zone, B-zone and C-zone bedrock beyond Royal Avenue and 47th Street. We note that the significant infiltration into the sewers in the vicinity of the Site (the infiltration into the FST alone in the vicinity of the NYPA conduits exceeds 6.5 MGD) have been collected and treated by the NFWB's WWTP (which is one of the few WWTPs in the nation to use carbon treatment to treat VOCs and SVOCs in wastewater) for many years without payment. This continues to this day. As a result of controlling the migration of Site-contaminated groundwater, the NFWB sewers and WWTP have and continue to provide significant benefit to the environment and to the Potentially Responsible Parties (PRPs).

Section 5.1.2

The discussion as to the operation of the FST, SouthSide Interceptor (SSI) South Gorge Interceptor and Gorge Pump Station (GPS) is accurate. Except during significant storm events, contaminated groundwater from the Site would be diverted from the FST to the SSI, then conveyed directly to the WWTP. During significant storm events, impacted groundwater from the Site might not be diverted from the FST to the SSI; rather, it could flow to the South Gorge Interceptor, and be pumped to the WWTP via the GPS. If flows are significant enough, water could be discharged directly to the Niagara River via a CSO at the FST terminus or a CSO at the GPS.

Section 5.1.4

We acknowledge that the FST and the New Road Tunnel have effectively intercepted the lateral movement of Site-impacted over burden and upper bedrock groundwater and prevented it from migrating offsite.

Section 7.1

Several of the remedial alternatives include a groundwater collection and treatment component. These alternatives consider a status quo approach to groundwater collection/treatment as well as onsite groundwater control/treatment.

The NFWB does not endorse the status quo (i.e., continued, uncontrolled, unmonitored groundwater infiltration in the NFWB sewer system) approach. First, it is expected that efforts to reduce infiltration into the FST in the vicinity of the NYPA conduits will commence in 2007. Second, we believe that impacted groundwater should be collected onsite and discharged to the NFWB sewer system via a monitored/sampled outfall. Per relevant USEPA, NYSDEC and NFWB regulations, such a discharge would likely require an SIU permit. Such an approach to Site-impacted groundwater could:

- allow the NFWB to provide cost-effective treatment for collected groundwater
- provide the NFWB with the information necessary to evaluate its WWTP capacity based on flow and loadings
- provide the information necessary for NYSDEC Division of Water review and concurrence

- provide inputs potentially helpful to the NFWB1s Pollutant Minimization Plan

In sum, the NFWB believes an engineered collection system, with discharge to the NFWB sewer system for treatment at the WWTP would be the most appropriate, cost-effective basis to address impacted groundwater at the Site.

Section 8

The NFWB endorses the proposed remedy for the Site, as well as the remediation of other Superfund and brownfield sites in the City of Niagara Falls. The NFWB believes it can be a resource to the community by providing cost-effective treatment of groundwater from many of those Sites. Consistent with our comments above, we encourage NYSDEC and/or the PRPs to work with the NFWB to develop the information necessary to evaluate and quantify the flow and loadings of collected groundwater from the Site so that the NFWB can determine the basis upon which it may be able to accept such flows. Also, the NFWB suggests that any discharges from the Site to the NFWB sewer system be via a direct outfall to the SSI, which should significantly reduce (if not eliminate) situations when untreated groundwater from the Site could be discharged to the Niagara River via a CSO.

RESPONSE TO NIAGARA FALLS WATER BOARD:

The PRAP acknowledges the significant role the Water Board sewers have played in reducing the potential off-site migration of Frontier Chemical site contaminants. The NYSDEC understands and appreciates the Water Board's concerns over the continued reliance on the adjacent sewer tunnels for overburden and upper bedrock groundwater control at the site. The NYSDEC does not endorse the continued "status quo" as an appropriate means of groundwater control and treatment. Any future site groundwater control and treatment system discharges must have appropriate regulatory approvals from the Water Board and the NYSDEC.

The PRAP states that site groundwater would be controlled in one of two ways, either: through an agreement with the Water Board which would allow use of the existing sewers and treatment facilities to continue; or through the construction and operation of a groundwater control and treatment system on-site, with permitted discharge to the Water Board utilities. NYSDEC acknowledges the inherent regulatory difficulties associated with continued use of the Water Board utilities alone. Among these challenges are obtaining a reliable estimate of chemical loadings and volumes to the sewers/treatment plant, and the ability to monitor these loadings in the future. Such loading and volume estimates would be necessary to establish a fee structure for future site groundwater control and treatment. Monitoring of site discharges to the Water Board sewers are also necessary per the regulatory requirements imposed on the Water Board's waste water treatment plant. The NYSDEC acknowledges that the regulatory requirements may ultimately make such estimates and monitoring impossible. However, these issues must be explored more fully before a decision can be made.

The potential use of existing utilities under an agreement with the Water Board would offer significant advantages over the design and construction of an on site hydraulic control/treatment system. For example, it would be extremely difficult to design and engineer an on-site groundwater control system which would be as effective as the existing Water Board utilities at controlling and treating the site's overburden and upper bedrock groundwater contamination.

Given the tremendous influence of the adjacent sewer tunnels on the immediate overburden and upper bedrock groundwater, any on site hydraulic control system would have to overcome the powerful effects of the adjacent sewer line sinks to the south and east. Moreover, since much of the site contamination is present in the overburden and upper bedrock groundwater along the southern side of the site (in close proximity to the Falls Street Tunnel), it may be impossible to intercept and prevent all site contamination from continuing entering the adjacent sewers.

The Water Board ultimately has final approval over discharges to its utilities. Should the Water Board elect to allow only point source discharges of contaminated groundwater from the site in the future, then the site remedy will include an on site groundwater control and treatment system.

A LETTER DATED FEBRUARY 21, 2006 WAS RECEIVED FROM R. WILLIAM STEPHENS OF STEPHENS & STEPHENS, LLP REGARDING POTENTIAL FUTURE COST ALLOCATION DETERMINATIONS:

This firm represented PRP groups for both Phase I and Phase II at the Frontier Chemical Royal Avenue Site in connection with actions brought to recover closure bond proceeds. As a result of our familiarity with the Frontier site, we have reason to believe that between 1,500 and 2,000 companies sent chemicals deemed hazardous to Frontier Chemical Royal Avenue between the years 1987 and 1992. We are informed that the present owners of the site have a complete set of hazardous waste manifests listing the persons or firms that were arrangers and shippers of chemicals to Frontier Chemical Royal Avenue.

The NYSDEC also through its manifest system created in the early 1980s has on file complete documents tracking chemicals sent to the Frontier Chemical Royal Avenue Site. It is incumbent upon the DEC to use its best efforts to create a complete data base of companies that sent chemicals to the site from the records available and to provide notice letters to such firms. DEC should also arrange a meeting of Potentially Responsible Parties. The costs of assembling such a list and notifying such parties could be a shared site cost. Efforts of the Department to find
a cooperating group of companies to perform whatever remediation action is selected will only be successful if all involved parties are required to participate.

RESPONSE TO STEPHENS & STEPHENS, LLP:

See above response to Solvents and Petroleum Service, Inc.

A LETTER DATED FEBRUARY 21, 2006 WAS RECEIVED FROM CLIFF ELLERBROOK OF GLENN SPRINGS HOLDINGS, INC. REGARDING THE PROPOSED REMEDY:

On behalf of Occidental Chemical Corporation, Glenn Springs Holdings Inc. ("GSHI") is providing the following comments on the Proposed Remedial Action Plan ("PRAP") for Operable Unit 1 of the Frontier Chemical Site on Royal Avenue in Niagara Falls, New York ("Site").

It is GSHI's opinion that any remedy selected for the Site should not include surface soil removal. Soil removal will not enhance the long-term beneficial reuse options potentially available for the Site, nor will it result in reduced long-term operations and maintenance ("O&MU) costs for the Site. Furthermore, it is impossible to rely on the projected cost estimates for the proposed soil removal for the purpose of remedy selection. The New York State Department of Environmental Conservation ("NYSDEC") does not know the extent of soil removal that would be necessary to achieve the proposed NAPL soil cleanup goal of 100 ppm. Consequently, the requirement to excavate soil as part of the selected remedy, as compared to other remedies that do not include soil removal, is unreasonable.

NYSDEC's analysis of the Site concludes that it contains NAPL, both in the overburden soils and in the overburden and bedrock groundwater. Consequently, it will not be possible to remove all of the NAPL using currently available technology. As a result, the Site will most likely always have significant restrictions placed upon it with regard to future development. A long-term management strategy will always be required, no matter which of the alternative remedies is selected and implemented. In that regard, the PRAP concedes that even with the remedy selected, which includes soil removal, it will be necessary to develop a long-term site management plan to address items such as impacted soils, property use restrictions, O&M of the remedial components, environmental easements, groundwater restrictions, periodic certifications, and institutional controls. Indeed, as stated in the PRAP, alternatives 3,4, and 5, which all include soil excavation, will incur the same long term O&M cost to address the NAPL remaining at the Site, which ranges from $50,000 to $169,000 per year. Clearly, the requirement in each of these remedial alternatives to excavate soil will have no positive impact on the long term O&M costs. Consequently, there is no beneficial purpose to be achieved in conducting soil excavation as part of the final remedy for the Site. Since it is not possible to eliminate the chemical concentrations, the NYSDEC's selection of a remedy that supposedly removes 36% of the chemical mass in not logical. In the first place, the NYSDEC cannot know whether this plan will remove l0%, 36%, or 90% of the chemical mass at the site. The fact that NYSDEC does not know how much of soil will ultimately need to be removed in order to achieve the 100 ppm cleanup goal is reflected in:

1. the data plotted on the figures accompanying the PRAP; and
2. the Site's local hydrogeologic environment.

The figures accompanying the PRAP (e.g., Figure 5) show a sprinkling of soil sample results from which the isoconcentration plots were developed. The hydrogeologic properties in the Niagara Falls area confirms that the overburden primarily consists of fine grained material; mostly silts and clays. This bedded material is interspersed with occasional sandy and silty lenses and zones. Add to this the fact that the Site has been developed as a manufacturing facility and the overburden has been heavily impacted by the construction of foundations, sewer lines, utilities, poles, tunnels, and other subsurface appurtenances. These disturbances probably disrupted, connected, and disconnected the impermeable and permeable layers and zones within the overburden to the point that it is almost impossible to predict the pathways of groundwater and chemical migration through the area. Not knowing which permeable pathways were available for the chemicals to have taken results in an inability to accurately estimate the volume of impacted soil. As noted in the PRAP, one of the steps of the selected remedy is to perform extensive pre-design soil sampling to delineate the areas with concentrations greater than

100 ppm. The need for an extensive sampling campaign clearly shows that the estimate used in the preparation of the cost for the selected remedy may have little or no bearing on the actual volume and therefore on the actual cost of such a remedy. It is respectfully submitted that although NYSDEC has made the best possible estimate of the mass of NAPL present in the soil and the volume of soil that could be removed in order achieve the 100 ppm remediation goal (using the available data), NYSDEC does not in fact know what portion of the chemical mass will be removed under the proposed remedy, nor does it know what volume of soil will have to be removed to reach the desired concentration level.

The selection of a remedy that includes excavation of a portion of the chemical mass has minimal incremental value over those that do not because:

- the concentration limit selected as the excavation limit is an arbitrary concentration;
- the removal action will not result in a clean site and unrestricted site at the end of the remediation;
- the NYSDEC does not know whether this remediation will remove 10%,36%, or 90% of the chemical mass;
- all of the restrictions applicable to the site will remain in place regardless of the amount of chemical mass removed; and
- The NYSDEC is proposing that the remedy must also include a groundwater pump and treat component in any event.

Consequently, GSHI is opposed to any remediation program involving excavation. The benefit is minimal, the remedy will still be incomplete, and the cost to complete that work will not be known until the work is completed.

While GSHI's primary objection to the selected remedy is the requirement to excavate soils, GSHI has additional concerns with the PRAP. These include:

1. It is believed that the tunnels along the east and south side of the Site provide groundwater containment beneath the Site. Therefore, we do not believe that the supplemental groundwater collection systems should be required.

2. If the installation of groundwater collection systems in the overburden and bedrock beneath the Site is to be required, the location of the installations should be reconsidered. While it is understood that the placement of the overburden collection system along the east and south property boundaries will prevent off-Site migration of chemicals, it may prove to be more effective to include a few interior sections into the more heavily impacted soil areas. In doing so, the groundwater in the overburden will draw in toward the center of the plumes, rather than outward causing clean perimeter areas to become impacted. This repositioning of the wells should also accelerate the remediation of the Site. Similarly, the bedrock groundwater collection wells should be centered in the heart of the elevated chemical concentrations to draw clean water from around the site in toward the collection points and accelerate the cleansing of the impacted bedrock fracture network.

3. The selected remedy includes installing a storm water sewer system through the impacted soils to collect and direct surface water runoff to the city sewer system. The installation of storm water sewers through impacted soils is not recommended. For such a small site, sheet flow on the ground surface will adequately handle the surface water flows. The surface water could even be allowed to percolate into the soils to help cleanse the impacted soils through the use of soil flushing techniques. The use of a permeable cap in conjunction with a properly designed overburden groundwater collection system to create a soil flushing remedy would also lessen the concerns regarding surface water runoff controls.

RESPONSE TO GLENN SPRINGS HOLDINGS, INC:

The NYSDEC calculated soil contaminant mass estimates based upon the data collected from the Supplemental RI. These estimates made a number of assumptions (such as homogenous soil composition and contaminant distribution), and as a result, they are likely conservative. They are estimates only. The PRAP stated that removal of soils containing total VOCs + MCT >100 ppm would remove an estimated 36% of contaminant mass within soils. The NYSDEC believes this to be a reasonable estimate given the data collected to date. An attempt to estimate overall site contaminant mass reductions in both soils and groundwater could not be reasonably performed.

The NYSDEC acknowledged in the PRAP that a pre-design sampling program will be necessary to establish the limits of soil excavation. The lack of extensive soil contaminant data (which would provide more precise estimates of soil removal volumes) does not make the decision to remove and treat the contaminated source soils unreasonable.

The NYSDEC acknowledges that the site will require a long term site management plan, including use restrictions, regardless of the final remedy selected. The presence of NAPL within the bedrock fracture system will serve as a continuing contaminant source for the bedrock aquifer. Due to the extensive contaminant mass already in the bedrock fractures, removal of the contaminated soils will not likely significantly reduce the long term operation, monitoring, and maintenance costs associated with the contaminated groundwater. However, removal of contaminant sources within the soils is appropriate since it will prevent further contaminant mass loadings to the bedrock aquifer.

The soil cleanup objective of total VOCs + MCT > 100ppm was not arbitrary. It was based upon a cost-benefit analysis of soil cleanup goals using 10ppm, 100ppm, 500ppm, and 1000ppm concentrations. The soil volumes and associated costs for these cleanup objectives were subject to the assumptions detailed above. The NYSDEC believes that they are reasonable estimates based upon the existing data.

The NYSDEC has acknowledged that the Falls Street Tunnel and New Road Tunnel have served as effective groundwater interceptors for the site overburden and upper bedrock. Under most conditions (except prolonged or extreme wet weather) the Niagara Falls Waster Board waste water treatment facility provides treatment of these flows. However, the interception (and subsequent treatment) of contaminated site groundwater is not by design, is not by agreement, is not properly permitted, and the Water Board has not been compensated for providing these services.

The location and design of any required groundwater hydraulic control and treatment system will be subject to pre-design studies, which will include but not be limited to: groundwater treatability studies, aquifer pump tests, groundwater aquifer modeling, etc. Figure 8 of the PRAP presented conceptual locations for overburden and bedrock collection and treatment locations. Pre-design studies for any hydraulic control and treatment system will determine the necessary details for the groundwater collection and treatment system.

Site storm water controls are a necessary component of the final cover system. The cover system may be asphalt, soil, or any other suitable material. The purpose of the cover material is to provide for clean material on the surface of the site, thus eliminating any potential direct human contact with any contaminated site material. The PRAP did not recommend a low permeability type cover system and the NYSDEC does not believe it would offer any significant benefit. Storm water controls will be part of the final design for the site remedy, subject to NYSDEC and local permit requirements.

A LETTER DATED FEBRUARY 21, 2006 WAS RECEIVED FROM R. WILLIAM STEPHENS OF STEPHENS & STEPHENS, LLP REGARDING THE PROPOSED REMEDY:

This firm represented PRP groups for both Phase I and Phase II at the Frontier Chemical Royal Avenue Site in connection with actions brought to recover closure bond proceeds. In the Proposed Remedial Action Plan for the Site issued by the Department, you have selected a remedy which requires excavation and disposal of soil "source areas" containing volatile organic compounds greater than 100 ppm at the Frontier Site. The proposed Alternative 4 is estimated to cost between 10.8 and 13.7 million dollars.

As you are aware, there are no private wells at or near the Frontier Royal Avenue Site and
all water is supplied by the municipality. The selection of a remediation which requires the excavation and disposal of soil "source areas" of greater than 100 ppm involves more remediation than is necessary taking into consideration the fact almost the entire Niagara Falls area contains contaminated soils in great concentrations which have not been remediated to this level at other sites.

For example, the Solvent Chemical site at 3163 Buffalo Avenue in Niagara Falls has soil contaminated with chlorinated benzenes approaching 40 to 50 percent in some areas and contains
significant soil contaminated with chlorinated benzenes far beyond the 100 ppm level. Additionally, the groundwater at the Solvent Chemical site is significantly contaminated with chlorinated benzenes and chlorinated aliphatics migrating to the Solvent site from off-site chemical sources where such chemicals were manufactured decades ago. Yet the ROD for the Solvent site does not require remediation and removal of soils but provides only for a cap and hydraulic control of off-site migration of groundwater. The Solvent site is located a short distance from the Frontier site and borders the Niagara River.

Other examples in the Niagara Falls area could be given. Manufacture of chemicals in the Niagara Falls area began over 100 years ago. We are certain that the chemical manufacturing plants which have existed and still exist in the area contain significant soil contaminants which have not been remediated to the level which the DEC urges should be required at Frontier Royal Avenue.

Institutional controls, a site cap, the removal of any buildings and hydraulic control of migration of ground water should be more than sufficient at the Frontier Royal Avenue Site. The excessive cost of excavation and disposal of contaminated soils provides no additional protection from exposures at the Frontier site. We suggest Alternative No. 2, institutional controls with a cover system and removal of above grounds structures. We believe this could be accomplished for less than $2 million.

We also recommend that the DEC cause a search to be made of its manifests from the early 1980s to 1992 to determine the parties that have sent chemicals to the site so that a complete Potentially Responsible Party list can be provided. The manifest system was expressly created so that such records would be available for this purpose.

RESPONSE TO STEPHENS & STEPHENS, LLP:

NYCRR Part 375 governs the remediation of inactive hazardous waste disposal sites in New York State. Per that regulation, the criteria used to evaluate and compare remedial alternatives includes: protection of human health and the environment, compliance with New York State standards, criteria, and guidance; short-term effectiveness, long term effectiveness and permanence; reduction of toxicity, mobility, or volume; implementability; cost effectiveness; and community acceptance. The NYSDEC evaluated various alternatives with respect to these criteria for the Frontier Chemical Royal Avenue site. An overburden containment alternative (#3) similar to the Solvent Chemical remedy was evaluated in the PRAP. As described in Section 8, the NYSDEC has determined that removal of site soils containing total VOCs+MCT >100ppm (remaining contaminant source soils) better meets these evaluation criteria than a containment (i.e. cover) alternative alone.

Regarding the search of manifests, please see the above response to Solvents and Petroleum, Inc.

A LETTER DATED FEBRUARY 21, 2006 WAS RECEIVED FROM PETER G. RUPPAR OF DUKE, HOLZMAN, YAEGER & PHOTIADIS, LLP REGARDING THE PROPOSED REMEDY:

This office is counsel to 5335 River Road, Inc, the owner of the above referenced site. We are writing to provide our comments on the Proposed Remedial Action Plan ("PRAP") for Operable Unit # 1, which includes the overburden and upper [A and B] bedrock fracture zones. The principal issue which we raise on behalf of our client is the selection of Alternative 4 over Alternative 3 as the recommended remedy.

Alternatives 3 and 4 are virtually identical, to a point. Both involve the demolition of remaining on-site structures; paving unpaved areas of the site; control/treatment of on-site groundwater by either employing the existing Water Board utilities (Falls Street and New Road

Tunnels) or through construction of an on-site groundwater control treatment system; the imposition of institutional controls through an environmental easement; and annual groundwater monitoring [PRAP p. 14- 1 6].

Also, Alternatives 3 and 4 are both protective of human health and the environment [PRAP p. 19]; both would offer long term effectiveness by providing a reliable means (a cover system) of preventing contact with contaminated soils [PRAP p. 19]; both would rely on a site management plan to ensure that any future site use or development adequately addressed the remaining soil and vapor contamination [PRAP p. 20]; both would provide for long term control and treatment of contaminated site groundwater [PRAP p. 20]; and both would control groundwater contaminant mobility within the overburden and upper bedrock groundwater [PRAP p. 20].

The only material respect in which Alternatives 3 and 4 differ, is that Alternative 4 provides, in addition, for the removal and off-site disposal of approximately 36% of contaminated overburden soils from the site [PRAP p. 20]. The estimated cost of removing and disposing of these soils is approximately $9 million. Thus, adding soil excavation and removal to the proposed remedy results in a five fold increase in the present worth cost of implementing Alternative 4 [$10,892,000 - $13,701,000] over the cost of implementing Alternative 3 [$1,861,000 - $4,671,000]. However, the added expense results in little or no corresponding benefit to human health or the environment. Both are protective [PRAP p. 19].

The principal component of all of the possible remedies considered in the PRAP [Alternatives 1-5] is the location of the site up gradient of the intersection of the New Road and Falls Street sewer tunnels, which intercept contaminated groundwater flowing through the overburden and upper bedrock fracture zones.

> "The location, depth, and hydraulic influence of the tunnels has effectually intercepted site overburden and upper bedrock groundwater and prevented it from migrating beyond the Royal Avenue and 47th Street tunnel alignments" [PRAP p. 8]

Under normal weather conditions all water entering the Falls Street Tunnel is ultimately treated at the City of Niagara Falls Wastewater Treatment Plant. It is only "during extended storm events or during those with very intense precipitation" that the capacity of the South Gorge Interceptor may be reached and there may be a discharge of untreated sewage to the Niagara River through one or more permitted combined sewer outfalls [PRAP p. 8]. The PRAP does not say how often such untreated discharge occurs [presumably infrequently] or the specific volume of sewage effluent which bypasses the treatment plant. Whatever the frequency or the volume, however, the overflow discharge apparently consists of all sewage entering the South Gorge Interceptor, not just groundwater from the site, and is regulated in its composition and volume under the SPDES permits issued to the outfalls by the Department.

Contaminated soils in the overburden currently pose little risk to human health

[PRAP p. 11]. The site is completely fenced and, after building demolition and paving is completed, the possibility of human exposure to on site soils, either through dermal contact or vapor inhalation, will effectively be eliminated. Alternative 3 would achieve this result in the shortest time frame [PRAP p. 19] and with relative ease of implementation [PRAP p. 20]. Alternatives 4 and Alternative 5 [which involves even more soil excavation] will both take longer to implement and will result in releases of organic vapors during the soil excavation work [PRAP p. 19], requiring "extensive engineering controls" to manage [PRAP p. 20].

Although there remain contaminants of concern in overburden soils at the site, the majority of the contamination, both dissolved phase and NAPL, has likely migrated downward into the fractured bedrock due to the influence of the adjacent unlined bedrock tunnels on overburden groundwater (drawing it downward into the fractured bedrock aquifer) [PRAP p. 9]. The November 2002 Supplemental Remedial Investigation Report prepared by Ecology & Environment Engineering, PC reflects a significant improvement in contaminant levels in the most heavily contaminated overburden wells when compared with data from the same wells tested by Ecco, Inc. in 1990. This indicates a downward migration of contaminated groundwater from the overburden into the A bedrock fracture zone and then into the sewer tunnels. A similar pattern appears between the A and B fracture zones. Contaminated groundwater is draining from the overburden and being colleted in the tunnels.

Both Alternative 3 and Alternative 4 meet the primary remediation goals for the site set forth in the PRAP. Neither will achieve the further remediation goals of meeting ambient groundwater quality standards or TAGM 4046 Recommended Soil Clean-up objectives. In light of the fact that the two alternative remedies are so similar in their remedial effectiveness, it is difficult, from the standpoint of cost effectiveness, to justify spending $9 million more on Alternative 4 than on Alternative 3, particularly when Alternative 4 involves a risk of exposure to organic vapors, which Alternative 3 does not. Further, from the standpoint of pragmatism, a remedy in the cost range of Alternative 3 (1.8 - $4.6 million) would stand a much greater chance of attracting cooperative private funding than a remedy such as Alternative 4, in the cost range ($10.8 - $13.7 million).

RESPONSE TO DUKE, HOLZMAN, YAEGER & PHOTIADIS, LLP:

Alternative 4 offers the advantage of reducing the volume of contaminants remaining in the Frontier Chemical Royal Avenue soils. Alternative 4 also requires overburden and upper bedrock groundwater control and treatment. Reduction of soil contaminant volumes will reduce the amount of contaminant loadings to the bedrock groundwater, and thus may ultimately reduce the amount of time that the groundwater controls must be operated. In addition, contaminants within site soils not only migrate downward into the upper bedrock groundwater, but also migrate lower into the deeper bedrock groundwater through connected vertical fractures. Removing the contaminant source within the site soils will also reduce this vertical migration into the lower bedrock zones.

APPENDIX B

Administrative Record

Administrative Record

Frontier Chemical Royal Avenue
Operable Unit No. 1
Site No. 9-32-110

1. Proposed Remedial Action Plan for the Frontier Chemical Royal Avenue site, Operable Unit No.1, January 2006, prepared by NYSDEC.

2. "Supplemental Remedial Investigation Report for the Former Frontier Chemical Waste Process Site, Niagara Falls, New York", Vol 1, November 2002, Ecology and Environment Engineering.

3. "Supplemental Remedial Investigation Report for the Former Frontier Chemical Waste Process Site, Niagara Falls, New York", Vol 2, November 2002, Ecology and Environment Engineering.

4. "Feasibility Study Report for the Former Frontier Chemical Waste Process Site, Niagara Falls, New York", May 2004, Ecology and Environment Engineering.

5. "Phase I Drum Removal Action Report", Vol. 1, May 1995, CRA.

6. "Phase I Drum Removal Action Report", Vol. 2, May 1995, CRA.

7. "Phase I Drum Removal Action Report", Vol. 3, May 1995, CRA.

8. "Sampling and Analysis/Site Security Plan", Vol 1, July 1994, BBL.

9. "Sampling and Analysis/Site Security Plan", Vol 2, July 1994, BBL.

10. "Sampling and Analysis/Site Security Plan", Vol 3, July 1994, BBL.

11. "Phase II Removal Action", July 1994, BBL.

12. "Site Cleanup Work Plan for USEPA", October 1993, Environmental Waste Technology, Inc.

13. "Evaluating the Technical impracticability of Ground-Water Restoration, Interim Final, Directive 9234.2-25", September 1993, USEPA.

14. "Niagara Falls Regional Groundwater Assessment", Vol 1, October 1992, Woodward-Clyde/CRA.

15. "Niagara Falls Regional Groundwater Assessment", Vol 2, October 1992, Woodward-Clyde/CRA.

16. "Interim Remedial Measure Report", September 1991, ECCO, Inc.

17. "Interim Remedial Measure Design and Performance Monitoring Report", September 1991, ECCO, Inc

18. "Hydrogeologic Investigation - Phase III", Vol 1, April 1989, ECCO, Inc.

19. "Hydrogeologic Investigation - Phase III", Vol 2, April 1989, ECCO, Inc.

20. "Hydrogeologic Investigation - Phase III", Vol 3, April 1989, ECCO, Inc.

21. "Hydrogeologic Investigation - Phase III", Vol 4, April 1989, ECCO, Inc.

22. "Hydrogeologic Investigation - Phase III", Vol 5, April 1989, ECCO, Inc.

23. "Hydrogeologic Investigation - Phase III", Vol 6, April 1989, ECCO, Inc.

24. "Hydrogeologic Investigation - Phase III", Vol 7, April 1989, ECCO, Inc.

25. "Results of Phase I and II Hydrogeologic Investigations of Frontier Chemical, Niagara Falls, New York", April 1988, Golder Associates.

26. "Report to Frontier Chemical Waste Process, Inc. on Regional and Historical Data Review - Royal Avenue Plant Site", October 1986, Golder Associates.

27. "Report to Frontier Chemical Waste Process, Inc. - Hydrogeologic Review and Proposed Groundwater Investigation- Niagara Falls Plant", November 1985, Golder Associates.

28. "Frontier Chemical Hydrogeologic Investigation Evaluation of Groundwater Quality", June 1985, Thomsen Associates/Empire Soils Investigations.

29. Referral Memorandum dated January 19, 2001 for referral for State funded RI/FS.

30. October 2001 Fact Sheet announcing start of Remedial Investigation and Feasibility Study funded by State Superfund.

31. January 2006 Fact Sheet announcing Proposed Remedial Action Plan and public meeting date.

32. Letter dated February 16, 2006 from Richard R. Roll of the Niagara Falls Water Board.

33. Letter dated February 21, 2006 by Peter G. Rupar of Duke, Holzman, Yaeger & Photiadis, LLP.

34. Two letters dated February 21, 2006 by R. William Stephens of Stephens & Stephens, LLP.

35. Letter dated February 21, 2006 by Cliff Ellerbrook of Glenn Springs Holdings, Inc.