RECORD OF DECISION

Frontier Chemical - Royal Avenue
Operable Unit Number: 02
State Superfund Project
Niagara Falls, Niagara County
Site No. 932110
March 2011

Prepared by
Division of Environmental Remediation
New York State Department of Environmental Conservation

DECLARATION STATEMENT - RECORD OF DECISION

Frontier Chemical - Royal Avenue
Operable Unit Number: 02
State Superfund Project
Niagara Falls, Niagara County
Site No. 932110
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Statement of Purpose and Basis

This document presents the remedy for Operable Unit Number: 02 of the Frontier Chemical - Royal Avenue site, a Class 2 inactive hazardous waste disposal site. The remedial program was chosen in accordance with the New York State Environmental Conservation Law and Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York (6 NYCRR) Part 375, 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 (the Department) for Operable Unit Number: 02 of the Frontier Chemical - Royal Avenue site and the public's input to the proposed remedy presented by the Department. A listing of the documents included as a part of the Administrative Record is included in Appendix B of the ROD.

Description of Selected Remedy

The estimated present worth cost to implement the remedy is $225,000. The cost to construct the remedy is estimated to be $0 and the estimated average annual cost is $13,500.

The elements of the selected remedy are as follows:

1. Development of a long-term plan to monitor the natural attenuation process, and determine its effectiveness at restoring deep bedrock groundwater quality.

2. Imposition of an institutional control in the form of an environmental easement for the controlled property that:
a. requires the remedial party or site owner to complete and submit to the Department a periodic certification of institutional controls in accordance with Part 375-1.8 (h)(3).
b. allows the use and development of the controlled property for industrial uses as defined by Part 375-1.8(g), though land use is subject to local zoning laws;
c. restricts the use of groundwater as a source of potable or process water, without necessary water quality treatment as determined by the Department, NYSDOH or County DOH;
d. prohibits agriculture or vegetable gardens on the controlled property;

e. requires compliance with the Department approved Site Management Plan;

3. Since the remedy results in contamination remaining at the site that does not allow for unrestricted use, a Site Management Plan is required, which includes the following:

a. An Institutional Control Plan that identifies all use restrictions for the site and details the steps and media-specific requirements necessary to assure the following institutional controls remain in place and effective. The Institutional Controls include the Environmental Easement discussed above. This plan includes, but may not be limited to:

i. descriptions of the provisions of the environmental easement including any land use and groundwater use restrictions;

ii. maintaining site access controls and Department notification; and

iii. the steps necessary for the periodic reviews and certification of the institutional controls;

b. A Monitoring Plan to assess the performance and effectiveness of the remedy. The plan includes, but not be limited to:

i. monitoring of deep bedrock groundwater to assess the performance and effectiveness of the remedy;

ii. a schedule of monitoring and frequency of submittals to the Department;

iii. provision to evaluate the potential for vapor intrusion for any buildings developed on the site, including provision for mitigation of any impacts identified;

iv. provision to evaluate the potential for soil vapor intrusion for existing buildings if building use changes significantly or if a vacant building become occupied.

4. Green remediation principals and techniques will be implemented to the extent feasible in the site management of the remedy as per DER-31. The major green remediation components are as follows;

- Considering the environmental impacts of treatment technologies and remedy stewardship over the long term;
- Reducing direct and indirect greenhouse gas and other emissions;
- Increasing energy efficiency and minimizing use of non-renewable energy;
- Conserving and efficiently managing resources and materials;
- Reducing waste, increasing recycling and increasing reuse of materials which would otherwise be considered a waste.

New York State Department of Health Acceptance

The New York State Department of Health (NYSDOH) concurs that the remedy 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.

Date

Dale A. Desnoyers, Director
Division of Environmental Remediation

RECORD OF DECISION

Frontier Chemical - Royal Avenue
Niagara Falls, Niagara County
Site No. 932110
March 2011

SECTION 1: SUMMARY AND PURPOSE

The New York State Department of Environmental Conservation (the Department), in consultation with the New York State Department of Health (NYSDOH), has selected a remedy for the above referenced site. The disposal of hazardous wastes at the site has resulted in threats to public health and the environment that would be addressed by the remedy. The disposal or release of hazardous wastes at this site, as more fully described in this document, has contaminated various environmental media. The remedy is intended to attain the remedial action objectives identified for this site for the protection of public health and the environment. This Record of Decision (ROD) identifies the selected remedy, summarizes the other alternatives considered, and discusses the reasons for selecting the remedy.

The New York State Inactive Hazardous Waste Disposal Site Remedial Program (also known as the State Superfund Program) is an enforcement program, the mission of which is to identify and characterize suspected inactive hazardous waste disposal sites and to investigate and remediate those sites found to pose a significant threat to public health and environment.

The Department has issued this document in accordance with the requirements of New York State Environmental Conservation Law and 6 NYCRR Part 375. This document is a summary of the information that can be found in the site-related reports and documents.

SECTION 2: SITE DESCRIPTION AND HISTORY

Location: The Frontier Chemical Royal Avenue site is approximately 9 acres in size and is located at the northwestern corner of Royal Avenue and 47th Street in the City of Niagara Falls.

Site Features: A residential neighborhood is approximately ½ mile west of the site. The Frontier Chemical site is in a heavily industrialized area of Niagara Falls. 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 Niagara River is located approximately 3/4 mile south of the site.

Current Zoning/Use(s): The site is currently zoned for industrial use. 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 is covered by either concrete or blacktop. Several large areas of demolition debris piles also occupy areas on

the surface of the site.

Historical Use(s): The site industrial use dates back to 1906 when it was owned and operated by the International Minerals and Chemical Company as a caustic chlorine (mercury cell) production plant. Between 1974 and 1992, Frontier Chemical operated a RCRA permitted facility at the site at which a wide variety of listed and characteristic hazardous wastes were stored and treated. Inadequate operation and maintenance at the facility, including uncontrolled releases of hazardous wastes, led the Department to issue a Summary Abatement Order in December of 1992. When the facility failed to comply with the Order, the Department requested that the USEPA conduct an emergency response action at the site. This action was completed in early 1995. As part of the action, drums and tanks containing hazardous wastes were removed and properly disposed off-site.

Several investigations of the site were performed between 1981 and 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.

In 1995, the Department 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 March 2006, the Record of Decision (ROD) for OU 1 was released. The selected remedy provided for: the removal of above grade structures and debris, excavation of soils containing VOCs greater than 100 ppm, a soil or asphalt cover system, groundwater control/treatment, a Site Management Plan, an Environmental Easement,, and periodic certification of the controls.

Operable Units: The remedial project has been divided into two operable units (OUs). 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. OU 1 consists of the overburden soils, as well as overburden and upper (defined as the A-zone and B-zone) bedrock groundwater. The other operable unit for the site is OU 2, which is defined as the deeper (C-zone and lower) bedrock groundwater. A Record of Decision was issued for OU 1 in March 2006.

Site Geology and Hydrogeology: Groundwater within the overburden soils is very limited, and is generally present only in a few small seams of sandy soils or in localized areas of granular backfill materials. A downward vertical groundwater gradient exists between the overburden soils and the top of the bedrock.

Although the upper bedrock groundwater is highly contaminated, the presence of upper bedrock sewer tunnels on the south and east side of the site has effectively prevented the off-site migration of contaminants to the surrounding soils and groundwater. The Falls Street Tunnel (FST) and the New Road Tunnel (NRT) are the two unlined bedrock sewer tunnels adjacent to the Frontier site. Each of these open bedrock sewer tunnels intersects the primary upper bedrock groundwater fracture system - which contains the majority of the site bedrock groundwater

contamination.

Operable Unit (OU) Number 02 is the subject of this document.

A Record of Decision was issued previously for OU 01.

A site location map is attached as Figure 1.

SECTION 3: LAND USE AND PHYSICAL SETTING

The Department may consider the current, intended, and reasonably anticipated future land use of the site and its surroundings when evaluating a remedy for soil remediation. For this site, alternatives (or an alternative) that restrict(s) the use of the site to industrial use as described in Part 375-1.8(g) is/are being evaluated in addition to an alternative which would allow for unrestricted use of the site.

A comparison of the results of the investigation to the appropriate standards, criteria and guidance values (SCGs) for the identified land use and the unrestricted use SCGs for the site contaminants is included in the Tables for the media being evaluated in Exhibit A.

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.

The PRPs for the site, documented to date, include:

Chairman of the Frontier Chemical Royal Avenue PRP Group

The Department and a group of over 170 PRPs entered into a Consent Order on August 15, 2008 The Order obligated the responsible parties to implement an RI/FS for OU-2. After the remedy is selected, the Department will approach the PRPs to implement the selected remedy.

SECTION 5: SITE CONTAMINATION

5.1: Summary of the Remedial Investigation

A Remedial Investigation (RI) has been conducted. The purpose of the RI was to define the nature and extent of any contamination resulting from previous activities at the site. The field activities and findings of the investigation are described in the RI Report.

The following general activities are conducted during an RI:

- Research of historical information,

- Geophysical survey to determine the lateral extent of wastes,
- Test pits, soil borings, and monitoring well installations,
- Sampling of waste, surface and subsurface soils, groundwater, and soil vapor,
- Sampling of surface water and sediment,
- Ecological and Human Health Exposure Assessments.

5.1.1: Standards, Criteria, and Guidance (SCGs)

The remedy must conform to 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.

To determine whether the contaminants identified in various media are present at levels of concern, the data from the RI were compared to media-specific SCGs. The Department has developed SCGs for groundwater, surface water, sediments, and soil. The NYSDOH has developed SCGs for drinking water and soil vapor intrusion. The tables found in Exhibit A list the applicable SCGs in the footnotes. For a full listing of all SCGs see: http://www.dec.ny.gov/regulations/61794.html

5.1.2: RI Information

The analytical data collected on this site includes data for:

- groundwater
- soil
- soil vapor

The data have identified contaminants of concern. A "contaminant of concern" is a hazardous waste that is sufficiently present in frequency and concentration in the environment to require evaluation for remedial action. Not all contaminants identified on the property are contaminants of concern. The nature and extent of contamination and environmental media requiring action are summarized in Exhibit A. Additionally, the RI Report contains a full discussion of the data. The contaminant(s) of concern identified for this Operable Unit at this site is/are:

1,1,1 tca	benzene
1,1-dichloroethane	chlorobenzene
1,2,4-trichlorobenzene	dichloroethylene
1,2-dichlorobenzene	methylene chloride
1,2-dichloroethane	tetrachlorethene
1,3-dichlorobenzene	toluene
1,4-dichlorobenzene	trichloroethene (tce)
acetone	vinyl chloride

xylene (mixed) chlorotoluene
phenol

As illustrated in Exhibit A, the contaminant(s) of concern exceed the applicable SCGs for:

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 issuance of the Record of Decision.

There were no IRMs performed at this site during the RI.

5.3: Summary of Human Exposure Pathways

This human exposure assessment identifies ways in which people may be exposed to site-related contaminants. Chemicals can enter the body through three major pathways (breathing, touching or swallowing). This is referred to as *exposure.*

This human health assessment characterizes exposures that may be presented by site contamination for both Operable Units. Since the site is fenced and the majority of the surface is covered with concrete or blacktop, people will not come in contact with contaminated soil and groundwater unless they dig below the surface. People are not drinking the contaminated groundwater because the area is served by a public water supply that is not affected by this contamination.

Volatile organic compounds in groundwater may move into the soil (air spaces within the soil), which in turn may move into overlying buildings and affect the indoor air quality. This process, which is similar to the movement of radon gas from the subsurface into the indoor air of buildings, is referred to as soil vapor intrusion. The potential exist for the inhalation of site contaminants, due to soil vapor intrusion, for any future on-site redevelopment and occupancy. This potential exposure will be evaluated and addressed as part of the March 2006 ROD.

5.4: Summary of Environmental Assessment

This section summarizes the assessment of existing and potential future environmental impacts presented by the site. Environmental impacts may include existing and potential future exposure pathways to fish and wildlife receptors, wetlands, groundwater resources, and surface water.

Based upon the resources and pathways identified and the toxicity of the contaminants of ecological concern at this site, a Fish and Wildlife Resources Impact Analysis (FWRIA) was deemed not necessary for OU 02.

High concentrations of organic contaminants exist in soil and groundwater. Non-aqueous phase liquids (NAPL) have been found in both the overburden and bedrock groundwater. NAPL has

also been detected in the upper bedrock fracure systems. NAPL will continue to act as a source of groundwater contamination.

Contaminants of concern at the site include various volatile organics (such as trichlorobenzene, dichlorobenzene, chlorobenzene, PCE, TCE, acetone, benzene, toluene, etc.), and various semi-volatile organics (such as chlorotoluene, phenol, dichlorophenol, etc.) Impacted media include soils, overburden and bedrock groundwater. Overburden and upper bedrock groundwater contaminant migration has been limited by the presence of the unlined bedrock tunnels on the east (the New Road Tunnel under 47th street) and south sides (the Falls Street Tunnel under Royal Avenue) of the site.

A Record of Decision (ROD) for Operable Unit No.1 was released in March 2006. The remedy calls for: removal of above grade structures and debris, Excavation of soils containing VOCs >100ppm, soil or asphalt cover system, groundwater control/treatment, a Site Management Plan, an Environmental Easement, Long-term Operation, Monitoring, and Maintenance, and periodic certification of the controls.

The PRP group performed a characterization and focused feasibility study for the deep bedrock groundwater (OU#2)during 2008-2010. The characterization included installation of bedrock monitoring wells in the deep fracture zones (C, D, and E zones) present below the upper bedrock fracture systems (A and B zones). The C, D, and E fracture zones are found at depths of approximately 60, 72, and 100 feet, respectively, from ground surface.

The contaminants detected in the C-zone groundwater were as much as 3 orders of magnitude (1,000 times) lower than the contaminant concentrations in B-zone groundwater. Water level measurements from the C zones show an upward gradient toward the shallow bedrock groundwater zones. While the concentrations of many contaminants in the D-zone are greater than those detected in the C-zone, nearly all contaminants detected were below 100 ppb. The exception was 1,3-dichlorobenzene and chlorobenzene in MW2D-08, with concentrations of 120 and 550 ppb, respectively. The water level measurements from the D-zones show an upward gradient toward the C-zones. The contaminants detected in the E-zone groundwater were similar to that of those detected in the C-zone. It should also be noted that the highest contaminants detected in the E-zone, trichloroethene and tetrachloroethene, are contaminants associated with an off-site bedrock groundwater contaminant plume that is associated with the DuPont Main Plant Site, located on Buffalo Avenue to the south-west of the Frontier Chemical site. Water level measurements from the E zones show an upward gradient toward the D-zones.

SECTION 6: SUMMARY OF THE EVALUATION OF ALTERNATIVES

To be selected the 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. The remedy must also attain the remedial action objectives identified for the site, which are presented in Exhibit B. Potential remedial alternatives for the Site were identified, screened and evaluated in the feasibility study (FS) report.

A summary of the remedial alternatives that were considered for this site is presented in Exhibit C. Cost information is presented in the form of present worth, which 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. A summary of the Remedial Alternatives Costs is included as Exhibit D.

6.1: Evaluation of Remedial Alternatives

The criteria to which potential remedial alternatives are compared are defined in 6 NYCRR Part 375. 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 Department has determined to be applicable on a case-specific basis.

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

3. 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.

4. 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.

5. Short-term Impacts and 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.

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-Effectiveness. Capital costs and annual 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.

8. Land Use. When cleanup to pre-disposal conditions is determined to be infeasible, the Department may consider the current, intended, and reasonable anticipated future land use of the site and its surroundings in the selection of the soil remedy.

The final criterion, Community Acceptance, 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.

9. Community Acceptance. Concerns of the community regarding the investigation, the evaluation of alternatives, and the PRAP are evaluated. A responsiveness summary will be prepared that describes public comments received and the manner in which the Department will address the concerns raised. If the selected remedy differs significantly from the proposed remedy, notices to the public will be issued describing the differences and reasons for the changes.

6.2: Elements of the Remedy

The basis for the Department's remedy is set forth at Exhibit E.

The estimated present worth cost to implement the remedy is $225,000. The cost to construct the remedy is estimated to be $0 and the estimated average annual cost is $13,500.

The elements of the selected remedy are as follows:

1. Development of a long-term plan to monitor the natural attenuation process, and determine its effectiveness at restoring deep bedrock groundwater quality.

2. Imposition of an institutional control in the form of an environmental easement for the controlled property that:

a. requires the remedial party or site owner to complete and submit to the Department a periodic certification of institutional controls in accordance with Part 375-1.8 (h)(3).

b. allows the use and development of the controlled property for industrial uses as defined by Part 375-1.8(g), though land use is subject to local zoning laws;

c. restricts the use of groundwater as a source of potable or process water, without necessary water quality treatment as determined by the Department, NYSDOH or County DOH;

d. prohibits agriculture or vegetable gardens on the controlled property;

e. requires compliance with the Department approved Site Management Plan;

3. Since the remedy results in contamination remaining at the site that does not allow for unrestricted use, a Site Management Plan is required, which includes the following:

a. An Institutional Control Plan that identifies all use restrictions for the site and details the steps and media-specific requirements necessary to assure the following institutional controls remain in place and effective. The Institutional Controls include the Environmental Easement discussed above. This plan includes, but may not be limited to:

i. descriptions of the provisions of the environmental easement including any land use and groundwater use restrictions;

ii. maintaining site access controls and Department notification; and

iii. the steps necessary for the periodic reviews and certification of the institutional controls;

b. A Monitoring Plan to assess the performance and effectiveness of the remedy. The plan includes, but not be limited to:

i. monitoring of deep bedrock groundwater to assess the performance and effectiveness of the remedy;

ii. a schedule of monitoring and frequency of submittals to the Department;

iii. provision to evaluate the potential for vapor intrusion for any buildings developed on the site, including provision for mitigation of any impacts identified;

iv. provision to evaluate the potential for soil vapor intrusion for existing buildings if building use changes significantly or if a vacant building become occupied.

4. Green remediation principals and techniques will be implemented to the extent feasible in the site management of the remedy as per DER-31. The major green remediation components are as follows;

- Considering the environmental impacts of treatment technologies and remedy stewardship over the long term;
- Reducing direct and indirect greenhouse gas and other emissions;
- Increasing energy efficiency and minimizing use of non-renewable energy;
- Conserving and efficiently managing resources and materials;
- Reducing waste, increasing recycling and increasing reuse of materials which would otherwise be considered a waste.

APPENDIX A

RESPONSIVENESS SUMMARY

Frontier Chemical - Royal Avenue
Operable Unit No. 2
State Superfund Project
Niagara Falls, County, New York
Site No. 932110

The Proposed Remedial Action Plan (PRAP) for the **Frontier Chemical** site was prepared by the New York State Department of Environmental Conservation (the Department) in consultation with the New York State Department of Health (NYSDOH) and was issued to the document repositories on February 14, 2011. The PRAP outlined the remedial measure proposed for the contaminated deep groundwater at the Frontier Chemical 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 March 7, 2011, which included a presentation of the remedial investigation/feasibility study (RI/FS) for the Frontier Chemical site 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 March 15, 2011. This responsiveness summary responds to all questions and comments raised during the public comment period. The following are the comments received, with the Department's responses:

COMMENT 1:

The Frontier Chemical PRP Group (the Group) supports the Department's adoption of monitored natural attenuation as the primary remedy for OU2 in the PRAP, and urges the Department to incorporate this action in a Record of Decision ("ROD") for OU2.

Although not a formal part of the OU2 PRAP, the Group further comments that its support for the OU2 PRAP does not infer support for the soil cleanup objectives ("SCOs") for the Site set forth in the OU1 ROD.

RESPONSE 1:

Comment Noted.

APPENDIX B

Administrative Record

Frontier Chemical - Royal Avenue
Operable Unit No. 2
State Superfund Project
Niagara Falls, County, New York
Site No. 932110

1. Proposed Remedial Action Plan for the Frontier Chemical, Operable Unit No.2, dated February 2011, prepared by the Department.

2. “Remedial Pre-Investigation, Soil Characterization, Soil Remediation Pilot Test, Deep Bedrock Groundwater Report” Frontier Chemical Site, Niagara Falls, New York, September 2010, by Conestoga-Rovers & Associates

3. Record of Decision for the Frontier Chemical Royal Avenue site, Operable Unit No. 1 , March 2006, prepared by NYSDEC.

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

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

6. "Phase I Drum Removal Action Report", Vols. 1-3, May 1995, CRA.

7. "Sampling and Analysis/Site Security Plan", Vols 1-3, July 1994, BBL.

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

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

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

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

12. "Interim Remedial Measure Report", September 199 1, ECCO, Inc.

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

14. "Hydrogeologic Investigation - Phase III, Vols. 1-7, April 1989, ECCO, Inc.

15. "Results of Phase I and I1 Hydrogeologic Investigations of Frontier Chemical, Niagara Falls, New York", April 1988, Golder Associates.

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

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

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

19. Letter dated March 8, 2011 by A. Timothy Webster, Chairman PRP Group - Comments on OU2 PRAP dated February 2011.

Exhibit A

Nature and Extent of Deep Bedrock Groundwater Contamination

The 2002 OU 1 remedial investigation (site soils and upper bedrock groundwater) had determined that the contaminants of concern at the site are volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs).

Bedrock C-Zone

Contaminant concentrations detected in the bedrock C fracture zone are summarized in Table 1 and depicted in Figure 5. Three of the five C-zone wells that were sampled during the characterization contained groundwater contaminants above SCGs.

The contaminants detected in the C-zone groundwater were as much as 3 orders of magnitude (1,000 times) lower than the contaminant concentrations detected in groundwater from the B-zone. Water level measurements from the C zones show an upward gradient toward the shallow bedrock groundwater zones.

Table #1 – C-zone Bedrock Groundwater

Detected Constituents	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)	Frequency Exceeding SCG
VOCs			
1,3 dichlorobenzene	ND[c] - 3.1	3	1 of 5
1,4 dichlorobenzene	ND – 4	3	1 of 5
benzene	ND – 30	1	3 of 5
chlorobenzene	ND – 26	5	1 of 5
cis-1,2 dichloroethene	0.62 – 23	5	1 of 5
tetrachloroethene	ND – 29	5	1 of 5
tolunene	ND – 7.3	5	1 of 5
trichloroethene	ND – 110	5	1 of 5
vinyl chloride	ND – 4.1	2	2 of 5

a - ppb: parts per billion, which is equivalent to micrograms per liter, ug/L, in water.
b- SCG: Standard Criteria or Guidance - Ambient Water Quality Standards and Guidance Values (TOGs 1.1.1), 6 NYCRR Part 703, Surface water and Groundwater Quality Standards, and Part 5 of the New York State Sanitary Code (10 NYCRR Part 5).
c- ND: Not detected above the laboratory detection limits

Bedrock D-Zone

Contaminant concentrations detected in the bedrock D fracture zone are summarized in Table 2 and depicted in Figure 6. While the concentrations of many contaminants in the D-zone are greater than those detected in the C-zone, the contaminant concentrations in the D-zone were also several orders of magnitude lower than that detected within the upper bedrock zone (OU-1) . The water level measurements from the D-zones show an upward gradient toward the C-zones.

Table #2 – D-zone Bedrock Groundwater

Detected Constituents	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)	Frequency Exceeding SCG
VOCs			
1,2 dichlorobenzene	ND[c] - 18	3	2 of 3
1,3 dichlorobenzene	ND - 110	3	2 of 3
1,4 dichlorobenzene	ND - 70	3	2 of 3
benzene	3.4 - 57	1	3 of 3
chlorobenzene	ND - 460	5	2 of 3
cis-1,2 dichloroethene	0.81 - 31	5	1 of 3
tetrachloroethene	ND – 5.1	5	1 of 3
trichloroethene	ND - 12	5	1 of 3
vinyl chloride	ND – 4.3	2	1 of 3
SVOCs			
monochlorotoluenes	ND – 92	5	2 of 3

a - ppb: parts per billion, which is equivalent to micrograms per liter, ug/L, in water.
b- SCG: Standard Criteria or Guidance - Ambient Water Quality Standards and Guidance Values (TOGs 1.1.1), 6 NYCRR Part 703, Surface water and Groundwater Quality Standards, and Part 5 of the New York State Sanitary Code (10 NYCRR Part 5).
c- ND: Not detected above the laboratory detection limits

Bedrock E-Zone

Contaminant concentrations detected in the bedrock E fracture zone are summarized in Table 3 and depicted in Figure 7. The contaminant concentrations detected in the E-zone groundwater were similar to those detected in the C-zone. Water level measurements from the E zones show an upward gradient toward the D-zones.

Table #3 – E-zone Bedrock Groundwater

Detected Constituents	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)	Frequency Exceeding SCG
VOCs			
Benzene	ND[c] - 3	1	1 of 3
cis-1,2 dichloroethene	ND - 20	5	2 of 3
tetrachloroethene	ND – 14	5	1 of 3
Trichloroethene	ND - 99	5	2 of 3

a - ppb: parts per billion, which is equivalent to micrograms per liter, ug/L, in water.
b- SCG: Standard Criteria or Guidance - Ambient Water Quality Standards and Guidance Values (TOGs 1.1.1), 6 NYCRR Part 703
c- Not Detected

The site soils represent the source of the VOC and SVOC contaminants at the Site. The source material will be addressed through implementation of the March 2006 ROD for OU#1. Most of the VOC and SVOC contaminants detected in the deep bedrock groundwater above SCGs are likely the result of the migration of some of the aqueous-phase contaminants from the upper bedrock fracture zones into the lower zones. However, there are strong upward vertical gradients from the lower bedrock fracture zones toward the upper bedrock fracture zones. These upward bedrock groundwater gradients, along with the apparent lack of connected vertical fractures between the bedrock fracture zones at the Site, have been effective at preventing the much more contaminated upper bedrock groundwater from reaching the deeper bedrock. .

The area surrounding Frontier Chemical is heavily industrialized. There are several well documented sources of deep bedrock groundwater contamination within this area of Niagara Falls. As such, the deep bedrock groundwater contaminants detected within the deep bedrock groundwater may be associated with sources other than the Frontier site.

Based on the findings of the deep bedrock groundwater characterization, the past disposal of hazardous waste has resulted in the contamination of the deep bedrock groundwater. The site contaminants that are considered to be the primary contaminants of concern which will drive the remediation of groundwater to be addressed by the remedy selection process are: 1, 3-dichlorobenzene, 1, 2-dichlorobenzene, 1, 4 dichlorobenzene, benzene, chlorobenzene, and monochlorotoluenes. Unlike the upper bedrock groundwater zones (OU-1), NAPL was not detected in any of the deeper bedrock groundwater zones.

Exhibit B

SUMMARY OF THE REMEDIATION OBJECTIVES

The objectives for the remedial program have been established through the remedy selection process stated in 6 NYCRR Part 375. The goal for the remedial program is to restore the site to pre-disposal conditions to the extent feasible. At a minimum, the remedy shall eliminate or mitigate all significant threats to public health and the environment presented by the contamination identified at the site through the proper application of scientific and engineering principles.

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of volatiles, from contaminated groundwater.
- Restore ground water aquifer to pre-disposal/pre-release conditions, to the extent practicable.

Exhibit C

Description of Remedial Alternatives

The following alternatives were considered based on the remedial action objectives (see Exhibit B) to address the contaminated media identified at the site as described in Exhibit A:

Alternative 1: No Action

The No Action Alternative is evaluated as a procedural requirement and as a basis for comparison. This alternative leaves the site in its present condition and does not provide any additional protection to public health and the environment. There are no costs associated with the no action alternative.

Alternative 2: Monitoring and Institutional Controls

Since the source of the site contaminants will be addressed in the remedy for OU-1 (soils and upper bedrock groundwater), Alternative 2 involves the monitoring of deep bedrock groundwater to ensure that, as expected, natural attenuation processes continue to reduce the concentrations of site contaminants. In addition, alternative 2 employs institutional controls for the site, to protect public health and the environment from the contamination identified at the site. Appropriate institutional controls for this site include an environmental easement and a Site Management Plan. Such institutional controls are already included in the requirements of the March 2006 Record of Decision for OU 1 of this Site.

Present Worth: *$225,000*
Capital Cost: *$0*
Annual Costs: ..... *$9,000 - $18,000*

Alternative 3: HydraulicContainment

Hydraulic containment of the deep bedrock groundwater would prevent the potential off-site migration of aqueous phase (dissolved) contaminants from the Site. Hydraulic containment of the deep bedrock groundwater can be achieved by use of pumping wells installed within the bedrock fracture systems. Such pumping wells can be utilized to extract and treat the bedrock groundwater, resulting in an inward hydraulic gradient on the site. Such a system can prevent the off-site migration of contaminants within the deep bedrock groundwater. This alternative also relies on institutional controls such as an environmental easement and a Site Management Plan. Such institutional controls are already included in the requirements of the March 2006 Record of Decision for Operable Unit No.1 of this site.

Present Worth: *$3,540,000*
Capital Cost: *$940,000*
Annual Costs: ..... *$200,000 - $215,000*

Exhibit D

Table #4
Remedial Alternative Costs

Remedial Alternative	Capital Cost ($)	Annual Costs ($)	Total Present Worth ($)
No Action	0	0	0
Monitoring and Institutional Controls	0	9,000 – 18,000	225,000
Hydraulic Containment	940,000	200,000 - 215,000	3,540,000

Exhibit E

SUMMARY OF THE PROPOSED REMEDY

The Department is proposing Alternative 2, Monitoring and Institutional Controls, as the remedy for this site. The elements of this remedy are described in Section 7.2.

Basis for Selection

The proposed remedy is based on the results of the deep bedrock groundwater characterization and the evaluation of alternatives.

Protection of Human Health and the Environment

The No Action Alternative is not protective of human health or the environment since it does not achieve remediation goals described in Exhibit B. Alternative 2 protects human health by using institutional controls to prevent the use of deep bedrock groundwater. Alternative 2 protects the environment by monitoring the deep bedrock groundwater quality to ensure that contaminant concentrations continue to attenuate. Alternative 3 protects human health and the environment through the use of extraction wells to control deep bedrock groundwater contaminants, and by the use of institutional controls.

Compliance with New York State Standards, Criteria, and Guidance (SCGs)

The no action alternative would not meet this criterion since it would not meet the SCGs for groundwater. Due to the complex nature of the deep bedrock fracture systems, there are no known remedial strategies which would allow for the restoration of deep bedrock groundwater quality (to groundwater standards) within a reasonable time frame. In addition, there are other sites in this area of Niagara Falls which contribute to the area-wide deep bedrock groundwater contamination. Like the no further action alternative, alternatives 2 and 3 would not meet this criterion.

Short-term Effectiveness

The no action alternative does not have any short term impacts on the community or on-site workers since no active remediation would take place under this alternative. Like the no further action alternative, Alternative 2 would not have any short term impacts on the community or on-site workers since no active remediation would take place. Alternative 3 would have limited short-term impacts, mainly those associated with installation of bedrock groundwater pumping wells. The impacts (possible noise and dust during drilling) can easily be controlled by standard construction practices.

The time needed to achieve the remediation objectives is shorter for Alternative 2 than Alternative 3, since it would not require any construction activities.

Long-term Effectiveness and Permanence

The no action alternative is not effective in the long term at minimizing the risks to human health or the environment. Without some form of institutional controls, uncontrolled future use of the site could result in potential exposures to human health and/or risks to the environment. Alternatives 2 and 3 have similar long-term effectiveness, but Alternative 3 has more complications since it relies on long term operation and maintenance of a deep bedrock groundwater extraction and treatment system. Alternative 3 would require a substantial commitment of future time and resources to ensure that the extraction and treatment system is maintained and continues to perform effectively.

Reduction of Toxicity, Mobility or Volume

Neither the no action alternative nor Alternative 2 reduce the toxicity, mobility, or volume of the contaminants within the deep bedrock groundwater at the site. Alternative 3, deep bedrock groundwater extraction and treatment, reduces the mobility of the contaminants in the deep bedrock groundwater fracture systems. Despite best efforts to design and operate an extraction and treatment system, Alternative 3 would not be particularly effective at reducing the toxicity or volume of contaminants in the deep bedrock groundwater.

Implementability

The no action alternative is the easiest to implement since no active remedial measures would be taken. Alternatives 2 and 3 are favorable in that they are both readily implementable.

Cost-Effectiveness

The no action alternative would be the least expensive to implement since there would be no cost associated with its implementation. The costs of alternatives 2 and 3 vary significantly. Alternative 3 has a much higher capital cost since construction of a remedial system is required. Alternative 2 provides equal protection of the groundwater resource, but has no capital cost. The long-term operation and maintenance and commitment of resources cost of Alternative 3 is much higher since it would require the extraction and treatment of deep bedrock groundwater.

Land Use

The anticipated future use of the site is industrial, so Alternative 3 is less desirable because it requires construction and operation of a deep bedrock groundwater treatment system. Such a system may have some effect on future use of the property. Alternative 2 requires a implementation of a Site Management Plan (which is also be required at the site for OU#1), but it is not expected to significantly restrict future industrial uses.

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

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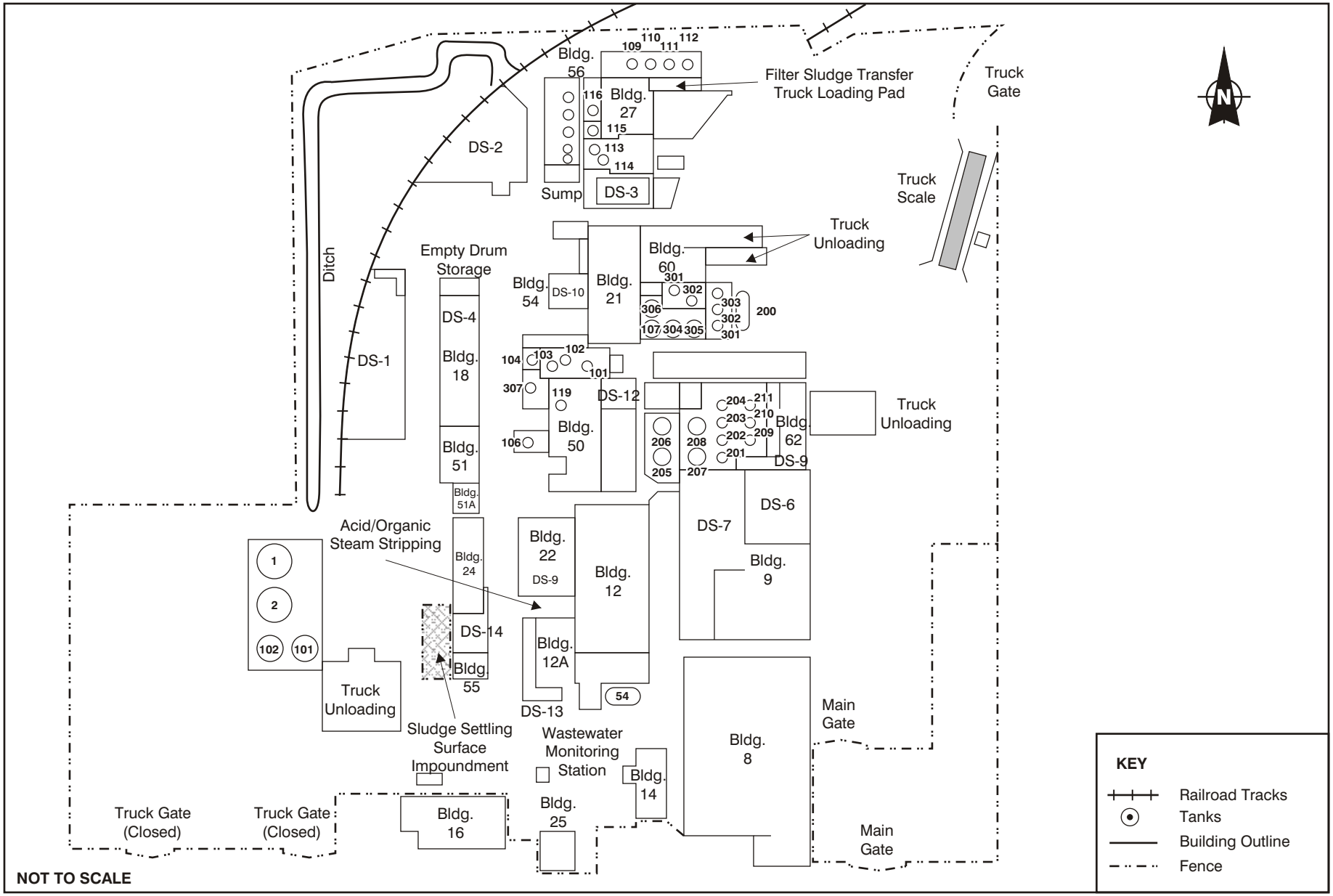
SCALE

0 0.5 1 Mile

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

Figure 2 - Site Detail



SOURCE: Frontier Waste Process, Inc. historical drawings.

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Figure 3 1984 Site Map - Frontier Chemical Royal Avenue Site (#9-32-110)

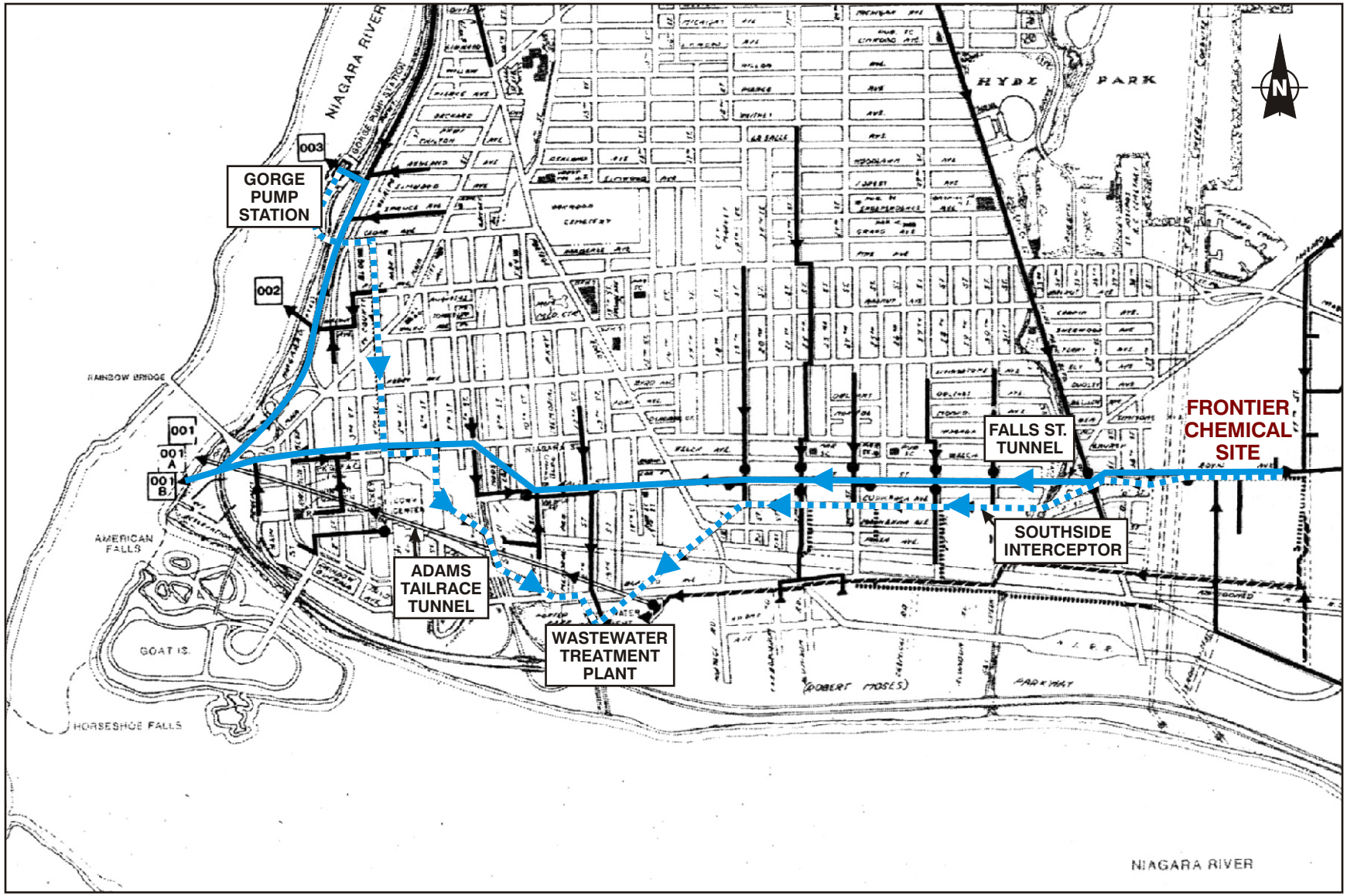

Figure Adapted by NYSDEC from E&E May 2004 Frontier Chemical Royal Avenue Feasibility Study Report

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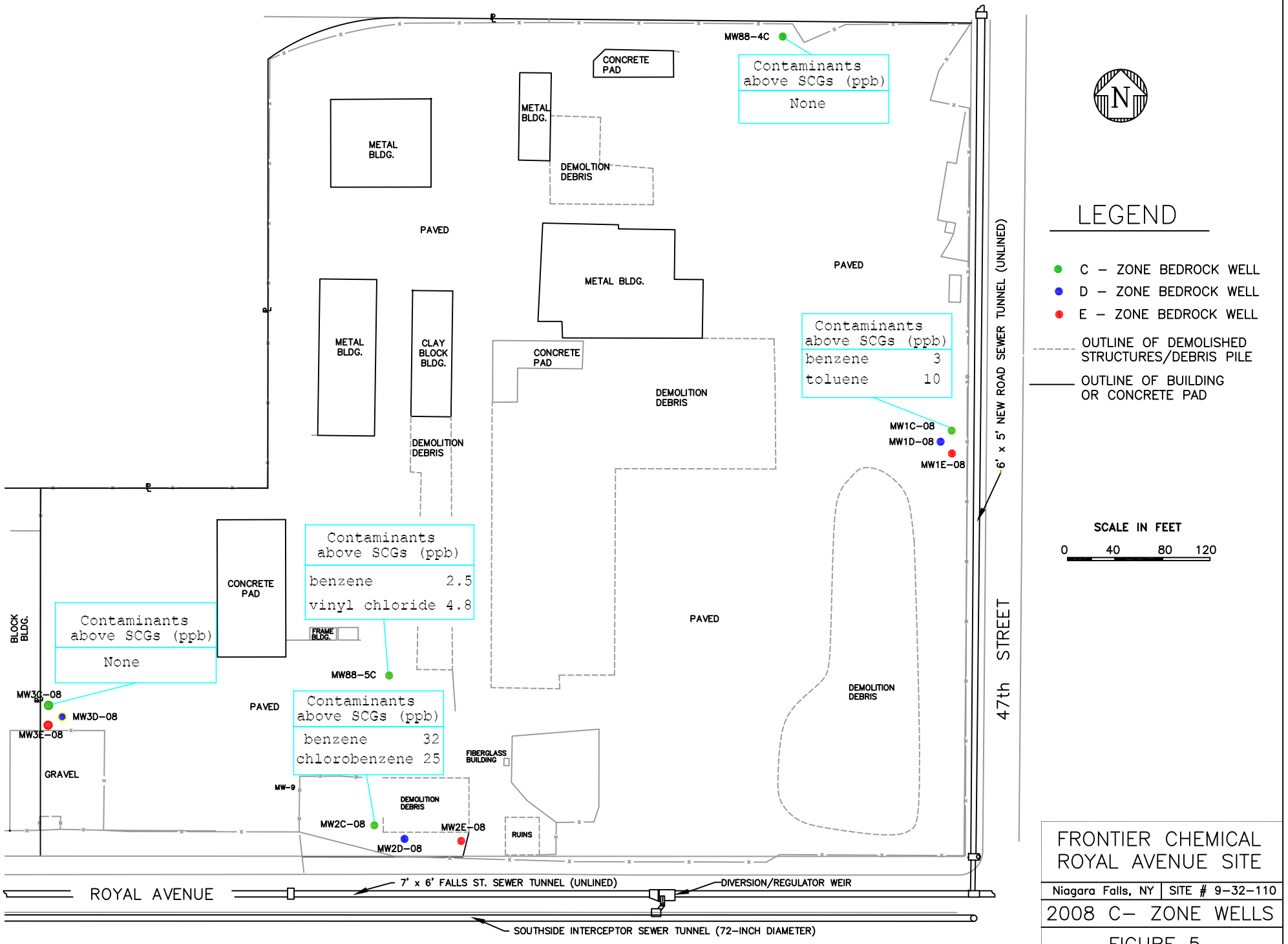
Figure 4 - Major Sewer Flows in the Vicinity of the Frontier Chemical Royal Avenue Site (#9-32-110)

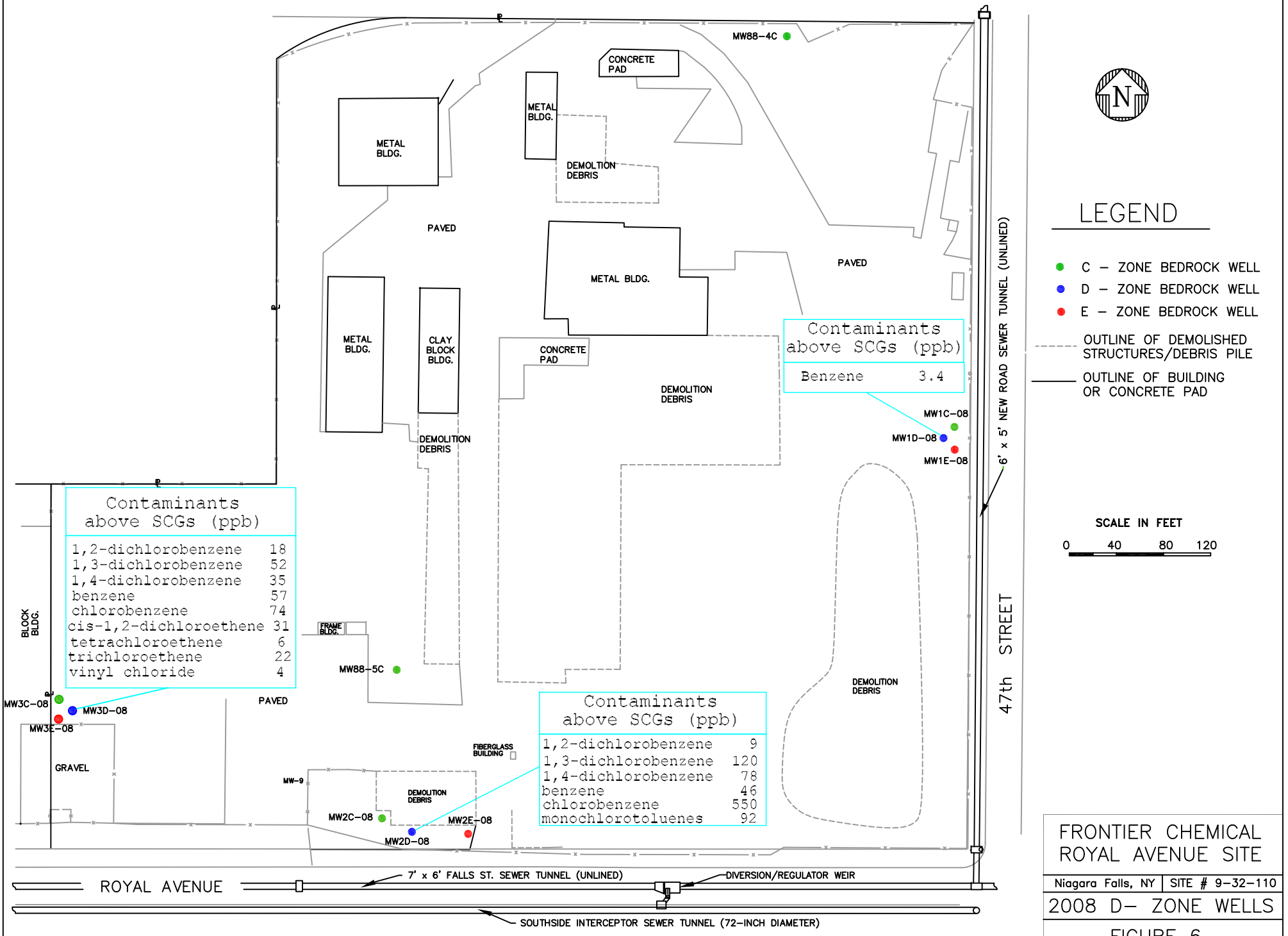


FRONTIER CHEMICAL
ROYAL AVENUE SITE

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

2008 C– ZONE WELLS

FIGURE 5

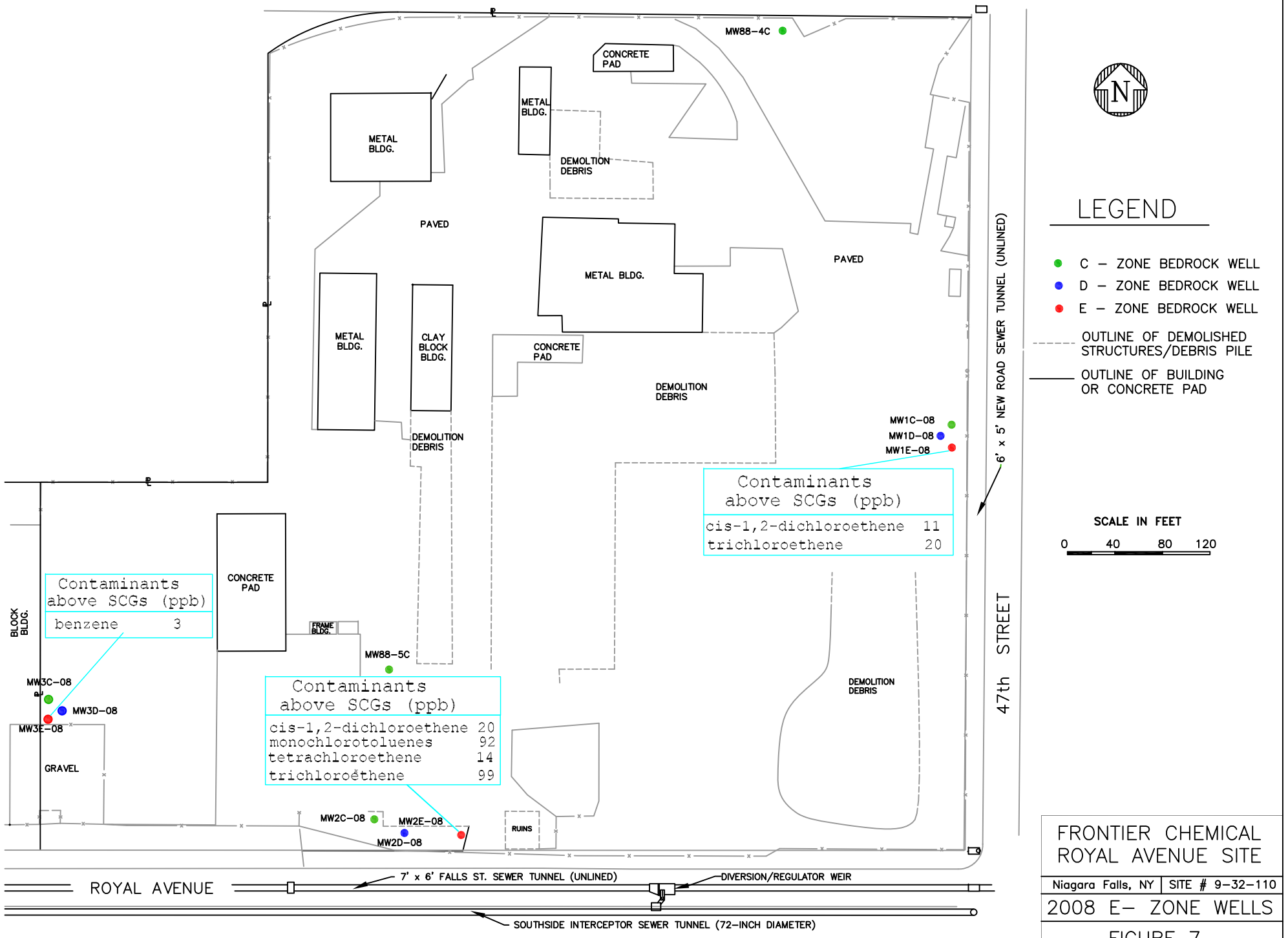


FRONTIER CHEMICAL ROYAL AVENUE SITE

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

2008 D– ZONE WELLS

FIGURE 6



FRONTIER CHEMICAL
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2008 E- ZONE WELLS

FIGURE 7