FRONTIER
CHEMICAL WASTE PROCESS, INC.

February 10, 1992

New York State Department of
Environmental Conservation
600 Delaware Avenue
Buffalo, New York 14203

RE: Interim Remedial Measure Revised Design and Performance Monitoring; Response to New York State Department of Environmental Conservation Letter of November 26, 1991

ATTN: Mr. Frank Shattuck

Dear Mr. Shattuck:

Enclosed is one copy of Frontier Chemical's Response to New York State Department of Environmental Conservation's letter of November 26, 1991 and the Revised Interim Remedial Measure Design and Performance Monitoring Report prepared by ECCO, Inc. with assistance from Frontier Chemical .

Sincerely,

Rudolph F. Scarpelli

Rudolph S. Scarpelli
Laboratory/Technical Director

CC: √Stan Radon - DEC Buffalo
William Wentz - DEC Albany
Steve Kaminsky - DEC Albany
James Reidy - EPA REGION II
John Evans - Frontier

RFS/mlm

FRO - 1992 - 5 - 2

4626 Royal Avenue, Niagara Falls, New Yc ..one (716) 285-8208 • Fax (716) 285-3521

[redacted]

ecco
The
Environmental
Consulting
Company

February 10, 1992

Mr. Rudolph Scarpelli
Laboratory/Technical Director
Frontier Chemical Waste Process, Inc.
4626 Royal Avenue
Niagara Falls, New York 14303

Dear Mr. Scarpelli:

RE: Frontier Chemical Waste Process, Inc.
Response to NYSDEC Comments to Letter
Dated November 26, 1991

ECCO, Inc., has reviewed the letter dated November 26, 1991, from Mr. Frank E. Shattuck, P.E., regional hazardous substances regulation engineer, NYSDEC, to Mr. Raymond Martin, president, Frontier Chemical Waste Process, Inc. ECCO, Inc., has addressed, with Frontier's assistance, the comments set forth in the above letter. The following discussion identifies each NYSDEC comment and follows with a comment or additional information.

I. Response to NYSDEC Comments

Comment 1:

"Response #1 (pg. 1 & 2) - Despite the limited number of data points, a pumping well potentiometric map can be constructed. Potentiometric maps shall be required as part of the reporting once the pump and treat system is operational. Additionally, a discussion of drawdown curves shall be included once the pump and treat is operational."

Response

Once the recovery well and treatment system is operational, a "start up" report will be submitted within 15 days discussing the following items:

- Results of a step drawdown test in the recovery well.

Brisbane Bldg.
Suite 515
Buffalo, New York 14203
(716) 852-3636

- Results of the constant rate pumping test performed in the recovery well with a discussion of the generated drawdown curves.
- Three maps depicting the potentiometric surface configuration within the areal extent of the observation wells prior to the step drawdown test, prior to the constant rate pump test, and at the completion of the constant rate pump test.
- Discussion of projected zone of capture with map.
- The abandonment of existing well MW-84-11 and the installation of "A" fracture and "B" fracture replacement monitoring wells, inclusive of boring logs.
- Discussion of background analytical results from tunnel and monitoring well sampling points.
- Recovery well log and as-built drawing.
- Operating recovery pump rate.
- Performance monitoring sampling frequency.
- Certification that the work was done in accordance with the IRM Design and Performance Monitoring Report, inclusive of any modifications.
- As appendices to the report, all recovery well test calculations, drawdown curves, total discharge during the tests and disposition, field sampling activity sheets, laboratory analytical and QA/QC results will be presented.

Comment 2:

"Response #5 (pg. 5) - Frontier should submit a Sampling and Analysis Plan as part of the Performance Monitoring Report and a Quality Assurance Project Plan under separate cover. Additionally, an Operation and Maintenance Plan should also be submitted once the Design and Performance Report is approved. An outline of what is typically included in an operation and maintenance plan is attached for guidance purposes. "

<u>Response</u>

A sampling and analysis plan is being submitted as a part of the revised Performance Monitoring Report. A Quality Assurance Project Plan (QAPjP) has been prepared by Frontier Chemical Waste Process, Inc., and is being submitted under separate cover. Upon approval of the Design and Performance Monitoring Report, an Operation and Maintenance Plan will be prepared and submitted.

Typo: Changed all "fractural" to "fractured" in the IRM Design and Performance Monitoring Report.

Comment 3:

"Response #6 (pg. 5 & 6) - The NYSDEC shall be copied on all correspondence with the City of Niagara Falls."

Response

Frontier is presently copying the NYSDEC on all correspondence with the City of Niagara Falls related to treatment and discharge of groundwater from the proposed recovery well.

Comment 4:

"Response #10 (pg. 6 & 7) - A table listing all of the hazardous constituents found in the groundwater shall be included in the final Design and Performance Monitoring Report."

Response

Table 1 has been prepared and is now presented in the IRM Design and Performance Monitoring Report.

Comment 5:

"Response #11 (pg. 7) - The data in the C-zone does suggest that there may be an off-site source. However, the NYSDEC is not convinced that it is solely an off-site source given the fact the four main constituents in the B-fracture zone are also in the C-fracture zone."

Response

Frontier's position remains that the data to date, both hydraulically and analytically, suggests an off-site source for the groundwater chemistry identified in the "C" fracture zone. However, Frontier does note the NYSDEC's interpretation of the data related to this zone.

Comment 6:

"Response #22 (pgs. 10 & 11) - The scope of the Interim Remedial Measures is to mitigate the migration of contaminants that might be going off site. Therefore, given the proximity of MW-84-11 to the Falls Street Tunnel, it is logical that an investigation regarding the DNAPL in MW-84-11 take place. Frontier should also consider proper abandonment and replacement of MW-84-11."

Response

Frontier agrees with the NYSDEC and will properly abandon well MW-84-11. Immediately following the abandonment of MW-84-11, two monitoring wells (i.e., one "A" fracture well and one "B" fracture well) will be constructed in the vicinity of MW-84-11. Information obtained during the construction and subsequent sampling of the two proposed replacement wells for MW-84-11 will provide information regarding the DNAPL in the vicinity of MW-84-11.

Prior to the abandonment of MW-84-11 and the construction of the two proposed wells in the vicinity of MW-84-11, a detailed scope of work for abandonment of MW-84-11 and construction and development of the replacement wells will be submitted to the NYSDEC for approval. Frontier's intent is to have both of the proposed replacement wells constructed and developed prior to performance of the constant rate pump test at the recovery well. The rationale for this schedule is to utilize the proposed replacement wells as observation wells during recovery well constant rate pump test and subsequently for determination of background groundwater quality prior to start-up of the recovery well.

II. Interim Remedial Measure Report

Comment 1:

"Page 8, middle paragraph - The diversion of water during dry-weather flow to the Waste Water Treatment Plant only reduces the likelihood of possible human contact. During times of higher water flow, water bypasses the diversion to the Waste Water Treatment Plant."

Response

Frontier acknowledges that during storm events, a portion of the flow within the adjacent Falls Street tunnel bypasses the diversions. The frequence of this occurrence and the quality of the water has not been qualitatively defined to date. This data need will be addressed as the program proceeds.

Comment 2:
"Section 4.1.1, Recovery Well - The description of the recovery well is inconsistent with the recovery well design in the IRM Design and Performance Monitoring Report. Which report includes the appropriate design?"

Response

The IRM report presented a conceptual recovery well design. The IRM Design and Performance Monitoring Report has incorporated the basic conceptual recovery well design and has elaborated on its installation. Therefore, the final recovery well design is presented in the IRM Design and Performance Monitoring Report, and it is consistent with the monitoring wells installed by Frontier Chemical Waste Process, Inc., since 1988. By the word consistent, it is meant that the proposed recovery well will be an open rock corehole with telescoping steel casings.

Comment 3:
"Despite what the NYSDEC's August 12, 1991, letter stated regarding Appendix D, Frontier designed their treatment system using this data, which is presented in Table 5. No use of historical data in the design was mentioned."

Response

The data presented in Table 5 in the IRM report is similar to historical data for those parameters in terms of the specific type of compound. Of course, variations in concentration levels are noted to a degree and are expected between data generated from distinct sampling events and the on-site locations of the wells sampled.

Comment 4:

"What do Frontier's underground sewers transport since the process waste is carried aboveground prior to MS-1?"

Response

Frontier's underground sewers transport sanitary and storm water which goes into the City of Niagara Falls sewer system and into the Waste Water Treatment Plant.

Comment 5:

"Was the Tank 101 sample in Table 5 taken prior to or after treatment?"

Response

The sample from Tank 101 was taken prior to treatment with activated carbon.

Comment 6:

"Section 4.1 states that engineering plans for the treatment system will be submitted, but the IRM Design and Performance Monitoring Report does not contain any plans."

Response

Treatment for the groundwater will utilize Frontier's existing aqueous operation with minor modifications. The process is described in Frontier's Part 373 Permit submittal to the NYSDEC, which includes relevant plans. The permit was most recently submitted in September, 1991. In Section 3.1 of the report, the reader is requested to refer to this document.

III. Interim Remedial Measures Design and Performance Monitoring Report

Comment 1:

"Section 2.3 Monitoring Well Installations should be Recovery Well.

- During the drilling operation of reaming out grout from the 8-inch casing, a hydrostatic water level check should be performed for 20 minutes.

- The 9-foot deep socket will be drilled into the bedrock by means of casing operation... . Coring should be followed by reaming with a 5 7/8" tricone. The plan should also specify what size and technique of coring will be used."

Response

- The text of the report has been corrected to reflect Section 2.3 - Recovery Well Installation.

- The grout will be allowed to cure (set) for 48 hours prior to commencement of reaming operations. After completion of the reaming operation to the top of the bedrock surface, the 8-inch casing will be filled with water to determine seal integrity by observing water level changes, within the 8-inch casing, for 20 minutes. If no significant water level changes are observed, coring operations will continue. If significant water level changes are observed, the 8-inch casing will be regrouted and retested as noted above.

- Coring will be accomplished by advancing either an NQ (2") or HQ (4") core barrel to the specified 9-foot depth and then reaming the corehole by means of a 5 7/8" tricone bit. Either conventional or wire line coring will be utilized to advance the core barrel.

"Section 2.4 - Future disposal should be in the on-site wastewater treatment system."

Response

As has been the procedure in past site activities, disposal of recovery well development waters will be realized via the on-site wastewater treatment system. A statement addressing this concern has been added to Section 2.4.

"Section 2.5 Aquifer Testing"

"How long will the step drawdown tests be performed? The constant rate pumping test will be conducted for a period of up to 96 hours. What is the minimum period of pumping that will be performed? What are the criteria for ceasing the pumping?"

Response

The step-drawdown test will be performed over a one-day time frame. During the step-drawdown test, the recovery well will be pumped at several increasingly higher pumping rates. The drawdown for each pumping rate will be recorded. Between each successive pumping rate, the recovery well will be allowed to recover to static, if possible. Five to six pumping rates at one-hour duration will be used.

Although a 24-hour time frame is usually sufficient for obtaining reliable data during a constant rate pump test within a confined aquifer, the constant rate pump test at the recovery well will be performed for a minimum of 48 hours. Prior to terminating the pump test at the observation wells, specifically "B" fracture wells after 48 hours, water levels will be reviewed to determine if the cone of depression has stabilized. If noticeable drawdown is still occurring within the "B" fracture observation wells, the pump test will be continued until the drawdowns have stabilized or the time frame of 96 hours has been exceeded.

"<u>Section 2.6 Recovery Well Operation</u>"

"An Operation and Maintenance Plan (OMP) should be prepared for NYSDEC review and approval. The OMP should include recovery well, monitoring well, treatment system operation, inspection and maintenance. It is suggested that reporting of operation, inspection and maintenance be included in the Performance Monitoring Reports.

Will the groundwater discharge line be aboveground or underground? If aboveground, how will Frontier keep the line from freezing?"

<u>Response</u>

- As noted in a preceding response to Comment #2 on page 2 of this letter, an OMP will be prepared and submitted to the NYSDEC. Also, reporting of operation, inspection and maintenance will be included in performance monitoring reports.

- The discharge line coming from the recovery well will be aboveground. The line will be steam traced and insulated to prevent freezing.

Comment:

"Figure 2 has some discrepancies. The Open Rock Hole is shown to be 15' into bedrock, although it should be 21' into bedrock according to the work plan."

<u>Response</u>

Figure 2 of the IRM Design and Performance Monitoring Report has been corrected to indicate the depth of the open rock hole as 21 feet.

"Section 3.2 - Treatment"

"The maximum concentration of any hazardous constituent ever detected in the groundwater, along with pH, hardness, iron, total dissolved solids, must be included. This list is required so personnel not familiar with Frontier or who do not have easy access to previous reports can appropriately review the design of the recovery system. Additional comments for this section includes:

- The replacement tanks' identification numbers from the Part 373 Permit Application must be used to avoid confusion.
- What does the DNAPL that has previously been found on site contain?
- What are the design removal efficiencies? Will there be any variation in contaminant removal efficiencies over time?
- How will the carbon be mixed into the tanks? Describe the filtering and activated carbon steps in more detail, or refer to specific pages in the Part 373 Permit Application.

Figure 3 - All tanks must be numbered with numbers from the Part 373 Permit Application. What will be done with the sludge from the multimedia filters and the activated carbon tanks?"

Response

See Table 1 for a listing of the maximum constituents detected in the groundwater. Iron and pH concentrations are also presented in Table 1. Analysis for hardness and total dissolved solids was not previously performed.

Identification numbers for the replacement tanks will use numbers from the Part 373 Permit Application.

From a sampling of October, 1989, and March, 1988, the DNAPL has been found to contain the following contaminants listed with respect to the particular well in which it was found:

	MW-84-11[1]	MW-87-4B (%)	MW-87-1A (%)	MW-88-2OB[1]
Benzene	5,100			
Chlorobenzene	9,600			
Chlorotoluene	24,000			
Dichlorobenzene	190,000			297,000
1,1-Dichloroethane	950			
1,2-Dichloroethane	160			
1,1-Dichloroethene	91			
Ethylbenzene	130			
Methylene Chloride	5,100			
Tetrachloroethene	21,000			
Toluene	4,300			
1,1,1-Trichloroethane	46,000			
Trichloroethene	30,000			
Trichlorofluoromethane	900			
Monochlorotoluene	- -	84 %	100 %	
1,2,4-Trichlorobenzene				87,000

1 = mg/L

Treatment of the groundwater will utilize Frontier's existing Aqueous Operation which includes activated carbon for the removal of soluble organics in the aqueous phase.

Frontier's Activated Carbon System consists of two adsorbers, each containing 20,000 pounds of granular activated carbon that are operated in series with water flowing from the top to the bottom in each adsorber. The system has two multi-media filters that are operated in parallel to remove solids prior to carbon adsorption. The filters can be backwashed and the resulting solids/aqueous mix is rerouted back for retreatment. The carbon adsorbers can also be backwashed with the resulting solids/aqueous mix rerouted and retreated in the same manner as the backwash from the media filters. The system is described in Frontier's Part 373 Permit Application, Appendix J, pages 14 and 15.

Since the effectiveness of activated carbon varies with respect to volume throughout, as well as feed concentration, the removal capabilities will vary proportionally. The effluent from carbon adsorption will be monitored at the discharge tanks for the parameters of concern such that they are within the compliance limits stipulated by the City of Niagara Falls

Wastewater Treatment Plant (WTP) for Frontier Chemical. The latter is the paramount factor which enables Frontier to discharge to the WTP.

Comment:

"Section 4.1 - Explain how adjustments for barometric pressure will be calculated and include an example. What about sample frequency in subsequent years? A Quality Assurance Project Plan and Sampling and Analysis Plan must be followed for this sampling program."

Response

Precipitation and barometric pressure data over the monitoring time frame will enable calculations of the barometric efficiencies. The barometric efficiency is expressed by the following:

Barometric Efficiency (BE) = Sw/Sb x 100
where: Sw = water level change
Sb = barometric pressure change

The barometric efficiencies will subsequently be used as a correction factor to changes in water level due to changes in barometric pressure during the aquifer pump testing. As an example, a well which was determined to have a 50 percent barometric efficiency would have a water column rise of 0.05 feet for every 0.01 foot decrease in barometric pressure measured in head of water, and conversely.

Comment:

"Section 4.2 - A Quality Assurance Project Plan and Sampling and Analysis Plan must be followed for this sampling program. A calculation should be made to estimate how long it will take for the recovery well to have an impact on the loadings to the tunnels. This should be considered in determining sample frequency."

"A cost estimate for capital, operation, inspection, and maintenance costs of the interim remedial measures and the Performance Monitoring Program shall be included. The cost estimate must be in undiscounted current dollars for the projected duration of the remedial measures."

Response

As discussed in Section 2.5 - Aquifer Testing, a constant rate pump test will be performed on the recovery well. Information generated from the pump test will enable the determination of aquifer hydraulic parameters specific to the recovery well location and screened aquifer. This information will be used to estimate the zone of capture and the time frame necessary to obtain the zone of capture. Using the aforementioned generated information, a calculation will be performed to estimate the theoretical time frame for the recovery well to have an impact on loadings to the adjacent tunnel system. This information will be provided in the same report discussing the aquifer test results and will be used to assess appropriate sample frequency.

Section 5.0 - Interim Remedial Measure Projected Costs, has been incorporated into the IRM Design and Performance Monitoring Report.

Comment:

"Section 4.3 - In the second sentence, modifications to the interim remedial measures, in addition to the performance monitoring system, should be identified and submitted for approval. The Six Month and One Year Performance Monitoring Reports should summarize treatment operations, including whether DNAPL was found in the settling tank. When will be zone of capture report be submitted? A start-up report should be submitted 15 days after the recovery well is running properly. It must include:

- Certification that the work was done in accordance with the IRM Design and Performance Monitoring Report, listing any changes made;
- The operating recovery pump rate;
- The aquifer test results, including calculations of aquifer parameters and plotting of the calculated and

measured zone of capture at nominal operating conditions;
- The recovery well log and as-built drawing;
- The total flow discharged during the aquifer test and verification of its disposition; and
- Analytical and QA/QC results in accordance with the QAPjP.

Appendix B - The extraction date, analysis date, preparation method, and chain-of-custody form must be included (see the deliverable requirements in Table I-1, on page I-10 of the QAPjP Guidance)."

Response

Modifications, if any, to the IRM will be identified and submitted to the NYSDEC for approval. The Six Month and One Year Performance Monitoring Reports will also summarize treatment system operations, maintenance and inspection. The zone of capture report will be incorporated into the "start-up" report. The "start-up" report, which will be submitted 15 days after the recovery well is operational, will include the above-noted items.

The extraction date, analysis date, preparation method and chain-of-custody form information, maintained by the City of Niagara Falls Waste Water Treatment Plant, were not available during the preparation of this correspondence. This information ,presently archived by the City, will be provided under separate cover as it becomes available from the City of Niagara Falls Waste Water Treatment Plant.

Additional Item

Frontier has communicated with the City of Niagara Falls concerning the City's review of the co-mingling of groundwater and processed water. The co-mingling of groundwater and processed water will allow Frontier to handle the discharge of the treated groundwater in an efficient manner. This approach to co-mingling of groundwater and processed water has been incorporated into Section 3.2 - Treatment.

Sincerely,
ECCO, Inc.

Andrew J. Kucserik
Senior Project Geologist

AJK/mcs

ecco INC.
The
Environmental
Consulting
Company

INTERIM REMEDIAL MEASURE REPORT

Frontier Chemical Waste Process, Inc.
Niagara Falls, New York

September, 1991
Revised February, 1992

Brisbane Bldg.
Suite 515
Buffalo, New York 14203
(716) 852-3636

INTERIM REMEDIAL MEASURE REPORT

Frontier Chemical Waste Process, Inc.
Niagara Falls, New York

Prepared for:
Frontier Chemical Waste Process, Inc.
4626 Royal Avenue
Niagara Falls, New York 14303

Prepared by:
ECCO, Inc.
Brisbane Building, Suite 515
Buffalo, New York 14203

Date: September, 1991
Revised: February, 1992

Table of Contents

Table of Contents, cont.

Appendices

Figures

Tables

1.0 INTRODUCTION

1.1 Purpose of Report

Frontier Chemical Waste Process, Inc. (Frontier), located in Niagara Falls, New York, (Figure 1) contracted ECCO, Inc., to assist in the preparation of the Interim Remedial Measure Design and Performance Monitoring Report. An Interim Remedial Measure Draft Report for the Frontier site dated May 1991 was submitted to the New York State Department of Environmental Conservation (NYSDEC). In a letter dated August 12, 1991, to Mr. Raymond Martin, president, Frontier, from Mr. Frank E. Shattuck, P.E., regional hazardous substances regulation engineer, NYSDEC, conditional approval of the proposed interim measure was granted provided identified comments and issues were addressed. The NYSDEC comments/issues were addressed and a revised Interim Remedial Measure Report was submitted on September 20, 1991.

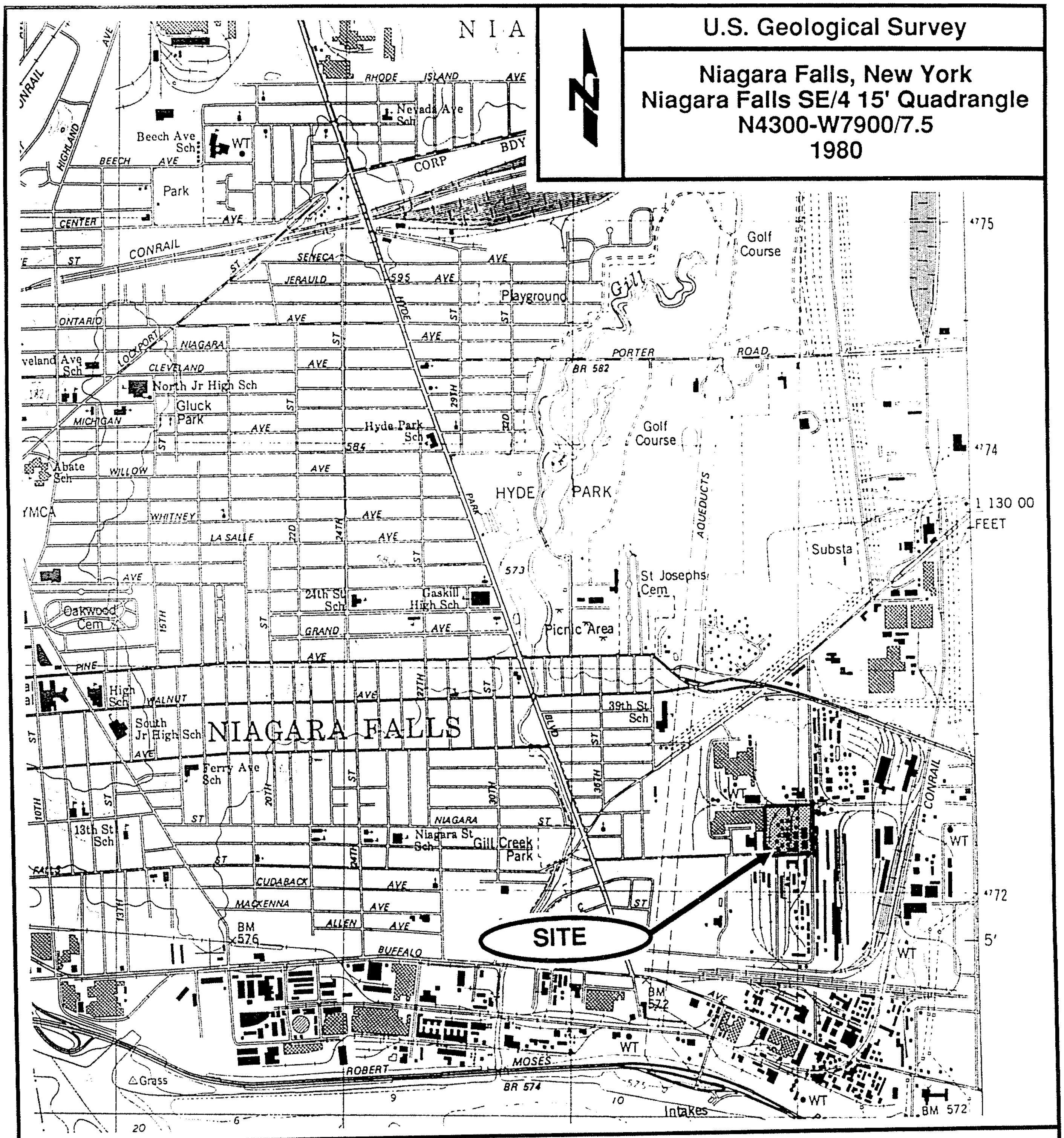
The proposed interim remedial measure is a combination of the existing in-place collection/interceptor drain, that is, the adjacent 47th Street and Falls Street Tunnels, and a recovery well intersecting the "B" fracture zone at the hydraulically downgradient end of the site west of Regulator 8.

The purpose of this document is to present the proposed design of the groundwater recovery well and treatment system. The following discussion prepared by both ECCO, Inc., and Frontier personnel, presents the design of the recovery well, a discussion of the treatment system and the proposed performance monitoring requirements for the overall interim remedial measure.

Frontier proposes to utilize portions of its existing aqueous operations system to treat the groundwater removed from the recovery well. For this reason, design drawings of the treatment system are not presented in this text. These drawings have previously been submitted to the NYSDEC in Frontier's NYSDEC Part 373 Application, EPA I.D. #NYD043815703. Frontier's most recent submittal of this application addressing NYSDEC comments is dated September 1991.

U.S. Geological Survey

Niagara Falls, New York
Niagara Falls SE/4 15' Quadrangle
N4300-W7900/7.5
1980



Frontier Chemical Waste Process, Inc.
47th Street and Royal Avenue
Niagara Falls, New York

ecco INC.
THE ENVIRONMENTAL CONSULTING COMPANY

Figure 1
Site Location Map
Scale: 1" = 2,083'

2.0 RECOVERY WELL

A "B" fracture recovery well is proposed to be installed at the Frontier site at a location south of Building #55 (Figure 1-1, Appendix A). The following sections describe the proposed methodology to be utilized for the recovery well installation and subsequent monitoring and pumping operations.

2.1 Decontamination Procedures

Prior to commencement of the recovery well installation, a truck mounted drill rig will be mobilized to the site. All tools, equipment and well materials will be mobilized to the site during this operation.

2.1.1 Decontamination Site

A decontamination area will be designated by Frontier at the truck staging area, west of the former settler, at location C-102 (see Figure 1-1, Appendix A). This area consists of a concrete pad sloped to a surface sewer drain, where trucks are kept prior to leaving or being accepted at the facility. Water and electric supply lines are located at the decontamination area.

All solid (i.e., soil) and liquid wastes generated during the decontamination operations will enter the sewer system via the surface drain for on-site treatment prior to discharge into the main sewer. Decontamination will be performed via a high-pressure steam cleaner provided by the drilling contractor.

Clean gloves and disposable Tyvec suits will be utilized between successive decontamination operations and will be disposed of in 55-gallon waste drums located adjacent to the decontamination area. Upon completion of all drilling operations, the decontamination area will be cleaned of all loose debris generated by the drilling contractor and steam cleaned prior to demobilization.

2.1.2 Drill Rig and Equipment

All equipment and tools utilized in the drilling operations will be decontaminated with a high-pressure steam cleaner prior to use. Drilling equipment will include all hollow-stem augers, rods, cutter heads, auger plugs, core barrels, casing (if necessary) and all hand tools.

The back end of the drill rig will also be cleaned between successive activities. The back end of each support vehicle (i.e., pickup) will be steam cleaned between activities.

2.1.3 Well Materials

All steel 6-inch, and 8-inch inside diameter casings will be steam cleaned prior to installation. Multiple lengths of steel casing, which are to be welded together, will be steam cleaned after welding is completed. All pre-cleaned well materials will be wrapped in polyethylene sheeting and kept off the ground surface prior to installation.

2.1.4 Equipment and Material Storage

All steel casings delivered to the site will be maintained in their respective shipping crates until needed and will be placed on wooden pallets to the east of the decontamination area. When not in use, the well materials will be covered with polyethylene sheeting. Cement, bentonite powder and bags of concrete mix will be also stored off the ground on wooden pallets and covered with polyethylene sheeting at a predesignated location.

2.2 Overburden Drilling Procedures

2.2.1 Hollow Stem Augers

A boring will be advanced to the top of the bedrock surface, through the overburden fills and soils, by means of 8 1/4-inch I.D. hollow-stem augers (HSA). The HSA will be utilized to create a stable borehole below which split-spoon soil sampling and well installation could be performed. The HSA will also serve as a temporary casing prior to installation of the permanent steel casings for the bedrock recovery well.

2.2.2 Soil Sampling

The nature of the overburden fill and soil materials will be investigated by means of split-spoon samplers advanced to the top of the bedrock. The purpose of the sampling is to provide information on the geologic stratigraphy encountered at the recovery well location and to confirm the depth to the bedrock surface.

All soil sampling will be performed in accordance with American Society for Testing and Material (ASTM) Standard D-1586. Blow counts will be obtained during the sampling to provide Standard Penetration Test (SPT) results. All recovered soil samples will be placed in 8-ounce glass jars and properly labeled according to borehole number, date, sample depth, sample number, and blow counts. The sample jar openings will then be covered with a layer of aluminum foil prior to sealing with the jar lids. The soil samples will be subsequently scanned with an HNU Model PI-101 Photoionization Detector by means of piercing the aluminum foil cover and obtaining the readings. The scanning will determine the presence of total volatile organics.

2.3 Recovery Well Installation

2.3.1 "B" Bedrock Fracture

The following procedure will be utilized for the installation of the "B" fracture bedrock recovery well:

- Overburden drilling will be accomplished in accordance with Section 2.2 of this report. The "B" fracture boring will be advanced to auger refusal and then one (1) foot into the top of the bedrock.

- With the HSA in place, a length of 8-inch inside diameter black steel casing will be lowered through the center of the HSA to the top of the bedrock surface. The purpose of the 8-inch casing is to provide separation of the overburden soils from the bedrock surface upon withdrawal of the HSA. This overburden casing will be pressure-grouted via a tremie pipe lowered into the casing. Upon completion of the pressure-grouting operations, the HSA will be removed from the overburden soils and decontaminated in accordance with Section 2.1 of this report. The grout will be allowed to cure for 48 hours prior to continuation of the drilling operations.

- After 48 hours has elapsed, the grout within the 8-inch casing will be reamed out, utilizing a tricone bit, to the base of the casing.

- After completion of the reaming operation to the top of the bedrock surface, the 8-inch casing will be filled with water to determine seal integrity by observing water level changes, with the 8-inch casing, for 20 minutes. If no significant water level changes are observed, coring operations will continue. If significant water level changes are observed, the 8-inch casing will be regrouted and retested as noted above.

- Upon completion of the reaming operations, a nominal 9-foot deep socket will be drilled into the bedrock by means of coring operations to facilitate the installation of a length of 6-inch I.D. diameter steel casing with centralizers. ~~The 6-inch casing will be pressure-grouted into the bedrock.~~ The grout will be allowed to cure prior to continuation of the drilling operations.

- After a minimum of 48 hours has elapsed, the grout within the 6-inch casing will be reamed out. Upon completion of the reaming operations, coring of the bedrock to 11 feet below the base of the 6-inch casing will be performed.

- Coring will be accomplished by advancing either an NQ (2") or HQ (4") core barrel to the specified 9-foot depth and then reaming the corehole by means of a 5 7/8" tricone (roller) bit. Either conventional or wire line coring will be utilized to advance the core barrel.

- The "B" fracture recovery well will be completed as an open rock hole at a depth interval of 9 feet to 21 feet below the top of the bedrock/overburden interface. The "B" fracture well will be isolated from the overburden soil conditions by means of the 8-inch steel casing and from the "A" fracture zone by means of the 6-inch steel casing telescoped through the 8-inch casing.

2.4 Well Development

Development of the newly installed recovery well will be performed. Evacuation of well waters will be performed by utilizing a surface-mounted jet pump or equivalent. Development will continue until well parameters stabilize to within 10 percent. These parameters are pH, temperature, specific conductivity, and turbidity. All evacuated waters will be disposed of in the on-site wastewater treatment system.

2.5 Aquifer Testing

Aquifer tests will be performed on the recovery well following development and stabilization. The purpose of the aquifer tests will be to assess the recovery well characteristics, determine aquifer parameter of the "B" fracture zone in the vicinity of the recovery well and allow proper sizing of the pump for the recovery well. Additionally, aquifer parameter determination will enable the zone of capture calculation.

The aquifer test will consist initially of a step drawdown test followed by a constant rate pump test. During both tests a 4-inch diameter submersible pump will be utilized. Water level within the recovery well and selected observation wells will be monitored via pressure transducers. A flow meter with totalizer will be utilized to monitor the pump rate and total discharge volume.

Prior to initiating the aquifer tests, background water levels will be monitored in the recovery well, MW87-4A, MW88-5B, MW88-2A & B, MW88-3A, & B and proposed replacement wells at MW-84-11. Monitoring of the background water levels will be performed via pressure transducer over a one-week period. Precipitation and barometric pressure data over the same time frame will enable calculations of the barometric efficiencies. The barometric efficiency is expressed by the following:

Barometric Efficiency (BE) = Sw/Sb x 100
where: Sw = water level change
Sb = barometric pressure change

The barometric efficiencies will subsequently be used as a correction factor to changes in water level due to changes in barometric pressure during the aquifer pump testing. As an example, a well which was determined to have a 50 percent barometric efficiency would have a water column rise of 0.05 feet for every 0.01 foot decrease in barometric pressure measured in head of water, and conversely.

Following the determination of barometric efficiency within the proposed observation wells, a step drawdown test will be performed on the recovery well. The purpose of the step drawdown test will be to determine:

- optimum pumping rate for the well;
- well loss coefficient; and
- specific capacity of the recovery well.

The step-drawdown test will be performed over a one-day time frame. During the step-drawdown test, the recovery well will be pumped at several increasingly higher pumping rates. The drawdown for each pumping rate will be recorded. Between each successive pumping rate, the recovery well will be allowed to recover to static. Five to six pumping rates at one-hour duration will be used.

At the completion of the step drawdown test and once the aquifer has stabilized, a constant rate pump test will be performed using the optimum pumping rate determined during the step drawdown test. The constant rate pumping test will be conducted for a period of up to 96 hours. Although a 24-hour time frame is usually sufficient for obtaining reliable data during a constant rate pump test within a confined aquifer, the constant rate pump test at the recovery well will be performed for a minimum of 48 hours. Prior to terminating the pump test after 48 hours, water levels within the observation wells, specifically "B" fracture wells, will be reviewed to determine if the cone of depression has stabilized. If noticeable drawdown is still occurring within the "B" fracture observation wells, the pump test will be continued until the drawdowns have stabilized or the time frame of 96 hours has been exceeded.

The observation wells in which water levels will be monitored are the previously identified wells utilized for background water levels. Information from the constant rate pump test will be used to calculate aquifer parameters and subsequently predict the zone of capture.

All waters removed during aquifer testing will be containerized and subsequently treated on site.

2.6 Recovery Well Operation

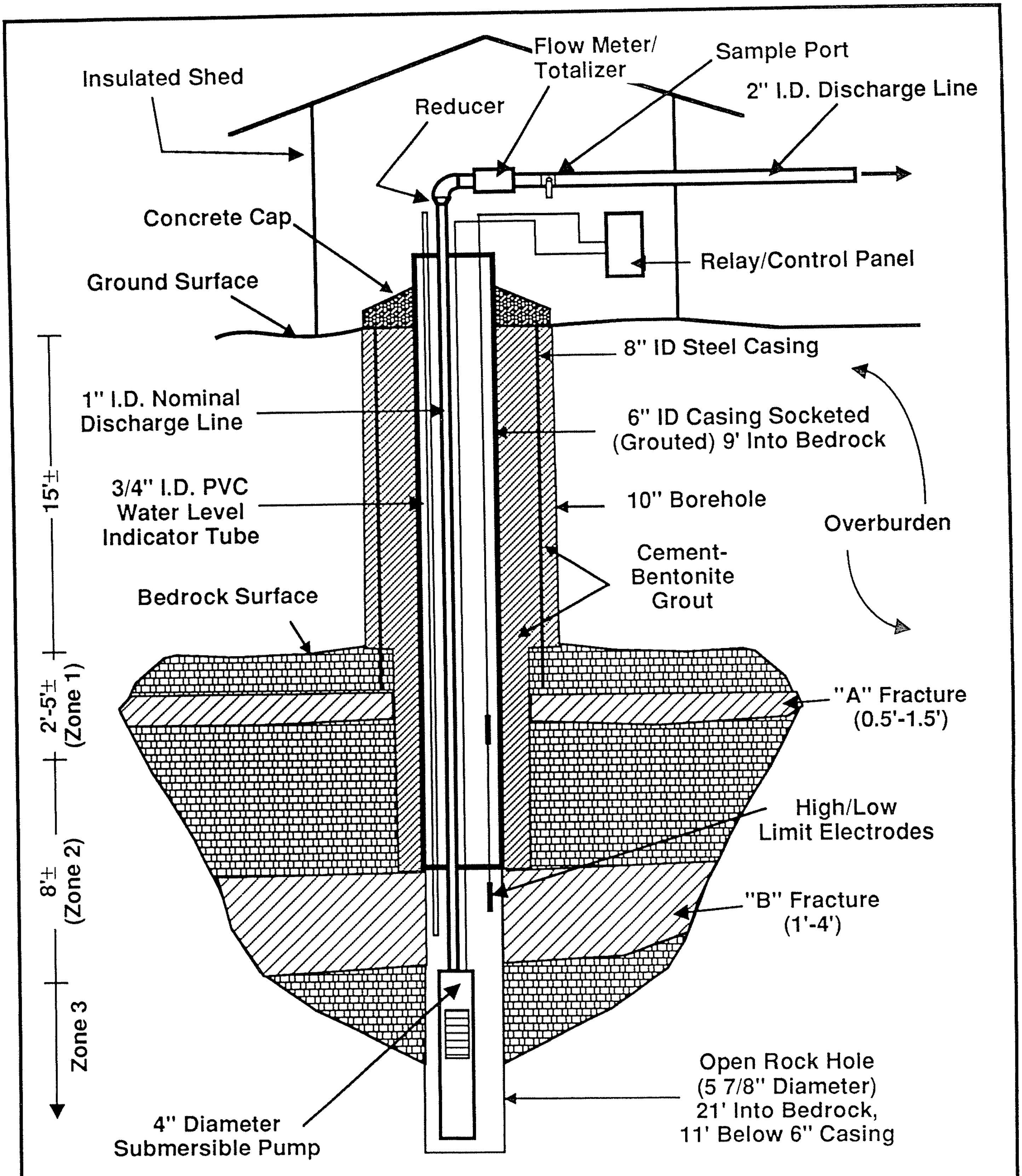
Upon completion of the aquifer testing and establishment of the operating recovery pump rate, the recovery well will be placed on-line and pumping of groundwater will commence.

A 4-inch submersible pump (Grundfos model 5S05-13 or equivalent) will be installed in the recovery well at a depth below the "B" fracture, within the open rock core hole (see Figure 2). High and low water electrodes (B/W Controls model B-1P or equivalent) will be installed in the well at predetermined depths. The pump cycling will be controlled by the high and low water electrode's relay system and the pump control panel (see Figure 2).

Flow rates will be monitored and totaled at the surface. A port will be installed for the purpose of subsequent recovery well discharge sampling.

The 1-inch I.D. pump discharge line will be connected at the wellhead to the facility 2-inch I.D. discharge line. The 2-inch aboveground, steam-traced line will transfer the recovery well discharge waters to the facility treatment area (see Figure 1-1, Appendix A).

The wellhead, relay/control panel and sampling ports will be enclosed in a lockable fabricated or pre-manufactured, insulated shed for year-round protection and security.



ecco INC.
THE ENVIRONMENTAL CONSULTING COMPANY

FIGURE 2
"B" FRACTURE
RECOVERY WELL
(NOT TO SCALE)

3.0 TREATMENT SYSTEM

3.1 Overview

Treatment of the groundwater generated from the recovery well will be performed utilizing Frontier Chemical's existing system for the treatment of aqueous wastes with several minor modifications. A plan view depicting the location of the recovery well, piping and treatment areas is presented in Appendix A as Figure 1-1.

Frontier's aqueous processing operation includes the following unit operations:

- Chemical oxidation/reduction;
- Magnesium hydroxide-lime neutralization;
- Dewatering;
- pH adjustment;
- Carbon Adsorption; and
- Batch discharging to the Niagara Falls Wastewater Treatment Plant (WTP).

The Frontier aqueous process operation is described in detail with appropriate design prints in the NYSDEC 373 Part B Application Appendix J. The most recent submittal of this application addressing NYSDEC comments is dated September 1991. The reader is requested to refer to this document for design prints of the treatment units and monitoring points referred to in the following discussion.

3.2 Treatment

Since the compounds of concern in the groundwater extracted from the recovery well are generally organics, pH and hardness (see Table 1) and can be removed with activated carbon, the carbon adsorption unit operation will be the main focus for treatment, with the realization that other portions of the operation will be used should a need arise. Iron and total dissolved solids concentrations were not previously analyzed.

The minor modifications previously alluded to include the use of a tank in containment area C-103. This tank is described in Frontier's Part 373 Permit Application, Appendix J, pages 14 and 15. This tank, with a capacity of 6,000 gallons, will be a replacement of an existing tank that has been decommissioned. The tank will be used as a settling and storage tank that will receive groundwater from the recovery well. On the possibility that the groundwater may contain Dense Non-Aqueous Phase Liquid (DNAPL), the tank will also be used to settle the DNAPL and provide a storage volume to allow for settling and initial placement of material. The DNAPL constituents previously encountered at the site and the associated wells are presented in Table 2.

Generally, DNAPL is denser than Aqueous-Phase Liquid (APL) and will settle to the bottom. This tank has a bottom discharge which will allow for periodic removal of the DNAPL. Frontier has a solvent blending operation on-site in which the DNAPL can be blended with other organic solvents and shipped off-site for incineration in cement kilns.

A replacement tank of similar capacity to Tank 109 in containment area C-108 will be used for batching the groundwater prior to treating with activated carbon. Tank #101 in containment area C-101 along with discharge tanks #1 and #2 will be used for monitoring and discharge of the material to the WTP. Figure 3 shows a process flow sheet for treatment that includes the modifications.

Frontier's Activated Carbon System consists of two adsorbers, each containing 20,000 pounds of granular activated carbon that are operated in series with water flowing from the top to the bottom in each adsorber. The system has two multi-media filters that are operated in parallel to remove solids prior to carbon adsorption. The filters can be backwashed and the resulting solids/aqueous mix is rerouted back for retreatment. The carbon adsorbers can also be backwashed with the resulting solids/aqueous mix rerouted and retreated in the same manner as the backwash from the media filters. The system is described in

1.2 Background

In the document entitled "Interim Remedial Measure Report, Frontier Chemical Waste Process, Inc., Niagara Falls, New York," dated September 1991, the proposed interim measure included a recovery well and groundwater treatment system. The objective of this proposed recovery well and treatment system is to reduce potential loading exiting the Frontier site through the "B" fracture zone in the section of the Falls Street Tunnel west of Regulator 8. The potential loading exiting the site may consist of the compounds previously detected during the historical well sampling events. A list of previously detected compounds, encountered during the groundwater monitoring programs, is presented as Table 1.

It was proposed that a recovery well sited north of Building 16 would be constructed. During the initial design phase of the proposed recovery well and treatment system, a logistics problem was identified with siting the recovery well adjacent to and north of Building 16. The identified problem was associated with the necessary piping from the recovery well to the treatment system. The piping would have to span a facility driveway used by tractors and trailers going to and from Containment Area C-102: Truck Loading and Unloading Area. The distance required was too great for a pipe bridge if the driveway were to remain unobstructed. For this reason, Frontier requests that the proposed recovery well location be moved hydraulically upgradient approximately 60 feet north (see attached Figure 1-1, Appendix A). This proposed relocation of the recovery well should not alter the effectiveness of the recovery well in accomplishing the above-noted objective.

Relocation of the recovery well to this location will site the well in an area still capturing the groundwater prior to entering the Falls Street Tunnel west of Regulator 8. The previously calculated capture zone width (see IRM Report) in the area of monitoring well MW88-SB located adjacent to the proposed relocation site ranged from 250 feet to 360 feet. If one were to assume a conservative capture zone of 250 feet, groundwater should be intercepted just upgradient of the area between MW84-9 and MW88-6, hence reducing the potential loading to the tunnel west of Regulator 8. The following discussion is based on this requested relocation.

Table 1 - Previously Detected Compounds
at the Frontier Chemical Waste Process, Inc., Site
Niagara Falls, New York

PARAMETER	WELL	MAXIMUM CONCENTRATION (1)
• 1,1,1-Trichloroethane	MW-88-3A	150,000
• 1,1,2,2-Tetrachloroethane	MW-84-11	17,250
• 1,1-Dichloroethane	MW-88-3A	8,400
• 1,1-Dichloroethylene (1,1-Dichloroethene)	MW-88-3A	820
• 1,1-Dichloroethane	MW-84-11	5,370
• 1,2-Dichloroethane	MW-87-4A	1,530
• 2-Butanone	MW-88-12A	7,300
• 4-Methyl-2-Pentanone	MW-81-2	4,040
• Acetone	MW-84-2	160,000
• Benzene	MW-88-2 OB	180,000
• Bromobenzene	MW-84-11	88
• Carbon Tetrachloride	MW-84-11	24,000
• Chlorobenzene	MW-88-2 OB	140,000
• Chloroform	MW-84-11	2,600
• Chlorotoluene	MW-84-11	497,000
• Dichloroethene (Dichloroethylene)	MW-84-13	1,100
• Dichlorofluoroethane	MW-84-11	71
• Dichloromethane	MW-84-11	1,340
• Dichlorotoluene	MW-84-11	92
• Ethylbenzene	MW-84-11	800
• Methyl Ethyl Ketone	MW-81-2	4,210
• Methyl Isobutyl Ketone	MW-87-4A	4,770
• Methyl Toluene	MW-84-11	414
• Methylene Chloride	MW-88-3A	120,000
• Tetrachloroethylene (Tetrachloroethene)	MW-84-11	18,900
• Toluene	MW-84-17	428,000
• Total Dichlorobenzene	MW-88-2 OB	360,000
• Total Monochlorotoluene	MW-87-4B	169,000
• Total Xylenes	MW-87-4A	2,250
• Trans-1,2-Dichloroethylene	MW-88-12A	120,000
• Trichlorobenzene	MW-84-11	1,060
• Trichloroethylene (Trichloroethene)	MW-88-7A	140,000
• Vinyl Chloride	MW-87-5C	4,900
• Iron	MW-81-2	13,000

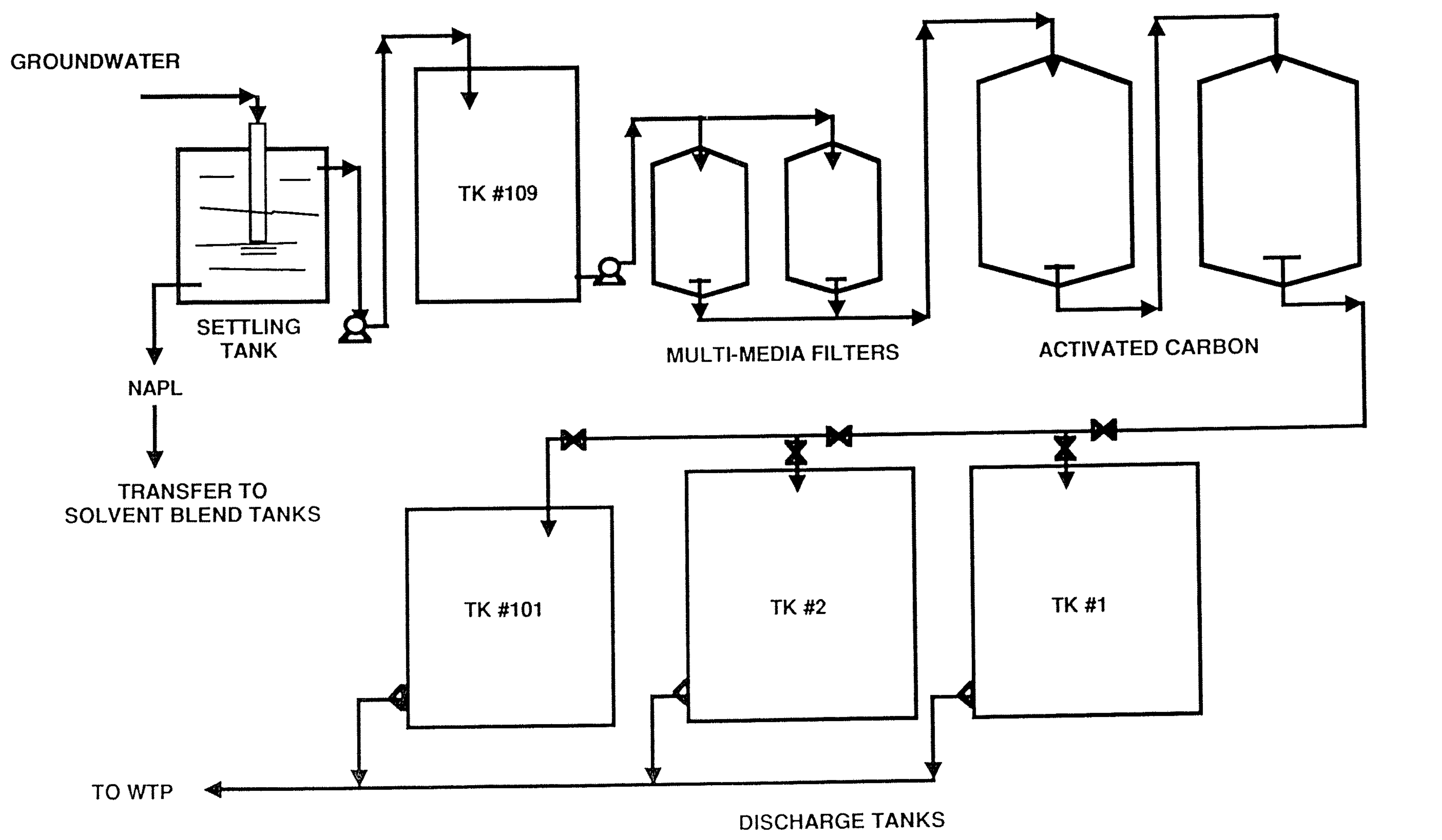
• pH ranges (2): 6.8 (MW-81-4) and 10.5 (MW-81-6)

NOTES: (1) - Concentrations are presented in parts per billion (ppb)
(2) - pH is presented in Standard Units

TABLE 2
Previously Detected DNAPL Constituents

	MW-84-11[1]	MW-87-4B (%)	MW-87-1A (%)	MW-88-2OB[1]
Benzene	5,100			
Chlorobenzene	9,600			
Chlorotoluene	24,000			
Dichlorobenzene	190,000			297,000
1,1-Dichloroethane	950			
1,2-Dichloroethane	160			
1,1-Dichloroethene	91			
Ethylbenzene	130			
Methylene Chloride	5,100			
Tetrachloroethene	21,000			
Toluene	4,300			
1,1,1-Trichloroethane	46,000			
Trichloroethene	30,000			
Trichlorofluoromethane	900			
Monochlorotoluene	- -	84	100	
1,2,4-Trichlorobenzene				87,000

[1] = mg/L



ecco INC.
THE ENVIRONMENTAL CONSULTING COMPANY

FIGURE 3

FRONTIER CHEMICAL WASTE PROCESS, INC.
GROUNDWATER TREATMENT

Frontier's Part 373 Permit Application, Appendix J, pages 14 and 15.

An insulated, aboveground 2-inch I.D. steel line will be used to take groundwater from the withdrawal well and transport it to the replacement tank in containment area C-103. The specific route taken by the piping is shown on the Figure 1-1 presented in Appendix A.

Groundwater (APL) from the recovery well goes into the settling and storage tank from the top where a pipe extends into the tank to within several feet of the bottom. The bottom of this pipe is teed to promote stilling within the tank and abet settling of any DNAPL. From this tank the APL is allowed to overflow into the replacement tank at Tank #109. The replacement tank will have a volume of about 17,000 gallons and will be used to batch and transfer the APL through activated carbon in Frontier's existing aqueous operation via Tank #113.

After carbon adsorption, the treated groundwater is transferred to discharge Tanks #1, #2 and/or #101 for monitoring and final discharge to the WTP. The three discharge tanks will be used in alternating modes, so as to allow sufficient lag time for monitoring and discharging of the materila to the WTP.

The use of replacement tanks R-1 in Containment Area C-103 and #109 in containment area C-108, is at present considered the most expedient approach to treating the groundwater utilizing the existing system. Should, however, other options prove to be more efficient in the very near future, they would be considered within the scope of maintaining the same treatment scheme. Any modifications will be submitted to the NYSDEC for review.

The monitoring requirements stipulated by the WTP as a prerequisite prior to discharge of the groundwater generated as a result of the pump tests reported in the Interim Remedial Measures (IRM) Report of September 1991 by ECCO, Inc., included:

- Total Cyanide
- Total Phenol
- Total Phosphorus
- SOC

- pH
- TSS
- Metals
  - Cadmium
  - Chromium
  - Copper
  - Lead
  - Mercury
  - Nickel
  - Zinc
- Selected Priority Pollutant Organics (EPA SW-846 (8260, 8270)
- PCBs
- Endosulfan
- Mirex
- Endosulfan Sulfate
- Dechlorane Plus
- Heptachlor

Data generated from the groundwater stored in Tank #101 prior to its treatment is shown in Appendix B. It is noted that aside from the organic compounds listed in EPA SW-846 (8260) that are of concern, which can include Dichlorobenzene, the rest of the parameters are at less-than-detected levels or at minimal concentrations within the detection limits of the respective parameters. Since the data was generated on the groundwater prior to treatment, it is not expected that changes after treatment would alter the characteristics of the data. Thus considering the above, Frontier Chemical will formally ask the WTP to reduce the monitoring requirements restricting the monitoring to the analysis of EPA SW-846 (8260) including Dichlorobenzene solely.

Being able to analyze for EPA SW-846 (8260) solely prior to discharge of the groundwater will enable Frontier to treat and discharge the groundwater within the framework of constraints in its existing aqueous processing operation without much additional difficulty. Equally important is the ability to discharge within Frontier's discharge limits at 50,000 gallons/day at the maximum mass quantities. It should be borne in mind that the treatment of the groundwater is to be realized without adding significant burdens to the existing treatment status, allowing for expansion as it becomes necessary. It is imperative that Frontier maintain its economic viability.

4.0 PERFORMANCE MONITORING

A performance monitoring system will be implemented for the proposed interim remedial action. The objective of the proposed performance monitoring system is to evaluate the effectiveness of the implemented interim remedial action towards satisfying the interim remedial measure objective. The criteria by which the system's effectiveness will be judged are:

- the areal extent of the zone of capture of the recovery well;
- changes in groundwater levels within the overlying water-bearing zone within and adjacent to the zone of capture;
- changes in contaminant concentrations or distribution in wells within and adjacent to the zone of capture; and
- changes in the contaminant concentrations within the adjacent tunnel system.

The following discussion of the proposed performance monitoring system is divided into two areas. The first area is the recovery well and its effect on the groundwater hydraulics and chemistry within and adjacent to the zone of capture of the well. The second area is the adjacent tunnel system and the effect of the recovery well on the water quality within this system.

During the execution of the Performance Monitoring Program, all sampling and analytical protocol will adhere to the Sampling and Analysis Plan presented in Appendix C and Frontier's Quality Assurance Project Plan.

4.1 Recovery Well Monitoring

The purpose of this monitoring program is twofold. Data obtained during this monitoring program will enable a quantification of the zone of capture and also enable an assessment of changes in the groundwater chemistry within and adjacent to the zone of capture. Prior to activating the recovery well and associated treatment system, daily static water levels will be obtained from the wells presented in Table 3 over a one-week period. Upon activating the recovery well and treatment system, daily water levels will be obtained from the Table 3 wells. Once stabilization of the water levels within these wells has been identified, weekly water levels will be obtained over a period of a month. Water levels obtained

No transducers

how will stabilization be defined

TABLE 3
IRM-Proposed Wells to be Monitored

- The recovery well, RW-1
- MW 87-4A, B
- MW 88-5B, C
- MW 88-2 OB, A, B
- MW 88-6 OB, A, B
- MW 88-3 A, B
- MW 84-9
- MW 84-11 (Proposed Replacement Wells) → MW 92-1A, MW 92-1B
- MW 88-13B
- MW 88-7B
- MW 88-11B
- MW 88-10B

during this monitoring activity will be adjusted, if appropriate, for changes in barometric pressure (see Section 2.5). Upon completion of the month time frame, the observed zone of capture will be identified and the monitoring time frame and wells to be monitored will be re-evaluated. The results of this evaluation process will be submitted to the NYSDEC for review and comment.

In addition to monitoring changes in water levels in the Table 3 wells, the groundwater quality will also be assessed. Prior to activating the recovery well, one round of groundwater samples will be obtained from those wells screened within the "B" fracture zone and analyzed for the following parameters:

- EPA Method 8260 - Priority Pollutant Volatile Organics plus Acetone, 2-Butanone, 4-Methyl-2-Pentanone, Total Xylenes, Total Monochlorotoluene.

Subsequent to the initial sampling and analysis event, sampling will be performed on the same wells following the aforementioned analytical program. The sample frequency during the first year will be:

- upon stabilization of the recovery well system;
- 30 days following stabilization; and
- every other month thereafter to the end of the first year.

4.2 The Adjacent Tunnel System Monitoring

Monitoring of water quality changes in the adjacent tunnel system will be conducted. Initially, prior to activation of the recovery wells, samples will be obtained from the tunnel system. This sampling event will consist of 24-hour composites. The samples will be collected from the same shafts/sampling points utilized during the interim remedial data acquisition task discussed in the Interim Remedial Measure Report. An attempt will also be made to coordinate with the City of Niagara Falls to obtain access to Shaft 14A. If successful, Shaft 14A will also be included as a sample point. During this sampling event and subsequent sampling events, flow measurements at each sampling location will be obtained. Following activation of the recovery well, sample events will be performed monthly for the first two months and every other month thereafter to the end of the first year. The analytical program for all tunnel samples/composites will adhere to the same program proposed for the recovery well monitoring.

4.3 Performance Monitoring Reporting

Throughout the first year of performance monitoring, the data (that is, groundwater levels, groundwater chemistry and tunnel system water quality) will be continuously evaluated. If modifications to the proposed performance monitoring system and/or the interim remedial measure are identified during this evaluation, Frontier will notify the NYSDEC of the identified modifications and associated rationale for comment/approval.

Frontier proposes three formal submissions during the first year of operations. These submissions are:

- "Start-up Report"
- Six Month Performance Monitoring Report
- One Year Performance Monitoring Report

The "Start-up" Report will be submitted fifteen (15) days after the recovery well system is operational. The report will address, at a minimum, the following items:

- Results of a step drawdown test in the recovery well.
- Results of the constant rate pumping test performed in the recovery well with a discussion of the generated drawdown curves.
- Three maps depicting the potentiometric surface configuration within the areal extent of the observation wells prior to the step drawdown test, prior to the constant rate pump test, and at the completion of the constant rate pump test.
- Discussion of projected zone of capture with map.
- The abandonment of existing well MW-84-11 and the installation of "A" fracture and "B" fracture replacement monitoring wells, inclusive of boring logs.
- Discussion of background analytical results from tunnel and monitoring well sampling points.
- Recovery well log and as-built drawing.
- Operating recovery pump rate.

- Performance monitoring sampling frequency.
- Certification that the work was done in accordance with the IRM Design and Performance Monitoring Report, inclusive of any modifications.
- As appendices to the report, all recovery well test calculations, drawdown curves, total discharge during the tests and disposition, field sampling activity sheets, laboratory analytical and QA/QC results will be presented.

The Six Month and One Year Performance Monitoring Reports will be submitted within thirty (30) days following receipt of the analytical results generated from the six month and one year performance monitoring sampling events. Both reports will address, at a minimum, the following items:

- All analytical and QA/QC results during the time frame of the reports,
- Potentiometric maps generated during the time frame of the reports,
- Discussion of the groundwater and tunnel water chemistry characterized during the time frame of each of the reports, and
- Summary of treatment system operations, maintenance and inspection.

5.0 INTERIM REMEDIAL MEASURE PROJECTED COST

The following costs have been estimated for the construction, operation, inspection and maintenance of the recovery well and treatment system. In addition, estimated costs have also been calculated for the proposed Performance Monitoring Program. The costs are presented on an annual basis. Projecting the duration of this interim remedial measure is not possible at this time.

Following is the projected costs:

I. CAPITAL COSTS

Capital costs are based on 1992 dollars.

ITEM DESCRIPTION	QUANTITY	UNIT $	COST
Recovery Well Construction (inclusive of testing & professional services)	lump sum	$ 43,000	$ 43,000
2" Dia Jacketed Steel Pipe; including coupling and hangers	500 feet	$ 15/ft	$ 7,500
3" Dia Steel Pipe; including coupling and support	25 feet	$ 20/ft	$ 500
1/2 Hp Pump; submersible well	1 each	$ 1,000/ea	$ 1,000
15 Hp Pump; centrifugal	1 each	$ 3,500/ea	$ 3,500
6,000 gal. Settling & Storage Tank; RFP	1 each	$ 6,000/ea	$ 6,000
15,000 Gal. Day Tank; RFP	1 each	$18,000/ea	$ 18,000
Miscellaneous; power, control, fittings, site prep.; 25 % of total	lump sum	$ 9,500/ls	$ 9,500
	TOTAL CAPITAL COST		$ 89,000

II. OPERATION AND MAINTENANCE (O&M) COSTS

A. POWER COST

1. 1/2 Hp Pump

Base calculation on 5 GPM operation over a 24-hour period, year around.

(1/2 Hp) x (24 Hr/Day) x (0.776 KWH/HpH) = 10 KWH/Day
(10 KWH/Day) x (365 Day/Year) x ($0.10/KWH) = $365/Year

2. 15 Hp Pump

While this pump will be operated intermittently, it will for all purposes pump the same volume of water as the 1/2 Hp pump. Thus, assume the same power usage.

Use = $365/Year

3. Total Power Usage

($ 365/Year) + ($ 365/Year) = $730/Year

Use = $1,000/Year

B. CARBON

Carbon usage is based on a projected effective treatment loading rate of 2.5 lbs Carbon/1,000 Gal. The cost of carbon is based on the cost for the present treatment system of $16,000/20,000 # Carbon, including shipping.

(5 GPM) x (60 Min/Hr) x $24 Hr/Day) = 7,200 Gal/Day

(7,200 Gal/Day) x (2.5 lbs Carbon/1,000 Gal) = 18 lbs Carbon/Day

(18 lbs Carbon/Day) x (365 Day/Year) x (16,000/20,000 lbs Carbon) = $5,256/Year

Use = $6,000/Year

C. DNAPL

The system is protected against DNAPL; although, it is not anticipated that any DNAPL will be encountered.

D. PARTS/MAINTENANCE

Parts replacement and maintenance will be in association with the pumps. These costs are projected based on an annual cost of 20 percent of pump capital cost.

(($1,000) + ($3,500)) x (0.2/Year) = $900/Year

Use = $1,000/Year

E. LABOR

Labor is based on a projection of 1/2 Hr/Day inspection time and 3 1/2 Hr/Wk maintenance time (6 Hr/Wk total). The cost associated with carbon handling is considered to be absorbed in normal facility operation costs. Labor costs are based on $30/Hr.

(6 Hr/Wk) x (52 Wk/Year) x ($30/Hr) = $9,360/Year

Use = $10,000/Year

F. FRONTIER'S DISCHARGE MONITORING

The following calculations were performed assuming that the addition of groundwater extracted from the recovery well will be 33 percent of Frontier's total discharge. Since monitoring of Frontier's discharge is and would be performed whether a recovery well was active or not, manpower costs have not been included, only analytical.

Batch Discharge
($290/batch) x (30 batches/Year) = $8,700/Year

additional
cost

City of Niagara Falls Monthly
($17,000) x (33%) = $5,670

City of Niagara Falls Quarterly
($3,376/Year) x (33%) = $1,125/Year

New York State Monthly
($16,580/Year) x (33%) - $5,530/Year

TOTAL $21,025/Year

G SUMMARY OF O&M COSTS

update costs yearly

Item	Cost
Power	$ 1,000/Year
Carbon	$ 6,000/Year
Parts/Maintenance	$ 1,000/Year
Labor	$10,000/Year
Monitoring	$21,025/Year
ANNUAL O&M COSTS	$39,025/Year

will have

III. PERFORMANCE MONITORING

A. Analytical
(12 groundwater samples/event) + (9 tunnel samples) = 21 samples

(21 samples/event) x ($200/sample) = $4,200/event

(8 sampling events during first year) x ($4,200/event) = $33,600

B. Sampling (manpower and equipment
($5,700/event) x (8 sampling events) = $45,600

C. Reporting = $20,000

TOTAL PERFORMANCE MONITORING COST = $100,000/Year

APPENDIX A

Figure 1-1

APPENDIX B

Tank 101
Analytical Results

FRONTIER ENVIRONMENTAL LABORATORIES, INC.

4626 Royal Avenue • M.P.O. Box 309 • Niagara Falls, New York 14302 • Phone (716) 285-2587 — FAX (716) 285-3521

Date: January 23, 1991

ANALYTICAL RESULTS
FOR

Frontier Chemical Waste Process, Inc.
4626 Royal Avenue
Niagara Falls, New York 14303

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM (ELAP)
CERTIFICATION #10797

FIELD INFORMATION

Name of Collector: G. Hapeman

ASSIGNED FEL# I.D.	SAMPLE I.D.#	SAMPLE TYPE	Site, Date and Time of Collection
4787-01	TK 101	Liquid	Site: Not Available Date: December 26, 1990 Time: 1500 hrs

Laboratory Information

Sample ID	Preservation Status Upon Acceptance	Date/Time Received
TK 101	Properly preserved and collected.	Date: December 26, 1990 Time: 1600 hrs

REPORT RELEASED BY: [signature]

FRONTIER ENVIRONMENTAL LABORATORIES, INC.

4626 Royal Avenue • M.P.O. Box 309 • Niagara Falls, New York 14302 • Phone (716) 285-2587 — FAX (716) 285-3521

DATE: January 23, 1991

ELAP # 10797

ANALYSIS FOR: Frontier Chemical Waste Process, Inc.

FEL# 4787-01

PARAMETER	DETECTION LIMIT ppb	RESULTS ppb
PCB	10.0	<DL
Endosulfan	2.0	<DL
Mirex	1.0	<DL
Endosulfan Sulfate	6.0	<DL
Dechlorane Plus	5.0	<DL
Heptachlor	1.0	<DL

DL = Detection Limit

TEST METHOD: EPA SW-846 (8080)

FRONTIER ENVIRONMENTAL LABORATORIES, INC.

4626 Royal Avenue • M.P.O. Box 309 • Niagara Falls, New York 14302 • Phone (716) 285-2587 — FAX (716) 285-3521

DATE: January 23, 1991

ELAP # 10797

ANALYSIS FOR: Frontier Chemical Waste Process, Inc.

FEL# 4787-01

SAMPLE ID	TEST	TEST METHOD	DETECTION LIMIT	RESULTS
TK-101	Cyanide	EPA SW-846 (9010)	0.36 ppm	<DL
	Phenol	EPA 1979 (420.1)	0.15 ppm	0.184 ppm
	Phosphorus	EPA 1979 (365.2)	0.016 ppm	0.09 ppm
	SOC	EPA SW-846 (9060)	1.00 ppm	100 ppm
	pH	EPA 1979 (150.1)	NA	8.27 @ 19.3° C
	Total Suspended Solids	EPA 1979 (160.3)	10 ppm	31 ppm

DL = Detection Limit

NA = Not Applicable

FRONTIER ENVIRONMENTAL LABORATORIES, INC.

4626 Royal Avenue • M.P.O. Box 309 • Niagara Falls, New York 14302 • Phone (716) 285-2587 — FAX (716) 285-3521

QUALITY ASSURANCE/QUALITY CONTROL DATA

CUSTOMER NAME: Frontier Chemical Waste Process, Inc.

FEL# 4787

SAMPLE ID#	PARAMETER	DUPLICATE RPD	SPIKE %,RECOVERY	QUANTITY OF SPIKE ADDED	QC CHECK % TV
TK 101	Cyanide	(2)*	87	10 ppm	101
	Phenol	3.86*	100	20 ppm	89
	Phosphorus	(2)*	112	0.5 ml	89
	SOC	5.1*	103	30 ppm	108
*	PCB	10.3	64.2	1.0 ppm	108

RPD = Relative Percent Difference

TV = True Value

* Quality Control results were generated from samples of similar matrix analyzed simultaneously with the FEL number referenced above.

FRONTIER ENVIRONMENTAL LABORATORIES, INC.

4626 Royal Avenue • M.P.O. Box 309 • Niagara Falls, New York 14302 • Phone (716) 285-2587 — FAX (716) 285-3521

DATE: January 23, 1991

ELAP# 10797

ANALYSIS FOR: Frontier Chemical Waste Process, Inc.

FEL# 4787-01

SAMPLE ID		TEST METHOD	DETECTION LIMIT ppm	RESULT ppm
TK-101	Cadmium	EPA SW-846 (7130)	0.01	0.03
	Chromium	" " (7190)	0.01	0.11
	Copper	" " (7210)	0.01	0.41
	Lead	" " (7420)	0.01	0.16
	Mercury	" " (7470)	0.0002	0.0005
	Nickel	" " (7520)	0.02	0.23
	Zinc	" " (7950)	0.01	0.74

TOTAL METALS DIGESTION METHOD: EPA SW-846 (3010)

FRONTIER ENVIRONMENTAL LABORATORIES, INC.

4626 Royal Avenue • M.P.O. Box 309 • Niagara Falls, New York 14302 • Phone (716) 285-2587 — FAX (716) 285-3521

QUALITY ASSURANCE/QUALITY CONTROL DATA

CUSTOMER NAME: Frontier Chemical Waste Process, Inc.

FEL# 4787

SAMPLE ID#	PARAMETER	DUPLICATE RPD	SPIKE %,RECOVERY	QUANTITY OF SPIKE ADDED	QC CHECK % TV
*	Cadmium	1.8	98.4	0.50 ppm	100.1
	Chromium	2.2	103.7	1.00 ppm	95.5
	Lead	6.1	94.4	1.00 ppm	97.8
	Mercury	3.5	97.3	0.005 ppm	94.9
TK 101	Copper	4.9	100.5	1.00 ppm	99.9
	Nickel	8.7	96.0	1.00 ppm	96.2
	Zinc	2.7	100.3	0.20 ppm	101.3

RPD = Relative Percent Difference

TV = True Value

* Quality Control results were generated from samples of similar matrix analyzed simultaneously with the FEL number referenced above.

FRONTIER ENVIRONMENTAL LABORATORIES, INC.

4626 Royal Avenue • M.P.O. Box 309 • Niagara Falls, New York 14302 • Phone (716) 285-2587 — FAX (716) 285-3521

DATE: January 23, 1991

ELAP # 10797

ANALYSIS FOR: Frontier Chemical Waste Process, Inc.

FEL# 4787-01 SAMPLE ID: TK-101

PARAMETER	DETECTION LIMIT μg/L	RESULTS μg/L
Benzene	4.0	99.0
Carbon Tetrachloride	4.0	6.2
Chlorodibromomethane	40.0	<DL
Monochlorobenzene	4.0	336
Dichlorobromomethane	40.0	<DL
Chloroform	4.0	20.6
Dichloroethylene	4.0	16.4
Bromoform	40.0	<DL
Dichloropropylenes	40.0	<DL
Ethylbenzene	4.0	32.6
Tetrachloroethanes	40.0	<DL
Tetrachloroethylene	4.0	998
Toluene	4.0	276
Trichlorothanes	4.0	91.0
Trichloroethylene	4.0	2940
Methylene Chloride	4.0	11.0
Monochlorotoluenes	4.0	462
Monochlorobenzotrifluoride	40.0	<DL

DL = Detection Limit

TEST METHOD: EPA SW-846 (8260)

SURROGATE RECOVERIES	% RECOVERY
1,2-Dichloroethane D4	92
Toluene D8	91
4-Bromofluorobenzene	93

FRONTIER ENVIRONMENTAL LABORATORIES, INC.

4626 Royal Avenue • M.P.O. Box 309 • Niagara Falls, New York 14302 • Phone (716) 285-2587 — FAX (716) 285-3521

DATE: January 23, 1991
ELAP # 10797
ANALYSIS FOR: Frontier Chemical Waste Process, Inc.
FEL# 4787-01 SAMPLE ID: TK-101

PARAMETER	DETECTION LIMIT µg/L	RESULTS µg/L
Monochlorophenol	10.0	<DL
Dichlorophenol	10.0	<DL
Monochlorocresol	10.0	<DL
Trichlorophenol	10.0	<DL
Hexachlorocyclohexanes	10.0	<DL
Dimethyl Phthalate	10.0	<DL
Butyl Benzyl Phthalate	10.0	<DL
Dibutyl Phthalate	10.0	<DL
Nitrosodiphenylamine	10.0	<DL
Dichlorobenzenes	10.0	209.4
Dichlorotoluene	10.0	<DL
Acenaphthene	10.0	<DL
Fluoranthene	10.0	<DL
Chrysene	10.0	<DL
Naphthalene	10.0	<DL
Benzo(a)Anthracene	10.0	<DL
Pyrene	10.0	<DL
Trichlorobenzene	10.0	<DL
Trichlorotoluene	10.0	<DL
Hexachlorobutadiene	10.0	<DL
Hexachlorobenzene	10.0	<DL
Dichlorobenzotrifluoride	10.0	<DL
Phenanthrene	10.0	<DL
Hexachlorocyclopentadiene	10.0	<DL
Tetrachlorobenzene	10.0	<DL

DL = Detection Limit
TEST METHOD: EPA SW-846 (8270)

SURROGATE RECOVERIES	% RECOVERY
Phenol D6	23
2-Fluorophenol	30
Nitrobenzene D5	53
2-Fluorobiphenyl	54
2,4,6-Tribromophenol	86
4-Terphenyl D14	73

FRONTIER ENVIRONMENTAL LABORATORIES, INC.

4626 Royal Avenue • M.P.O. Box 309 • Niagara Falls, New York 14302 • Phone (716) 285-2587 — FAX (716) 285-3521

QUALITY ASSURANCE/QUALITY CONTROL DATA

CUSTOMER NAME: Frontier Chemical Waste Process, Inc.

FEL# 4787

SAMPLE ID #	PARAMETER	MATRIX SPIKE DUPLICATE RPD	MATRIX SPIKE % REC	QUANTITY OF SPIKE ADDED
*	1,1-Dichloroethene	13	95	250 ng
	Trichloroethene	8	92	250 ng
	Benzene	8	98	250 ng
	Toluene	11	83	250 ng
	Chlorobenzene	9	96	250 ng
	Phenol	12	24	200 ng
	2-Chlorophenol	2	55	200 ng
	1,4-Dichlorobenzene	0	54	100 ng
	N-Nitroso-Di-Propylamine	14	62	100 ng
	1,2,4-Trichlorobenzene	15	58	100 ng
	4-Chloro-3-Methylphenol	0	46	200 ng
	Acenaphthene	3	71	100 ng
	4-Nitrophenol	9	11	200 ng
	2,4-Dinitrotoluene	15	64	100 ng
	Pentachlorophenol	45	86	200 ng
	Pyrene	14	84	100 ng

RPD = Relative Percent Difference

TV = True Value

* Quality Control results were generated from samples of a similar matrix.

APPENDIX C

Sampling and Analysis Plan

1.0 INTRODUCTION

This Sampling and Analysis Plan has been prepared to present the protocol to be followed during performance monitoring of the interim remedial measure to be implemented at Frontier Chemical Waste Process, Inc., Niagara Falls, New York.

The performance monitoring program includes sampling of on-site ground water wells and adjacent tunnel system and is discussed in the text to which this document is an appendix.

2.0 GROUNDWATER

2.1 Monitoring Well Preparation for Sampling

Prior to sampling, all wells will be prepared by purging, as set forth in the following discussion. Purge water from all wells will be collected and visually inspected for DNAPL. If DNAPL has not been collected for analyses from a well prior to this inspection, identified DNAPL in the purge water will be collected if practicable and submitted for analyses.

All bedrock wells will be purged a minimum of five well volumes prior to sample collection. There are no restrictions on the pumping rate used during purging of the bedrock wells.

The intake of the pump or sample tubing will be placed in the well into the top of the open cored interval unless physical restrictions interfere with such placement. In such instances, the intake of the pump will be set as close to the top of the open cored interval as possible.

A sample from at least each well volume interval will be analyzed for temperature, pH and conductivity to ensure that the well has been sufficiently purged prior to sampling. Sufficient purging will be indicated by stabilization of consecutive temperature and conductivity measurements to within plus or minimum 10 percent of the stable value and plus or minus 1 pH unit over the last three well volumes. If stabilization is not achieved after eight well volumes have been pumped, such stabilization will not be required as a precondition to sampling. It is to be noted that once the required number of well volumes to reach stabilization has been determined for a particular well, no additional well stabilization testing will be undertaken.

The static water level will be measured in each well prior to and at the completion of purging. The volume pumped and time when pumping is initiated will also be documented.

2.2 Monitoring Well Sampling

2.2.1 Water Level Measurement

Measurement of the water level for the monitor wells is realized with a measuring tape that has an electrical sensor. The device should provide readings accurate to 0.05 foot. Prior to its use, the probe and wire is cleaned in accordance with the protocols in Frontier's Quality Assurance Project Plan (QAPjP) and rinsed with Deionized Water between wells. Each well shall have a reference point which has been established with respect to United States Geologic Survey (USGS) datum. Data is recorded in a notebook and should include:

a. Date/Time
b. Barometric pressure for the day
c. Monitor well I.D.
d. Water level (top of casing)
e. Depth of water in well
f. Initial of person taking measurement

2.2.2 Groundwater Sampling

Wells are sampled after purging and when the volume of water is adequate to provide for the sample volumes. Should a well not produce the full sample volume over a maximum of four days, it is then considered non-sampleable.

Teflon/stainless steel bailers are used for collecting groundwater samples. The groundwater is placed directly into laboratory supplied containers from the bailers. Since the parameters of interest with this project are the Volatile Organic Compounds, the sampling will be restricted to the above which requires 40 ml glass vials with teflon-lined septa. The transfer of the groundwater is conducted over a pail to contain any spillage that might occur. Groundwater spillage is transferred into 55-gallon drums along with purge water.

After collection, the samples are labeled, stickered with custody seals and placed into coolers that contain ice or pre-cooled cooler packs. Chain-of-custody documentation is initiated. The samples are then delivered to the laboratory.

2.2.3 Field Parameters

During sampling for groundwater, the following field parameters will be obtained:

a. pH
b. Conductivity
c. Temperature
d. Physical appearance
e. Turbidity

The above are appropriately recorded. All field measurement meters, where appropriate, will be calibrated prior to initiating the sampling activities on a daily basis. All calibration measurements will be properly recorded.

3.0 ADJACENT TUNNELS

Sampling and analysis will be performed at locations within both the 47th Street tunnel and the Falls Street tunnel. In order to properly characterize the quality of the water within the tunnel systems, 4 water samples will be obtained at 6-hour intervals, over a 24-hour period at each tunnel sampling location.

All water samples will be collected by means of utilizing pre-cleaned, dedicated, stainless steel bailers lowered into the aqueous stream. During the sampling, the following field parameters will also be monitored and recorded:

- Specific conductivity,
- pH,
- Temperature,
- Flow, and
- Physical appearance (odor, color, clarity).

Field measurements of pH, specific conductivity, and temperature will be obtained by means of a Cole-Palmer Instruments, Co., Digisense pH Meter, Model No. 5995, and a Cole-Palmer Instruments, Co., Conductivity Meter Model No. 1481-55. Flow measurements will be obtained by means of a Marsh-McBirney, Inc., Model 201 Portable Liquid Flowmeter, or equivalent. All equipment will be calibrated prior to use.

All water samples will be collected in accordance with accepted U.S. EPA and/or NYSDEC protocols. During each sampling event and at each sample location, two (2) liters of aqueous sample will be obtained and placed in pre-cleaned, one-liter amber glass sample containers. Each container will be labeled with the following items:

- date and time of sample event
- sampling point/location

The samples will then be preserved (i.e., chilled to 4°C), chain of custody initiated and the samples delivered to Frontier Environmental Laboratories for subsequent compositing and analysis. Upon completion of the four sampling events, a proportional composite will be prepared for each sampling point in the laboratory for subsequent analysis.

4.0 ANALYTICAL PROGRAM

The proposed analytical program to be performed on the composite aqueous samples will consist of the following parameters:

- Priority Pollutant Volatile Organics (U.S. EPA Method 8240), plus Acetone, 2-Butanone, 4-methyl-2-Pentanone, total Xylenes, total Monochlorotoluenes

The analytical methodology during the performance of the aforementioned analytical program is presented in Frontier's Quality Assurance Project Plan (QAPjP).