TARRYTOWN FORMER MGP SITE
NORTHERN DNAPL BARRIER AND COLLECTION TRENCH
REMEDIAL DESIGN REPORT
TARRYTOWN, NEW YORK
December 2003

by

Haley & Aldrich of New York
Rochester, New York

for

New York State Department of Environmental Conservation
Albany, New York

File No. 28590-002
December 2003

HALEY & ALDRICH

UNDERGROUND
ENGINEERING &
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HALEY & ALDRICH

23 December 2003
File No. 28590-002

Bureau of Construction Services
Division of Environmental Remediation
New York State Department of Environmental Conservation
625 Broadway, 12th Floor
Albany, New York 12233-7013

Attention: Lech M. Dolata

Subject: Tarrytown Former MGP Site
Northern DNAPL Barrier and Collection Trench
Remedial Design Report
Tarrytown, New York

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Dear Mr. Dolata:

On behalf of National RE/sources, Haley & Aldrich of New York (Haley & Aldrich) is pleased to present this Tarrytown Former MGP Site - Northern DNAPL Barrier and Collection Trench Remedial Design Report for your approval. A description of the planned Northern DNAPL Area remediation and supporting drawings are contained herein. This report addresses the comments presented in your16 December 2003 letter.

The identified scope of remediation is based on the 22 July 2003 Revised Conceptual Remediation Plan prepared by Haley & Aldrich. The remediation will be performed under the provisions of the New York State Department of Environmental Conservation (NYSDEC) Voluntary Cleanup Program.

This is one in a series of Remedial Design Documents submitted to NYSDEC, as outlined in the Conceptual Remediation Plan. Prior submittals include the design reports for remediation of the Holder and Tar Well Area, the LNAPL Area and the Western DNAPL Area. Additionally, a Site Management Plan, including a Soil Management Plan for post-remediation use of the site has been submitted.

BACKGROUND

The site is located on the east side of the Hudson River, north of the Tappan Zee Bridge, in the Village of Tarrytown, New York, as shown on Drawing T-1. The site plan is shown on

Drawing C-1 (see Appendix A). The site encompasses approximately 20 acres, and is primarily industrial-commercial in use.

The main activities on the site are an asphalt batch plant in the northwest portion and a trucking terminal and maintenance facility in the southeast portion. The central portion of the site includes a former manufactured gas plant (MGP), reportedly operated between 1873 and 1938. The operational boundary and outlines of former structures of the MGP, derived from Sanborn™ maps, are shown on Drawing C-1. The MGP was last operated by the Westchester Lighting Company, which has been succeeded in ownership by the Consolidated Edison Company of New York, Inc. (Con Edison).

As described in a number of previous reports (see References), the site exhibits contamination in several areas that are derived either from the former MGP or from former fuel storage and handling operations. This remedial design report addresses contamination associated with DNAPL generally located within the northern portions of the site. The work area is shown on Drawing C-1.

REMEDIAL ACTION

Description

The Northern DNAPL Area, as shown on Drawing C-1, is located underneath the existing County Asphalt office building, and is depicted (Parsons, 2000) to be about 500 feet long and 200 feet wide. The primary environmental concern in this area is soil affected by discrete zones saturated with DNAPL (presumably coal tar), as observed in soil borings SB-7, SB-10, SB-16 and SB-19 and in monitoring wells MW-11, MW-13 and MW-26. The subject zones are located between 12 and 15 ft below ground surface (b.g.s.) on the west side of the building and between 9 and 13 ft b.g.s. on the east side. The zone of saturation appears at the bottom of the fill, and extends zero to one foot into the top of the natural soil layer. The natural soil layer is apparently of low permeability and exhibits an increase in clay content with depth, thus providing a barrier to vertical downward migration of the DNAPL.

Purpose

The saturated zone of DNAPL is well below grade (deeper than 9 ft) and therefore isolated from surface activities. The purpose of the remedial action for the Northern DNAPL Area is to prevent potential westward migration by installing a barrier and to facilitate DNAPL recovery capability up-gradient from the barrier.

NORTHERN DNAPL AREA REMEDIAL DESIGN DESCRIPTION

This section describes the features of the two main components of the remedial design for the Northern DNAPL Area: the barrier and the recovery trench. Design drawings are provided in Appendix A. Technical specifications prepared for the Northern DNAPL Barrier and Recovery Trench describe the scope of work (01012), construction dewatering (02150), excavation and backfill (02200), degradable slurry collection trench (02410), and the barrier steel sheet piling (02161) and are included in Appendix B.

Barrier

As shown on Drawing C-2, a maximum 360-foot long barrier, located to the west of the depicted limits of the Northern DNAPL Area is proposed. Soil borings SB-14, SB-15, SB-20, SB-21, SB-22 and SB-23 indicate that there are no zones of soil saturated with DNAPL crossed by the proposed barrier. The barrier will consist of watertight sheeting, driven approximately five feet into the lower permeability silty clay. Slots will be cut into the portion of the sheets extending from a point one foot above the top of the recovery trench drainage stone to the high groundwater level. Slots will be cut approximately 8.26 ft center-to-center. This will allow groundwater to pass the barrier. The barrier will be cut off at least three feet below the ground surface.

Recovery Trench

A recovery trench will be installed on the up-gradient side of the barrier wall. The trench will be approximately 360 feet long and reach depths ranging from 17 to 18.5 feet below ground surface. The collection media will extend from the bottom of the trench to approximately four feet below ground surface (a depth such that the slurry is not needed to support the trench walls). From that depth to the surface the recovery trench will be backfilled with ordinary fill.

The recovery trench will be constructed after the barrier is in place using biopolymer slurry methods. The biopolymer slurry has a minimum unit weight of about 63 pounds per cubic foot and is used to hold the trench open during excavation and backfilling. At the completion of the excavation and backfill, an enzyme is introduced to break down the polymer. This 'broken' slurry is then removed from the trench, as discussed below.

Proper construction of a biopolymer-supported excavation requires good mixing of the biopolymer, careful excavation management, use of adequate enzyme for breakdown of the biopolymer, and adequate flushing of the polymer from the constructed matrix.

The proper mixing of the slurry is important because unmixed polymer, once trapped in the drainage stone pore space, may become difficult to breakdown and/or remove. To ensure

proper mixing, an eductor will be used to prevent the formation of unmixed balls of polymer powder (commonly referred to as "fish eyes").

During trenching, a steel caisson pipe will be used to separate the excavation area, where soil particles from the excavation are being temporarily suspended in the slurry, from the gravel backfilling area. This will minimize the amount of unwanted soil particles trapped in the collection stone pore space. Also during excavation, when a section has been excavated to grade, the excavation will stop for a period of 15 to 30 minutes to allow the soil that is temporarily suspended to settle to the trench bottom. Once on the bottom, the excavator can be used to carefully remove the sediment while minimizing the amount that is re-suspended.

Excess slurry that may be generated by displacement when the permeable backfill is placed will be pumped to a temporary storage tank on site. After the recovery trench has been developed, the slurry left in the temporary tank will be broken in the tank. The broken slurry will be sent to the sediment dewatering area, for ultimate treatment an at the on-site water treatment plant.

At the completion of the trench installation, or portions thereof, there will be excess biopolymer slurry in the trench and within the pore space of the gravel backfill material. In order to re-establish the permeability of the surrounding soils and to permit groundwater to flow into and through the trench, it is necessary to breakdown the biopolymer slurry. The biopolymer slurry breakdown is accomplished by: 1) breaking down the polymer to simply carbohydrates (sugars), and 2) encouraging native soil microbes to consume the carbohydrates, and, if necessary 3) polishing.

The steps taken to ensure breakdown of the biopolymer slurry as described in the following paragraphs. During the trenching operations, temporary wells will be installed within the permeable backfill, typically placed at 50 to 100 foot spacing. Pumps are set up to withdraw slurry form the temporary wells and surcharge the slurry over the surface of the permeable backfill. The set up of the pump permits circulating slurry from the well over the backfill and back to the well. The opposite circulation direction (from slurry into well) may be equally as effective. Each well is pumped in turn, multiple pumps may be used.

The pH of the slurry is adjusted to match the optimum range of the enzyme breaker. Controlled amounts of muriatic acid or lime soda ash may be added to the slurry for pH adjustment. Additives are diluted with water or slurry prior to adding to the trench while continuously pumping.

After the pH of the slurry is satisfactory, the liquid enzyme breaker is added while continuing to circulate the slurry. Enzyme breaker is added at a rate necessary to break the slurry and is adjusted based on observations during the recirculation process. The enzyme breaker addition is generally in the range of 1 gallon enzyme breaker per 4,000 to 20,000 gallons slurry. A Marsh Funnel viscosity less than 30 seconds is indicative that the slurry has been broken. In

proper mixing, an eductor will be used to prevent the formation of unmixed balls of polymer powder (commonly referred to as "fish eyes").

During trenching, a steel caisson pipe will be used to separate the excavation area, where soil particles from the excavation are being temporarily suspended in the slurry, from the gravel backfilling area. This will minimize the amount of unwanted soil particles trapped in the collection stone pore space. Also during excavation, when a section has been excavated to grade, the excavation will stop for a period of 15 to 30 minutes to allow the soil that is temporarily suspended to settle to the trench bottom. Once on the bottom, the excavator can be used to carefully remove the sediment while minimizing the amount that is re-suspended.

Excess slurry that may be generated by displacement when the permeable backfill is placed will be pumped to a temporary storage tank on site. After the recovery trench has been completed and developed, the slurry left in the temporary tank will be broken in the tank and the broken slurry will be returned to the trench via either the temporary or permanent wells.

At the completion of the trench installation, or portions thereof, there will be excess biopolymer slurry in the trench and within the pore space of the gravel backfill material. In order to re-establish the permeability of the surrounding soils and to permit groundwater to flow into and through the trench, it is necessary to breakdown the biopolymer slurry. The biopolymer slurry breakdown is accomplished by: 1) breaking down the polymer to simply carbohydrates (sugars), and 2) encouraging native soil microbes to consume the carbohydrates, and, if necessary 3) polishing.

The steps taken to ensure breakdown of the biopolymer slurry as described in the following paragraphs. During the trenching operations, temporary wells will be installed within the permeable backfill, typically placed at 50 to 100 foot spacing. Pumps are set up to withdraw slurry form the temporary wells and surcharge the slurry over the surface of the permeable backfill. The set up of the pump permits circulating slurry from the well over the backfill and back to the well. The opposite circulation direction (from slurry into well) may be equally as effective. Each well is pumped in turn, multiple pumps may be used.

The pH of the slurry is adjusted to match the optimum range of the enzyme breaker. Controlled amounts of muriatic acid or lime soda ash may be added to the slurry for pH adjustment. Additives are diluted with water or slurry prior to adding to the trench while continuously pumping.

After the pH of the slurry is satisfactory, the liquid enzyme breaker is added while continuing to circulate the slurry. Enzyme breaker is added at a rate necessary to break the slurry and is adjusted based on observations during the recirculation process. The enzyme breaker addition is generally in the range of 1 gallon enzyme breaker per 4,000 to 20,000 gallons slurry. A Marsh Funnel viscosity less than 30 seconds is indicative that the slurry has been broken. In

some cases polishing is performed using hydrogen peroxide as an aid in breaking the slurry. Peroxide is added at the rate of up to 500 ppm while circulating slurry.

A bio-starter may be added after the slurry has been broken to help initiate microbe activity. The bio-starter is a mixture of natural materials, such as peat moss or compost, added to introduce beneficial natural microbes.

Pumping and re-circulation continues after the slurry has been broken until a minimum of three pore volumes of the trench are circulated to flush and develop the trench.

The recovery trench will extend one to two feet into the silty clay layer. Six recovery wells will be installed, spaced evenly along the trench alignment. The bottom of the recovery trench will be sloped at five percent toward each well, with high points at the midpoint between each well. The backfill will be permeable stone from the bottom to at depth below ground surface such that the trench sides are safely self-supported and excavated soils thereafter. A geotextile will separate the permeable stone from the subsequently placed fill soils.

Two observation wells will be installed. One will be located 10 to 15-feet from each end of the recovery trench (pending clearance of site obstructions) to enable detection of mobile DNAPL that may possibly migrate around the ends of the recovery trench.

Management of excavated soils and excavation water will be similar to that previously described for the Western DNAPL recovery trench. In the Northern DNAPL area, the soil above the high water table is uncontaminated. It will be stockpiled and used later as backfill. The soil below may or may not exhibit some low level of MGP contamination (odor, sheen, and blebs) and will be field screened to determine if it needs to be disposed at a permitted facility off site.

Water that collects and needs management in the excavation will be pumped from the excavation, and sent to the on-site water treatment system, prior to discharge. Discharge will comply with the NYSDEC-approved Construction Water Management Plan, prepared by D.A. Collins Environmental Services, dated September 8, 2003.

SOIL TREATMENT AND/OR DISPOSAL

Soil thermal treatment and/or disposal will be done off site at an appropriately permitted facility. Construction and demolition debris will be disposed off site at a permitted facility. If the on-site petroleum-contaminated or MGP-contaminated soils are found to be suitable, approval from NYSDEC will be sought for beneficial use of the contaminated soil in the manufacturing of asphalt.

SCHEDULE

The remedial action described above is expected to take approximately fourteen weeks once work permits are in place and equipment and materials have been mobilized.

CLOSURE

Your consideration of this design report and approval within the near future would be most appreciated in order for work to begin. Please contact us if you need more information.

Sincerely yours,
HALEY & ALDRICH OF NEW YORK

Jonathan D. Babcock, P.E.
Senior Engineer

Wayne C. Hardison, P.E.
Vice President

Enclosures:

References
Appendix A Design Drawings
- Drawing T-1 Project Notes and Drawing List
- Drawing C-1 Site Plan Showing Access Control
- Drawing C-2 Remedial Action Plan
- Drawing C-3 Construction Details

Appendix B Technical Specifications
- 01012 Scope of Work
- 02150 Construction Dewatering
- 02161 Northern DNAPL Barrier Steel Sheet Piling
- 02200 Excavation and Backfill
- 02410 Degradable Slurry Collection Trench

G:\Projects\28590\002 Predesign Phase I\Northern DNAPL Barrier and Collection Trench\report\rev 12-23-03 final north dnapl design report.doc

REFERENCES

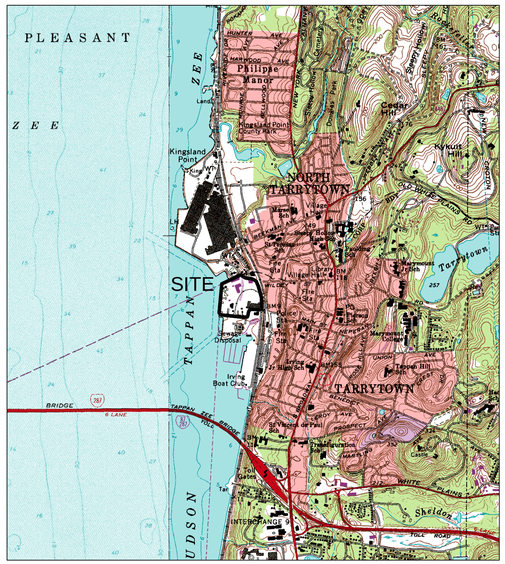
1990	Metcalf & Eddy	Preliminary Soil Gas Survey Results, Leaseway Motorcar Transportation Corporation, Tarrytown, New York.
	Metcalf & Eddy	Site Assessment for Anchor Motor Freight, Inc., Tarrytown, New York.
	Metcalf & Eddy	Remedial Action Plan for Anchor Motor Freight, Inc, Tarrytown, New York.
	Metcalf & Eddy	Underground Storage Tank Removal, Valente Industries, Tarrytown, New York.
	Metcalf & Eddy	New Trench Drain System, Anchor Motor Freight, Inc., Tarrytown, New York.
	Metcalf & Eddy	Geoprobe Subsurface Investigations, Leaseway Motorcar Transportation Corporation, Tarrytown, New York.
	Woodward-Clyde	Results of Geophysical Survey, Leaseway Motorcar Transportation Corporation, Tarrytown, New York.
	Rust	Site Environmental History, Anchor Motor Freight, Inc. Tarrytown, New York.
	RETEC	Site Investigation, Anchor Motor Freight, Inc. Tarrytown, New York.
	Rust	Underground Storage Tank Field Observation Report, Leaseway Motorcar Transportation Corporation, Tarrytown, New York.
	Parsons Engineering Science	Site Investigation Report for the Tarrytown Site, ConEdison, Tarrytown, New York.
1998	Parsons Engineering Science	Sediment Remediation Engineering Evaluation Report for the Tarrytown Site, ConEdison, Tarrytown, New York.
	Parsons Engineering Science	Supplemental Site Investigation Report Tarrytown Former MGP Site, ConEdison, Tarrytown, New York.
	Handex	Site Status Report, Penske Truck Leasing, Tarrytown, New York.
	Parsons Engineering Science	Supplemental Sediment Sampling Report Tarrytown Former MGP Site, ConEdison, Tarrytown, New York.
	Parsons Engineering Science	Supplemental Site Investigation Report, Tarrytown Former MGP Site, ConEdison, Tarrytown, New York.
	Haley & Aldrich	Supplemental Site Investigation – Spring 2003, Tarrytown Former MGP Site, Tarrytown, New York
	Haley & Aldrich	Pre-Design Investigation Report, Tarrytown Former MGP Site, Tarrytown, New York
	Haley & Aldrich	Western DNAPL Barrier and Sediment Removal, Remedial Design Report, Tarrytown Former MGP Site, Tarrytown, New York
	Haley & Aldrich	Holder and Tar Well, Remedial Design Report, Tarrytown Former MGP Site, Tarrytown, New York

APPENDIX A

Design Drawings

TARRYTOWN PROPERTY DEVELOPMENT
TARRYTOWN FORMER MGP SITE
NORTHERN DNAPL BARRIER AND RECOVERY TRENCH REMEDIATION

PROJECT LOCUS



SCALE: 1" = APPROX. 2000'

PROJECT NOTES

1. THE WORK OF THIS CONTRACT SHALL COMPLY WITH ALL CONTRACT REQUIREMENTS AND ALL NATIONAL, STATE, AND LOCAL LAWS, REGULATIONS, REQUIREMENTS AND STANDARDS INCLUDING, BUT NOT LIMITED TO OSHA.

2. CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS, EQUIPMENT AND SUPERVISION NECESSARY TO COMPLETE THE WORK AS SHOWN, INDICATED AND/OR REQUIRED FOR ALL ITEMS TO BE COMPLETE AND PROPERLY OPERABLE.

3. CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATION OF WORK WITH OWNER AND SITE TENANTS. COORDINATE WORK WITH FACILITY OPERATIONS TO MAINTAIN FACILITY TRAFFIC.

4. CONTRACTOR SHALL BE RESPONSIBLE TO RESTORE TO MATCH ORIGINAL CONDITIONS ANY AND ALL ITEMS DAMAGED AS A RESULT OF THE WORK OF THIS CONTRACT, AND UPON COMPLETION OF THE WORK CLEAN THE AREAS TO THE SATISFACTION OF NATIONAL RE/SOURCES AND ITS REPRESENTATIVE AS IDENTIFIED IN THE CONTRACT DOCUMENTS. DAMAGE TO UTILITIES SHALL BE REPAIRED TO STANDARDS ACCEPTABLE TO THE APPLICABLE UTILITY OWNER.

5. CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING SCAFFOLDING, BARRICADES, PROTECTIVE PLASTIC COVERS, WARNING SIGNS AND FIRE EXTINGUISHERS, ERECTING AND MAINTAINING TEMPORARY WORK, SHORING, ETC. AS MAY BE REQUIRED FOR PROTECTION OF THOSE AREAS IN OR ABOUT THE SITE.

6. CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD VERIFYING ALL EXISTING CONDITIONS, INCLUDING, BUT NOT LIMITED TO, THE LOCATIONS, DIMENSIONS AND SIZES OF ALL OBSTACLES, ADJACENT FACILITIES AND OVERHEAD AND UNDERGROUND UTILITIES AND APPURTENANCES PRIOR TO COMMENCING WORK.

7. CONTRACTOR SHALL FIELD MEASURE AND VERIFY ALL EXISTING CONDITIONS. DISCREPANCIES SHALL BE REPORTED TO THE OWNER'S REPRESENTATIVE AND RESOLVED PRIOR TO PROCEEDING WITH THE WORK.

8. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL FAMILIARIZE HIMSELF WITH EXISTING CONDITIONS AND DOCUMENT THEM WITH PHOTOGRAPHS AND/OR VIDEO.

9. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR ALL SAFE WORKING CONDITIONS AND SHALL OBSERVE ALL SAFETY REQUIREMENTS ESTABLISHED BY JURISDICTIONAL AGENCIES AND THE OWNER. WHERE CONFLICTS EXIST, THE MORE STRINGENT REQUIREMENTS SHALL APPLY.

DRAWING LIST

DRAWING NO.	REV.	TITLE
T-1	C	PROJECT NOTES AND DRAWING LIST
C-1	C	SITE PLAN SHOWING SITE ACCESS CONTROLS
C-2	C	REMEDIAL ACTION PLAN
C-3	C	CONSTRUCTION DETAILS

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C	11/23/03	AGENCY REVIEW	H&A
B	11/10/03	AGENCY REVIEW	H&A
A	10/15/03	INTERNAL REVIEW	H&A

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TARRYTOWN PROPERTY DEVELOPMENT
TARRYTOWN FORMER MGP SITE
NATIONAL RE/SOURCES
TARRYTOWN, NEW YORK

PROJECT NOTES AND DRAWING LIST

Date: SEE REV. BLOCK	Scale: AS SHOWN	File No. 28590-002

Project Engineer:	JDB
Designed By:	BEBA
Drawn By:	WCA
Checked By:	JDB
Sheet No.:	1 of 1
Drawing No.	Issue
T-1	

28590/002 PREDESIGN PHASE I/NORTHERN DNAPL BARRIER AND COLLECTION TRENCH/DRAWINGS/T-1.DWG

28590/002 PREDESIGN PHASE I/NORTHERN DNAPL BARRIER AND COLLECTION TRENCH/DRAWINGS/C-1 SITE PLAN REV.DWG

BASE MAP LEGEND:

- NO PHYSICAL BOUNDS
- ADJACENT PROPERTY LINE
- PATENT & GRANT LINES
- DEED PARCEL & TAX LINE
- TAX PARCEL LINE
- EXISTING FENCE
- EXISTING STONE WALL
- EXISTING TREE LINE
- EXISTING OVERHEAD WIRES
- EXISTING UNDERGROUND WATER LINE
- EXISTING UNDERGROUND GAS LINE
- EXISTING UNDERGROUND SEWER LINE
- EXISTING UNDERGROUND STORM LINE
- EXISTING HYDRANT
- EXISTING SANITARY SEWER MANHOLE
- EXISTING CATCH BASIN
- EXISTING STORM SEWER MANHOLE
- EXISTING UTILITY POLE
- EXISTING WATER VALVE
- EXISTING GAS VALVE
- EXISTING WATER SHUT OFF
- EXISTING LIGHT POLE
- EXISTING SIGN
- LIGHT POLE
- MONITORING WELL LOCATION
- FORMER STRUCTURES
- NEW FENCE
- WORK ZONE LIMITS
- ZONES SATURATED WITH MGP DNAPL
- LENSES SATURATED WITH MGP DNAPL
- TRUCK MOVEMENT

GENERAL NOTES:

1. BASE PLAN ILLUSTRATING EXISTING SITE STRUCTURES AND FEATURES DERIVED FROM THE CHAZEN COMPANIES' DRAWING ENTITLED "ALTA/ACSM LAND TITLE SURVEY LANDS OF FERRY INVESTMENTS, LLC" DATED 12/02/02. DATE OF SURVEY WAS 12/08/98.

2. MONITORING WELL LOCATIONS DERIVED FROM PARSONS ENGINEERING SCIENCE, INC., FIGURE 3-1 ENTITLED "TOTAL BTEX CONCENTRATIONS IN SOIL SAMPLES, SUPPLEMENTAL INVESTIGATION TARRYTOWN SITE" DATED NOVEMBER 2000.

3. THE LOCATIONS OF BORINGS OBSERVED BY HALEY & ALDRICH WERE APPROXIMATELY DETERMINED IN THE FIELD WITH SURVEY TAPE MEASUREMENTS FROM PHYSICAL MAPPING FEATURES. THE LOCATION OF THE BORINGS SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

4. VERTICAL DATUM: NAVD 88.

5. HORIZONTAL DATUM: NYS PLANE EAST ZONE NAD 83.

ISSUE	DATE	REVISIONS	BY
C	11/23/03	AGENCY REVIEW	H&A
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A	10/15/03	INTERNAL REVIEW	H&A

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TARRYTOWN PROPERTY DEVELOPMENT
TARRYTOWN FORMER MGP SITE
NATIONAL RE/SOURCES
TARRYTOWN, NEW YORK

SITE PLAN SHOWING SITE ACCESS CONTROLS

Project Engineer:	JDB
Designed By:	BEBA
Drawn By:	WCA
Checked By:	JDB
Sheet No.:	1 of 1
Date:	SEE REV. BLOCK
Scale:	AS SHOWN
File No.	28590-002
Drawing No.	C-1
Issue	

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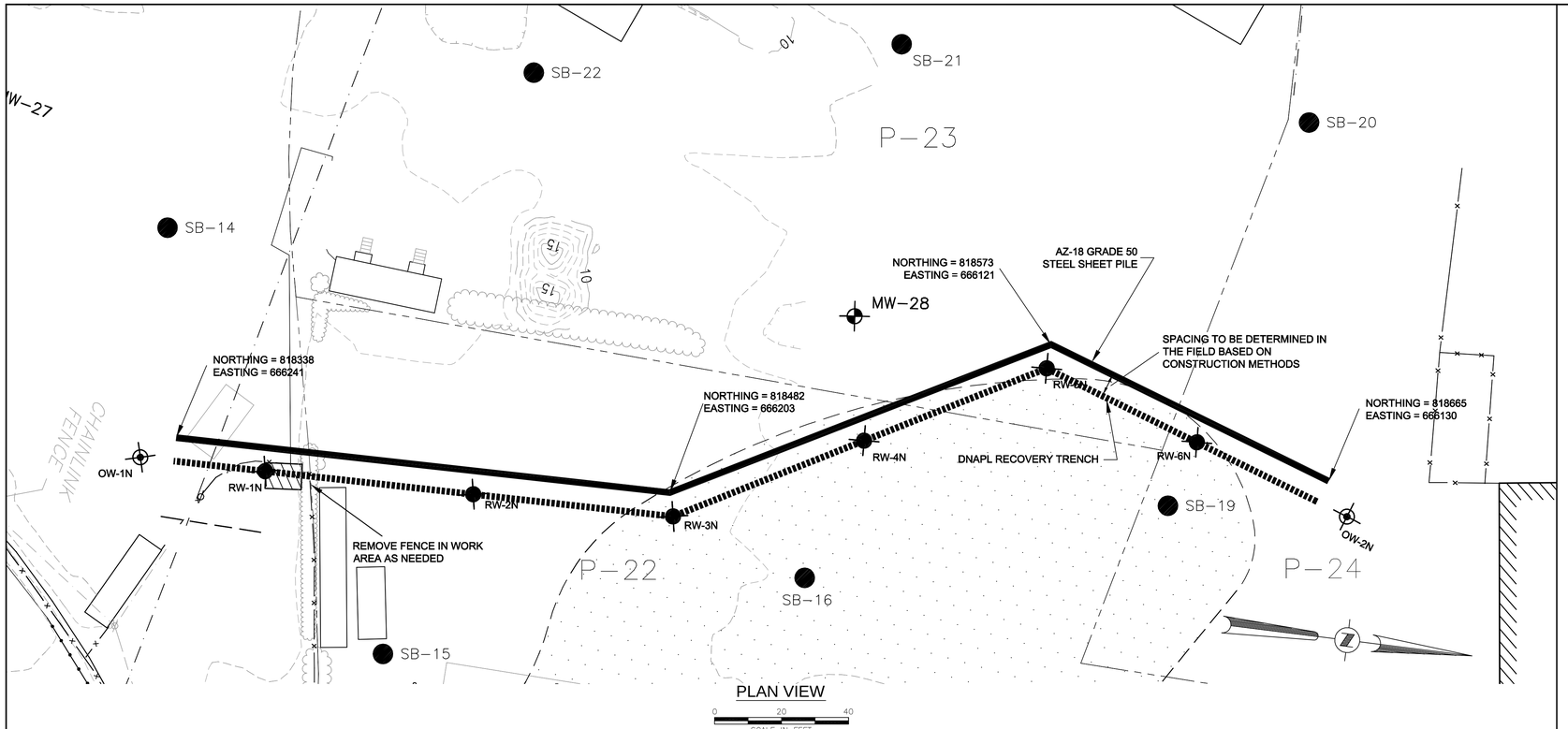
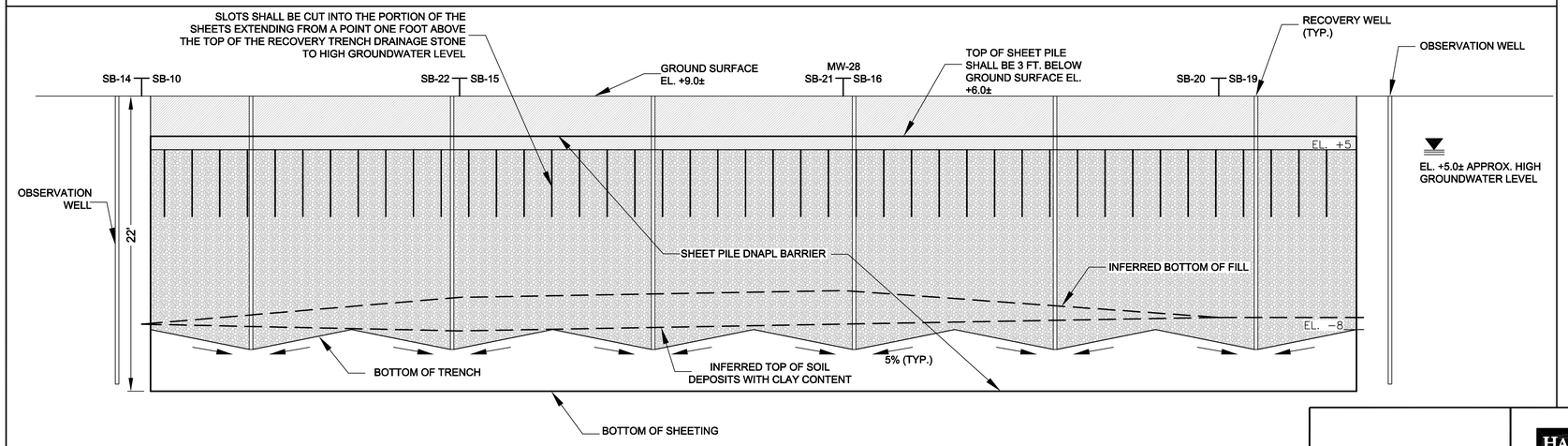
SCALE IN FEET

28590/002 PREDESIGN PHASE I/NORTHERN DNAPL BARRIER AND COLLECTION TRENCH/DRAWINGS/C-2 REMEDIAL ACTION REV.DWG





RECOVERY & BARRIER TRENCH PROFILE

0 20 40
HORIZONTAL SCALE IN FEET
0 5 10
VERTICAL SCALE IN FEET

LEGEND:

- ADJACENT PROPERTY LINE
- PATENT & GRANT LINES
- EXISTING SITE CONTOURS
- FENCE
- MW-23 — MONITORING WELL LOCATION
- RW-1N — PROPOSED RECOVERY WELLS
- OW-1N — PROPOSED OBSERVATION WELLS
- SB-16 — EXISTING SOIL BORINGS
- ZONES SATURATED WITH MGP DNAPL (SEE NOTE 2)
- ORDINARY FILL
- NYS DOT CRUSHED/WASHED GRAVEL (ITEM # 703-0201-3A)
- SB-20 — SB-19: AT THIS LOCATION, INFERRED DEPTHS OF BOTTOM OF FILL AND TOP OF SOIL DEPOSITS WITH CLAY CONTENT WERE DERIVED FROM THE INDICATED SOIL BORINGS
- P-24 — PARCEL NUMBER

GENERAL NOTES:

1. BASE PLAN ILLUSTRATING EXISTING SITE STRUCTURES AND FEATURES DERIVED FROM THE CHAZEN COMPANIES' DRAWING ENTITLED "ALTA/ACSM LAND TITLE SURVEY LANDS OF FERRY INVESTMENTS, LLC" DATED 12/02/02. DATE OF SURVEY WAS 12/08/98. TOPOGRAPHIC CONTOURS REFLECT TIME OF SURVEY. IDENTIFIED RELIEF NOT ANTICIPATED AT TIME OF CONSTRUCTION.

2. MONITORING WELL LOCATIONS & ZONES SATURATED WITH MGP DNAPL DERIVED FROM PARSONS ENGINEERING SCIENCE, INC., FIGURE 3-1 ENTITLED "TOTAL BTEX CONCENTRATIONS IN SOIL SAMPLES, SUPPLEMENTAL INVESTIGATION TARRYTOWN SITE" DATED NOVEMBER 2000.

3. THE LOCATIONS OF BORINGS OBSERVED BY HALEY & ALDRICH WERE APPROXIMATELY DETERMINED IN THE FIELD WITH SURVEY TAPE MEASUREMENTS FROM PHYSICAL MAPPING FEATURES. THE LOCATION OF THE BORINGS SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

4. SUBSURFACE PROFILES ARE APPROXIMATE ONLY AND ARE INTENDED TO PROVIDE A GENERAL ILLUSTRATION OF SITE CONDITIONS.

5. THE BORING ILLUSTRATIONS DEPICT SUBSURFACE CONDITIONS ONLY AT SPECIFIC LOCATIONS AND AT THE PARTICULAR TIME NOTED ON THE ASSOCIATED BORING REPORTS. SOIL CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURRING AT THE BORING LOCATIONS. ALSO, THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN SOIL CONDITIONS AT THESE BORING LOCATIONS.

6. THE STRATIFICATION LINES DESIGNATING THE INTERFACE BETWEEN SOIL TYPES AND BEDROCK SURFACE ON THE FIGURES REPRESENT APPROXIMATE BOUNDARIES INFERRED FROM THE SAMPLING AND DRILLING PERFORMANCE. THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.

4. VERTICAL DATUM: NAVD 88.

5. HORIZONTAL DATUM: NYS PLANE EAST ZONE NAD 83.

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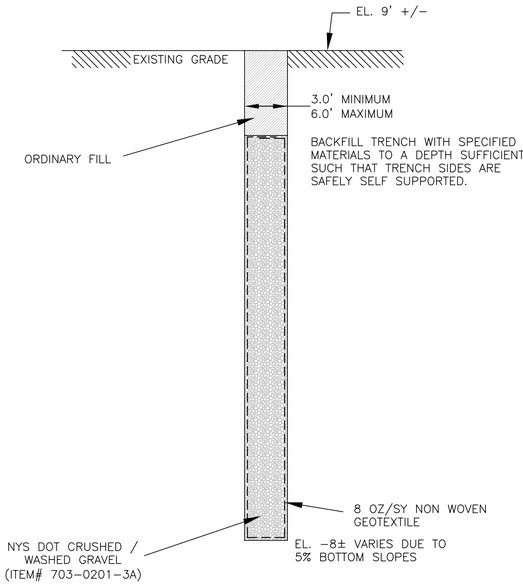
TARRYTOWN FORMER MGP SITE
NATIONAL RE/SOURCES
TARRYTOWN, NEW YORK

REMEDIAL ACTION PLAN

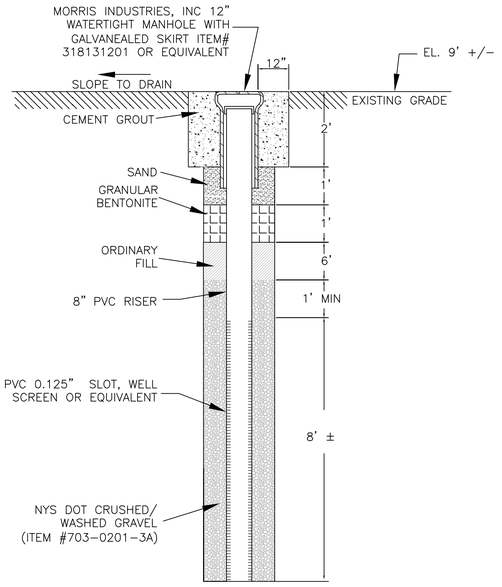
Date:	Scale:	File No.
SEE REV. BLOCK	AS SHOWN	28590-002

Project Engineer:	JDB
Designed By:	BEBA
Drawn By:	WCA
Checked By:	JDB
Sheet No.:	1 of 1
Drawing No.	C-2
Issue	



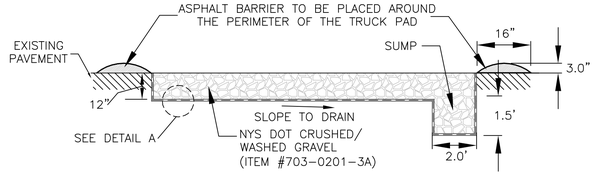
RECOVERY TRENCH SECTION

SCALE: NONE



OBSERVATION AND RECOVERY WELL DETAIL

SCALE: NONE



TRUCK TRACKING\WASH PAD DETAIL

SCALE: NONE

DETAIL A

SCALE: NONE

ISSUE	DATE	REVISIONS	BY
C	11/23/03	AGENCY REVIEW	H&A
B	11/10/03	AGENCY REVIEW	H&A
A	10/15/03	INTERNAL REVIEW	H&A

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TARRYTOWN PROPERTY DEVELOPMENT
TARRYTOWN FORMER MGP SITE
NATIONAL RE/SOURCES
TARRYTOWN, NEW YORK

CONSTRUCTION DETAILS

Date: SEE REV. BLOCK	Scale: AS SHOWN	File No. 28590-002	
0 10 20 SCALE IN FEET			

Project Engineer:	JDB
Designed By:	BEBA
Drawn By:	WCA
Checked By:	JDB
Sheet No.:	1 of 1
Drawing No.	C-3
Issue	

28590/002 PREDESIGN PHASE I/CONSTRUCTION DRAWINGS/C-6 RECOVERY DETIAL.DWG

APPENDIX B

Technical Specifications

SECTION 01012 - SUMMARY OF WORK – NORTHERN DNAPL

PART 1 – GENERAL

1.01 PROJECT DESCRIPTION

A. A brief description of project activities:

The work will include:

- Mobilize construction equipment and personnel to the site;
- Develop and implement a Health & Safety Plan to protect workers, visitors and neighbors;
- Implement a Community Air Monitoring Plan to protect off-site individuals;
- Prepare all required submittals to facilitate the timely progress of work;
- Clear the site of surface obstructions within the alignment of the proposed recovery trench and barrier;
- Prepare site, including implementation of sedimentation and erosion control measures (hay bales and tracking pad);
- Implement and execute site access controls including security fencing;
- Perform pre-construction utility location work and administrative requirements;
- Construction of a recovery trench by implementation of slurry trenching methods;
- Provide dewatering of the recovery trench during construction, as needed;
- Installation of a sheet pile barrier, watertight below groundwater level;
- Prepare contaminated soil and debris from the excavation for transportation and send them off site for disposal at a permitted facility;
- Construct and maintain contaminated soil and uncontaminated soil stockpile areas;
- Provide dewatering as needed for excavations and spoil pile containment areas;
- Provide water treatment for dewatering water;
- Prepare and maintain bills of lading for materials transported off-site for disposal;
- Work area clean-up;
- Decontaminate equipment and personnel;
- Providing project documentation;
- Demobilization.

1.02 INTENT OF DOCUMENTS

A. Contractor shall furnish the following:

1. All labor, tools, materials, equipment, transportation, taxes, and related items essential for completion of the Work.

2. All systems complete and left in good operating condition.

3. Apparatus, appliance, material or Work not shown on Drawings but mentioned in Specifications, or vice versa.

4. Accessories, reasonably inferable from Drawings and Specifications, necessary to make work complete and ready for operation.

5. New equipment and material unless otherwise called for.

B. Notes or instructions shown on any one Drawing apply, where applicable, to all other Drawings.

C. References to codes, specifications and standards called for in the Specification Sections and on the Drawings mean the latest edition, amendment and revision of such referenced standard in effect on the date of these Contract Documents.

D. Code Compliance: Provide Work in compliance with the following:

1. State Fire Prevention Code.

2. State Department of Labor Rules and Regulations.

3. Occupational Safety and Health Administration (OSHA) Regulations.

4. National Electric Code.

5. Ordinances and building code of the Village of Tarrytown, New York.

6. All other Codes applicable to the Work.

7. Plans and Specifications in excess of code/regulations requirements and not contrary to the same.

1.03 GLOSSARY

ANSI	American National Standards Institute
ASTM	American Society for Testing Materials
IRI	Industrial Risk Institute
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
UFPO	Underground Facilities Protective Organization
UL	Underwriters' Laboratories, Inc.

OSHA	Occupational Safety and Health Administration
Approval/Approved/Review	Review by the Engineer only for conformance with information given in the Contract Documents. Such review shall not extend to means, methods, techniques, sequences or procedures of construction or to safety precautions and programs incident there to.
As Called For	Materials, equipment including the execution specified/shown in the Contract Documents.
Code Requirements	Minimum requirements.
Engineer	Haley & Aldrich, Inc.
Equal or Equivalent	Equally acceptable as determined by the Engineer.
Final Acceptance	Owner acceptance of the project from Contractor upon certification by the Engineer.
Furnish	Supply and deliver to installed location.
Inspection	Visual observations by Owner's Site Representative.
Install	Mount and connect equipment and associated materials ready for use.
Or Approved Equal	Approved equal or equivalent as determined by the Engineer.
Owner	National Resources, 485 West Putnam Avenue, Greenwich, CT 06830.
Property Owners	Ferry Landings, LLC and Ferry Investments, LLC
Provide	Furnish, install and connect ready for use.
Relocate	Disassemble, disconnect, and transport equipment to new locations, then clean, test and install ready for use.
Replace	Remove and provide new item.
Satisfactory	As specified in Contract Documents

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. 02150 – Construction Dewatering

B. 02161 – Northern DNAPL Barrier Steel Sheet Piling

C. 02200 – Excavation and Backfill

D. 02410 – Degradable Slurry Collection Trench

1.05 DIVISION OF SPECIFICATIONS

For convenience, these specifications are divided into various sections. Such division is not intended to limit or define subcontractors. The complete performance of the work will be the responsibility of the Contractor.

1.06 WORKMANSHIP

All workers employed on this project shall be persons skilled in that work which they are to perform. Work will not be approved if it does not meet the quality of workmanship as called for in these specifications. If this quality of workmanship is not exactly defined herein, it shall be assumed to be the best standards of workmanship for that trade. The Engineer shall determine whether or not the quality of workmanship is acceptable.

If the workmanship for a portion of this work is not acceptable, same shall be removed and replaced at the Contractors' expense.

1.07 SITE SAFETY & WORK RULES

A. Contractor and subcontractors shall be responsible for strict adherence to the Site Health & Safety Plan and Contractor Work Rules. Adherence shall be applied continuously and not be limited to normal working hours.

B. Contractor and subcontractors shall take all precautions to provide safety provisions to adequately protect the public, the personnel and property of the Owner and Engineer, and all other persons, property and equipment, involving his work at the job site, based on applicable laws, building and construction codes, whether required by the following mentioned laws and codes or not, and completely responsible for conditions.

C. Contractor and subcontractors shall protect the Work from theft, vandalism and unauthorized entry. Contractors shall maintain responsibility for security of the Work throughout the construction period until Owner acceptance precludes the need for Contractor security. Contractor shall maintain a list of authorized personnel and visitors, and submit a copy to Engineer on request.

1.08 PERMITS AND FEES

A. The Contractor shall give all required notices relative to the work when inspections are required, obtain and pay for all permits and necessary approvals, and make all deposits necessary for the completion of the remediation as herein specified.

1.09 TAXES

Contractor shall include such local, state and federal taxes as may be applicable to the work of this Contract.

END OF SECTION

SECTION 02150 - CONSTRUCTION DEWATERING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the work specified in this Section, and as shown on the Contract Drawings.

B. The work of this section includes, but is not limited to:

1. Controlling, managing and removing seepage, surface water, and precipitation in excavations and soil stockpile areas at the site.

2. Diverting surface water away from excavations, trenches, utilities, and all other work areas.

3. Installing dewatering sumps including but not limited to berm, geotextile, crushed stone, main and auxiliary pumps, piping and/or hoses, and appurtenances.

4. Replacing dewatering sump geotextile material as necessary to maintain free flow through geotextile.

5. Removing accumulated sediment around dewatering sumps as necessary.

6. Providing temporary electrical power to the localized dewatering sumps.

7. Dewatering areas required for work to be undertaken in the dry as specified or detailed.

1.02 RELATED SECTIONS

Carefully examine all of the Contract Documents for requirements that affect the work in this section. Other specification sections include work related to the work of this section; work shall be coordinated between specification sections.

1.03 DEFINITIONS

A. NPDES: National Pollutant Discharge Elimination System.

B. TSS: Total Suspended Solids as determined by USEPA SW-846 Method 160.2.

C. USEPA: United States Environmental Protection Agency.

1.04 REGULATORY REQUIREMENTS

A. Comply with federal, State of New York, and Village of Tarrytown codes, policies, regulations, and laws affecting work in this Section.

B. All work shall be in accordance with the National Electrical Code.

C. Obtain all permits and inspections required, including Discharge Criteria provided by NYSDEC.

1.05 PERFORMANCE CRITERIA

A. The specific means and methods of this Section are to be determined by the Contractor who shall be solely responsible for the performance, location, arrangement, and depth of any system or systems selected to accomplish the work.

B. Adequately dewater and control drainage in order to complete the work in-the-dry.

C. Pump, store, collect, and treat (if required) dewatering effluent in accordance with all federal, state, and local codes, ordinances, and regulations or agencies having jurisdiction over the Work.

D. Modify the systems as required in order to accomplish the work.

E. Maintain continuous and effective dewatering systems and surface water control around-the-clock at all times, seven days a week, during all periods of construction which require dewatering.

F. Minimum requirements noted herein shall in no way relieve the Contractor of the responsibility to provide adequate dewatering and drainage controls, maintenance systems and treatment systems.

1.06 SUBMITTALS

A. Submit the following information to the Engineer at least four weeks before installing dewatering equipment at the site:

1. A complete description of equipment and materials to be used and the procedure to be followed in installation, operation, maintenance and removal in relation to the proposed sequence of excavation and backfilling.

2. Provisions for standby equipment and standby power supply.

3. Proposed locations of points of discharge of water.

4. Manufacturers' information/catalog cuts for the flow meter and totalizer proposed to measure flow rate and total volume of dewatering effluent pumped from the main dewatering sump.

B. Anticipated peak and average discharge rates.

C. Notify the Engineer of any changes to the dewatering and drainage control measures.

D. Submit to the Engineer daily records of discharge rates, including peak and average flows and total daily pumped volume.

E. In the event the Contractor plans to mobilize, start-up, shut-down or demobilize a treatment system, provide a written notification to the Engineer at least three days prior to implementing these changes.

1.07 QUALITY ASSURANCE

A. Collect samples of the pumped discharge at the frequencies specified in accordance with a NPDES Permit, if acquired. Contractor shall cooperate with Engineer to facilitate collection of discharge samples.

1.08 PROJECT/SITE CONDITIONS

A. The following list of reports contain subsurface information, including but not limited to, soil and groundwater environmental test data, boring logs, test pit logs, groundwater levels, and related information. The Contractor shall review the soil and groundwater quality data summarized in the following reports (and other environment reports, if necessary):

1. Preliminary Soil Gas Survey Results, Leaseway Motorcar Transportation Corporation, Tarrytown, New York, Metcalf & Eddy, 1990.
2. Site Assessment for Anchor Motor Freight, Inc., Tarrytown, New York, Metcalf & Eddy, 1991.
3. Remedial Action Plan for Anchor Motor Freight, Inc, Tarrytown, New York, Metcalf & Eddy, 1991.
4. Geoprobe Subsurface Investigations, Leaseway Motorcar Transportation Corporation, Tarrytown, New York, Metcalf & Eddy, 1994.
5. Site Investigation Report for the Tarrytown Site, ConEdison, Tarrytown, New York, Parsons Engineering Science, 1997.
6. Supplemental Site Investigation Report Tarrytown Former MGP Site, ConEdison, Tarrytown, New York, 2000.

PART 2 - PRODUCTS

2.01 GENERAL

A. Materials and equipment shall be of suitable size, capacity and type to achieve the performance criteria stated in this Specification.

B. All materials and equipment shall be maintained in good working order at all times during the course of the Work. Any leaks or spills shall be immediately fixed or cleaned.

C. Maintain and employ adequate back-up equipment in the case of equipment breakdown.

D. Provide water treatment system satisfying the following minimum requirements:

1. 4 – 20,000 gallon frac tanks (two influent and two effluent)
2. 100 gpm treatment capacity
3. Influent particulate filtration
4. 2 – 1,800 pound capacity vessels:
   a. The first containing Organo-clay or equivalent
   b. The second containing liquid-phase granulated carbon effluent particulate filtration.
5. Effluent particulate filtration.

F. Effluent water quality testing shall be performed to meet New York State requirements for discharge either to the local water pollution control facility or to the Hudson River.

PART 3 - EXECUTION

3.01 WATER MANAGMENT

A. Implement dewatering and drainage controls in accordance with the accepted submittals and with good practice. The Contractor shall adapt and modify the dewatering system(s) as required throughout the course of the Work to meet the requirements in NYSDEC Discharge Criteria and this Section. The design and operation of these systems shall be the sole responsibility of the Contractor. The Contractor shall not discharge any liquids without prior testing and approval by the Engineer and NYSDEC. The initial effluent test shall be performed on a batch basis. Based on the initial effluent test results, the Engineer and NYSDEC may allow continuous discharge of the effluent if it has been determined that no new contaminants were added to the treated liquid.

B. Maintain site, construction dewatering equipment, and subsurface drainage in an acceptable manner during the course of the Work. Collect and discharge surface water, seepage, precipitation, groundwater and other water at the Site. Control the inflow of water at all times during construction. Leaks in sheet pile walls shall be sealed immediately.

C. Provide, install, maintain, and operate pumps and related equipment, including standby equipment, of sufficient capacity to adequately dewater excavations until the required construction, installation, and backfilling of underground structures are completed.

D. Implement dewatering and drainage control continuously, 24 hours per day, seven days per week as required to meet the requirements of this Section.

E. All sumps shall be surrounded by suitable Filter Fabric or other acceptable materials to prevent the migration or pumping of fine grained materials and subgrade disturbance.

F. Maintain site grades to direct surface runoff to collection points. Construct berms as necessary around the excavations to prevent inflow of surface waters. Prevent surface water from running or collecting over prepared subgrades or fill surfaces. Do not permit standing water to accumulate in excavations.

G. Modify dewatering procedures which cause or may cause, in the opinion of the Engineer, damage to new or existing facilities. Modifications to dewatering system(s) shall be made at no additional cost to the Owner.

H. Remove and backfill dewatering elements when no longer required, using methods acceptable to the Engineer.

I. The Contractor shall incorporate any nonproductive time due to interruptions in dewatering into the schedule and costs for the Work.

3.02 MAINTENANCE

Remove accumulated sediment around the dewatering sumps as necessary. Stockpile sediment in contaminated soil stockpile area.

END OF SECTION

SECTION 02161 – NORTHERN DNAPL BARRIER STEEL SHEET PILING

PART 1 - GENERAL

1.01 GENERAL

A. Examine all Drawings and all other Specification Sections for requirements therein affecting the work of this Section.

B. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DEFINITIONS AND REFERENCE STANDARDS

A. ASTM: American Society for Testing and Materials
B. ASTM A 6/A 6M: General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
C. ASTM A572: Specifications for High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
D. ASTM A 328/A 328M: Steel Sheet Piling
E. Owner's Representative: Authorized representatives of the Owner. For the scope of work covered under this Section, this term will include Haley & Aldrich of New York.

1.03 DESCRIPTION OF WORK

A. Work to be done under this Section includes, but is not limited to, providing all labor, materials, equipment, and incidentals as necessary to the conduct and complete the Work specified herein and shown on the Drawings.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. 01012 – Summary of Work – Northern DNAPL

B. 02150 – Construction Dewatering

C. 02200 – Excavation and Backfill

D. 02410 – Degradable Slurry Collection Trench

1.05 SUBMITTALS

A. Shop Drawings: Shop drawings shall include details and dimensions of templates and other temporary guide structures for installing piling. Shop drawings shall provide details of the method of handling piling to prevent permanent deflection, distortion or damage to piling interlocks.

B. Driving Records: Driving records of the sheet piling driving operations shall be submitted after driving is completed. These records shall provide a system of identification which shows the disposition of approved piling in the work, driving equipment performance data, piling penetration rate data, piling dimensions and top and bottom elevations of installed piling.

C. Product Data Pile Driving Equipment: Complete descriptions of sheet piling driving equipment including hammers, extractors, protection caps and other installation appurtenances shall be submitted for approval prior to commencement of work.

D. Pulling and Redriving: The proposed method of pulling sheet piling shall be submitted and approved prior to pulling any piling.

E. Materials Tests: Certified materials tests reports showing that sheet piling and appurtenant steel materials meet the specified requirements shall be submitted for each shipment and identified with specific lots prior to installing materials. Material test reports shall meet the requirements of ASTM A 6/A 6M.

PART 2 - PRODUCTS

2.01 STEEL SHEET PILING

A. Metal sheet piling shall be hot-rolled steel sections conforming to ASTM A572 Grade 50.

2.02 MATERIALS TESTS

A. Sheet piling shall be tested and certified by the manufacturer to meet the specified chemical, mechanical and section property requirements prior to delivery to the site. Testing of sheet piling for mechanical properties shall be performed after the completion of all rolling and forming operations. Testing of sheet piling shall meet the requirements of ASTM A328.

2.03 DELIVERY, STORAGE AND HANDLING

A. Materials delivered to the site shall be new and undamaged and shall be accompanied by certified test reports. The manufacturer's logo and mill identification mark shall be provided on the sheet piling.

B. Sheet piling shall be stored and handled in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks.

C. Storage of sheet piling should also facilitate required inspection activities.

2.04 INTERLOCK SEAL

A. The interlock seal shall be Adeka Ultra Seal A-30 or Owner's Representative-approved equivalent.

PART 3 – EXECUTION

3.01 DRIVING HAMMERS

A. Hammers shall be steam, air, or diesel drop, single-acting, double-acting, differential-acting, or vibratory type.

B. The driving energy of the hammers shall be between 8,750 and 16,000 foot-pounds or as recommended by the manufacturer for the piling weights and subsurface materials to be encountered.

3.02 INTERLOCK SEAL

A. Interlock seal shall be applied within the interlock between the bottom of sheet pile and the elevation of the drain holes cut in the sheeting. Apply per manufacturer's specifications.

3.03 PLACING

A. Pilings shall be carefully located as shown.

B. Pilings shall be placed plumb with out-of-plumbness not exceeding 1/8 inch per foot of length and true to line. Temporary wales, templates, or guide structures shall be provided to insure that the pilings are placed and driven to the correct alignment. At least two templates shall be used in placing each piling and the maximum spacing of templates shall not exceed 20 feet.

3.04 DRIVING

A. Pilings shall be driven with the proper size hammer and by approved methods so as not to subject the pilings to damage and to ensure proper interlocking throughout their lengths. Driving hammers shall be maintained in proper alignment during driving operations by use of leads or guides attached to the hammer.

B. A protecting cap shall be employed in driving when using impact hammers to prevent damage to the tops of pilings. Pilings damaged during driving or driven out of interlock shall be removed and replaced at the Contractor's expense.

C. Pilings shall be driven without the aid of a water jet.

D. Adequate precautions shall be taken to insure that pilings are driven plumb.

E. If obstructions restrict driving a piling to the specified penetration the obstructions shall be removed or penetrated with a chisel beam. If the Contractor demonstrates that removal or penetration is impractical, the Contractor shall notify the Owner's Representative. Pilings shall be driven to depths shown and shall extend up to the elevation indicated for the top of pilings.

F. Caution shall be taken in the sustained use of vibratory hammers when a hard driving condition is encountered to avoid interlock-melt or damages. The use of vibratory hammers should be discontinued and impact hammers employed when the penetration rate due to vibratory loading is one foot or less per minute

3.05 CUTTING-OFF OF PILES DRIVEN TO REFUSAL

A. Pilings driven to refusal or to the point where additional penetration cannot be attained and are extending above the required top elevation in excess of the specified tolerance shall be cut off to the required elevation. Pilings driven below the required top elevation and pilings damaged by driving and cut off to permit further driving shall be extended as required to reach the top elevation by splicing when directed at no additional cost to the Owner.

B. All pilings shall be cut off at an elevation no less than 3 ft below final grade.

3.06 HOLES IN SHEET PILES

A. The Contractor shall cut holes in pilings for drains as shown or as directed. All cutting shall be done in a neat and workmanlike manner. A straight edge shall be used in cuts made by burning to avoid abrupt nicks.

3.07 INSPECTION OF DRIVEN PILING

A. The Contractor shall inspect the interlocked joints of driven pilings extending above ground. Pilings found to be out of interlock shall be removed and replaced at the Contractor's expense.

3.08 PULLING AND REDRIVING

A. In the pulling and redriving of piles as directed, the Contractor shall pull selected pilings after driving to determine the condition of the underground portions of pilings. Any piling so pulled and found to be damaged to the extent that its usefulness in the structure is impaired shall be removed and replaced at the Contractor's expense. Pilings pulled and found to be in satisfactory condition shall be redriven when directed.

END OF SECTION

SECTION 02200 – EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.01 GENERAL

A. Examine all Drawings and all other Specification Sections for requirements therein affecting the work of this Section.

B. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK

A. Work to be done under this Section includes, but is not limited to, providing all labor, materials, equipment, and incidentals as necessary to conduct and complete the Work specified herein and shown on the Drawings.

B. Excavate all materials, including soil, boulders, abandoned utilities, existing building foundations, pavements, curbs, cobblestone, and all other materials as necessary to construct the site improvements shown on the Drawings.

C. Preserve and protect existing and new site improvements during the course of the Work.

D. Prepare, grade, shape, compact and protect all subgrades, backfills, and ground surfaces as indicated shown on the Drawings.

E. Place plastic separators, vapor barriers, and geotextiles as necessary.

F. Furnish materials, specified herein, from off-site approved source(s) as required to complete the Work.

G. Place and compact backfill materials required to construct the proposed site improvements as shown on the Drawings.

H. Segregate, handle, stockpile, manage, and reuse suitable excavated soils. Certain on-site fill soils may be reused on-site as specified herein. The Contractor shall mechanically separate or screen on-site soils to remove debris as directed by the Engineer prior to reuse. Only those soils approved by the Engineer shall be reused on-site.

I. Manage and legally dispose off-site all excess or unsuitable generated materials, including but not limited to, soil, rock, water, demolition waste, timber, steel and debris that cannot be reused on-site in accordance with applicable requirements.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02150 Construction Dewatering

B. Section 01010 Summary of Work – Holder and Tar Well Area

C. Section 01011 Summary of Work – Western DNAPL and Sediment Removal Area

D. Section 01012 Summary of Work – Northern DNAPL Area

E. Section 02161 Northern DNAPL Barrier Steel Sheet Piling

F. Section 02410 Degradable Slurry Collection Trench

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. ASTM: Specifications of the American Society for Testing and Materials

B. AWS: Standard Code for Welding in Building Construction (American Welding Society)

C. AASHTO: American Association of State Highway and Transportation Officials

D. ACI: American Concrete Institute

E. PCI: Prestressed Concrete Institute

F. Code: Uniform Construction Code, State of New Jersey

G. USEPA: United Stated Environmental Protection Agency

H. NYSDEC: New York State Department of Environmental Conservation

I. OSHA: Occupational Health and Safety Administration

J. Engineer: Authorized representatives of the Architect, or Owner. For the scope of work covered under this Section, this term will include Haley & Aldrich of New York.

K. Site Improvements: When used in the context of "protecting adjacent site improvements" shall include, but not be limited to, buildings, utilities, pavements, roadways, slabs, sidewalks, curbs, foundations, and all other improvements and features that are outside the limits of the site, or those elements within the limits of the site that are to remain.

1.05 JOB CONDITIONS

A. The Contractor shall review and understand the information in the report titled “Pre-Design Investigation Report, Tarrytown Former MGP Site, Tarrytown, New York,” by Haley & Aldrich of New York, 2003. This report is made available to the Contractor for information

only and shall not be interpreted as a warranty of subsurface conditions whether interpreted from written text, boring logs, or other data.

B. The Contractor shall expect to encounter remnants of old utilities, foundations, and other buried structures during excavation.

1.06 QUALITY CONTROL

A. The Engineer will observe the Contractor's earthwork activities, including excavation, subgrade preparation and backfilling. As such, the Contractor shall provide sufficient notice to the Engineer to allow the Engineer to be present to observe and test the Work.

B. The Contractor will conduct field and laboratory testing to confirm compliance with the requirements of this Section. Field and laboratory testing will be conducted in general conformance with ASTM or other applicable reference standards. The Contractor shall cooperate with the Engineer in all respects to facilitate any testing or observations. The Engineer may perform check testing of field or laboratory tests and will observe the field work.

C. The presence of the Engineer shall not relieve the Contractor of his/her responsibility to perform the Work in accordance with the Contract Documents, nor shall it be construed to relieve the Contractor from full responsibility for the means and methods of construction, protection of site improvements against damage, and for safety on the construction site.

D. The Contractor shall adhere to the applicable requirements of the OSHA Standards and to all other applicable ordinances, codes, statutory rules, and regulations of federal, state, and local authorities having jurisdiction over the Work of this Section.

E. The Contractor may conduct additional field and laboratory testing or screening tests for his/her own information at no additional cost to the Owner.

F. Work not in conformance with the specified requirements shall be improved, or removed and replaced, at no additional cost to the Owner. All costs related to testing of nonconforming Work or materials shall be paid for by the Contractor, at no additional cost to the Owner.

G. Tolerances:

1. Construct finished soil and backfill surfaces to plus or minus ½-inch of the grades and elevations indicated on the Drawings.

2. Maintain the moisture content of fill material as it is being placed within plus or minus two percent of the optimum moisture content of the material as determined by the laboratory tests specified herein.

1.07 SUBMITTALS

A. General

1. The Contractor shall forward excavation support submittals to the Engineer a minimum of two weeks prior to any planned work related to the Contractor's submittals. Other submittals shall be made one week prior to the planned work.

2. The time period(s) for submittals are the minimum required by the Engineer to review, comment, and respond to the Contractor. The Engineer may require resubmission(s) for various reasons. The Contractor is responsible for scheduling specified submittals and resubmittals so as to prevent delays in the work.

3. The Contractor's submittals for any temporary sheeting and shoring shall be reviewed and accepted by the Engineer prior to conducting any work.

4. The Contractor's submittals for excavation support shall be prepared and stamped by a Professional Engineer registered in the State of New York, retained by the Contractor. The Contractor's Professional Engineer shall have a minimum of 5 years' experience in the design of excavation support systems similar to those required for this project.

5. Acceptance of the Contractor's submittals by the Engineer does not relieve the Contractor of the responsibility for the adequacy, safety and performance of the Work.

B. Excavation

1. A narrative describing the schedule, construction sequence and procedures for excavation, cold weather subgrade protection, backfilling, dewatering, soil handling, stockpiling, and other related activities. This includes soil management to eliminate cross-contamination of soils.

C. Backfill Materials and Equipment

1. Proposed types and sources of all off-site fill materials. For each type of soil or stone material to be utilized as fill or backfill, the Contractor shall deliver two 50-lb bag samples from each borrow source or supplier to the Engineer's laboratory for review and laboratory testing. Do not import any material to site unless accepted by the Engineer. With each sample provide the following documentation:

   a. Grain-size (ASTM D422) and compaction (ASTM D1557) test reports from independent soils laboratory.
   b. Location of borrow source site.
   c. Present and past usage of the source site and material.
   d. All previously existing report(s) associated with an assessment of the source site as relates to the presence of oil or hazardous materials.
   e. Analytical test results demonstrating that the proposed backfill material is clean.

2. Proposed flowable fill mix, including mix design, design strength, mix quantities, and water/cement ratio.

3. Details of compaction equipment, including descriptions, product literature, specifications and ratings, proposed for use in compacting fill and backfill materials.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials to be imported to the site shall not contain detectable amounts of oil and/or hazardous materials.

B. Ordinary Fill: shall consist of soils excavated on the site or other well-graded, natural, mineral soil free from organic materials, loam, wood, snow, ice, frozen soil cinders, trash, debris, and other weak, compressible, or deleterious materials. Ordinary Fill excavated from the site shall not contain particles larger than six (6) inches in maximum dimension and shall have a maximum of 35 percent passing the No. 200 sieve. It shall be characterized as having total BTEX concentrations of less than 10 ppm and total PAH concentrations of less than 500 ppm. Ordinary Fill imported from off-site shall not contain particles larger than four (4) inches in maximum dimension and shall have a maximum of 15 percent passing the No. 200 sieve. Ordinary Fill shall have physical properties such that it can be readily spread and compacted to the specified densities in a reasonable length of time. The material shall not contain materials subject to decay, decomposition, or dissolution.

Ordinary Fill shall be used for backfill above the relieving platform, within trenches excavated for the tie rods, and in excavations made at the sheet pile deadman.

C. Granular Fill: shall consist of clean, aggregate sand and gravel free of organic material, loam, trash, snow, ice, frozen soil or other deleterious material, and that can be used for fill in standing water. It shall be natural glacial or river deposits of “bank run” or “pit run” aggregate or quarry processed aggregate. The material shall meet requirements of NYSDOT Standard Specifications, Construction and Materials, for No. 1 or 1A stone. Alternative material gradations proposed by the Contractor will also be considered.

Granular Fill shall be used below the relieving platform. Alternatively, Flowable Fill could be used in this area.

D. Flowable Fill: shall be used above the Granular Fill within approximately 1 ft of the bottom of the relieving platform, as shown on the Drawings. Also, Flowable Fill shall be used between the new sheet piles and existing concrete seawall face. Flowable Fill shall also be used to fill voids while excavating for anchor rod trenches, if any are encountered.

Flowable Fill shall have a minimum strength of 125 psi. It shall be designed to be tremied or pumped in place below water, with admixtures as required to prevent dispersion or trapped water.

E. Geotextile: Shall consist of a non-woven, synthetic, chemically resistant non-biodegradable fabric. Minimum fabric weight of eight ounces per square yard and Grab Tensile strength of 150 lbs. (ASTM D4632) is required. Geotextile shall be used between Ordinary Fill and Granular Fill, and over openings cut into the timber deck of the relieving platform prior to backfilling the relieving platform, and in other locations to prevent fine-grained soils from migrating into coarse-grained soils, or through seams or openings as judged necessary by the Engineer.

PART 3 - EXECUTION

3.01 EXCAVATION

A. Excavation shall include the removal of all encountered materials, including but not limited to, soil, boulders, asphalt pavement, concrete (reinforced and unreinforced), steel sheeting, steel structures, timber piles, timber sheeting, cobblestones, miscellaneous debris, buried and abandoned foundations, site improvements, incidental structures and all other materials necessary to complete the Work of this Section.

B. All excavation and backfilling for structures, utilities, and site improvements shall be performed in-the-dry.

C. Where excavations are required to be made into the Zone of Influence (defined as a 1 horizontal to 1 vertical plane extending outward and downward from the bottom outer edge of a structure) below a foundation, utility or other structure, the Contractor shall design a excavation/bracing system to: 1) protect the soil within the Zone of Influence from loosening and becoming disturbed, and 2) protect the structure from movement.

D. The Contractor shall control the grading to prevent water from running to excavated areas or damaging subgrades or site improvements.

E. For excavations below the water table or when perched or trapped water is encountered, the Contractor shall install a dewatering system to safely draw down the water to permit construction in the dry. All water must be handled in accordance with applicable regulations.

F. Where final subgrade soils have been softened, frozen or otherwise disturbed, due to the presence of water, as a result of unfavorable weather or any other cause, remove the material and replace with suitable approved material at no additional cost to the Owner.

G. Exercise care to preserve the material below and beyond the lines of excavation. Where excavation is carried out, through error, below indicated grade or beyond the lines of excavation, backfill to the indicated grade with acceptable materials at no additional cost to the Owner and at the direction of the Engineer.

H. Excavations shall be of sufficient width and depth at all points to allow work to be built in a workman-like manner and, when needed, to allow for sheeting and shoring, pumping and draining, and/or for removing and replacing any unsuitable materials.

3.02 HANDLING AND SEGREGATION

A. Excavate, segregate, stockpile, and handle excavated materials in a manner that prevents cross contamination.

B. Soil stockpiles shall be segregated into at least three categories: acceptable for backfill, potentially acceptable for backfill, and contaminated. Visual field screening will be used to categorize the spoils. Soil categorized as potentially acceptable for backfill shall be managed as contaminated soil, until it has been determined that it is acceptable as backfill.

C. To determine whether or not soil categorized as potentially acceptable for back is acceptable for backfill, soil samples (one composite sample per 500 cubic yards) shall be taken and analyzed in a laboratory certified by the NYSDEC. Soil that is characterized as having total BTEX concentrations less than 10 ppm and total PAH concentrations less than 500 ppm is acceptable for use as backfill, provided it meets other requirements of this section.

D. Existing fill soils proposed for reuse on-site by the Contractor and approved by the Engineer shall be processed through a mechanical screener or by other equivalent means to remove cobbles, boulders and other deleterious materials greater than 6-inches in size.

E. Discard debris excavated at appropriate licensed disposal or recycling facility.

3.03 SOIL STOCKPILE MANAGEMENT

A. Soil stockpiles shall be managed to prevent stormwater run-on and run-off.

B. Contaminated soil stockpiles shall be lined with 10 mil plastic sheeting. They shall be covered with black plastic sheeting, 6 mil min, except for the working area.

C. Drainage from contaminated soil and excavation dewatering water shall be treated with carbon filtration on-site prior to discharge

D. Soil stockpiles shall be enclosed by hay bales which have been anchored to the ground or by other equivalent means to retain sediment.

3.04 SUBGRADE PREPARATION

A. Care shall be taken to avoid disturbance to subgrades below the tie rods. Prepare subgrades no steeper than one vertical to ten horizontal.

B. Provide a firm, smooth, stable, undisturbed subgrade as judged by the Engineer.

C. Movement of construction equipment directly over exposed subgrades shall not be permitted.

D. The exposed subgrade must be examined in the field by the Engineer to observe the strength and bearing capacity of the soils. It may be necessary to over-excavate and replace weak, disturbed or otherwise unsuitable soils. In areas of weaving, or soft or unstable soils, as judged by the Engineer, the soft materials shall be excavated and replaced with lean concrete, granular fill, or other acceptable materials at no additional cost to the Owner.

3.05 PLACEMENT AND COMPACTION OF MATERIALS

A. Ordinary Fill Placement

1. Place and compact fill to the limits specified herein, and shown on the Drawings in order to complete the Work. Unless otherwise specified or directed, material used for filling and backfilling shall meet the requirements specified under Part 2 Products for the specific application. If material removed from the excavations does not meet requirements to be re-used on-site (either for physical or chemical properties), provide other acceptable material.

2. Do not place frozen fill. Do not place fill, susceptible to freezing, in temperatures less than 32 degrees Fahrenheit. Do not place fill on frozen ground.

3. Slope fill surfaces at the end of each day to provide for free surface drainage.

4. Placement of fill shall not begin prior to observation and approval of subgrade conditions by the Engineer. The Contractor shall not place any fill material in the absence of the Engineer, unless authorized by the Engineer.

5. If excessive weaving, rutting, pumping, or instability, as judged by the Engineer, during compaction is observed, compaction efforts shall be discontinued until the Contractor stabilizes the subgrade. If required, the Contractor shall excavate and replace the unstable fill material with acceptable compacted material at no additional cost to the Owner.

6. Dewater all subgrades prior to filling as required to prevent disturbance. Place all fill in-the-dry.

7. Compaction by puddling or jetting is prohibited.

8. Control groundwater and surface run-off to minimize disturbance of material being placed.

9. Place fill to the elevations and grades shown on the Drawings. Where fill material meets previously existing grades, provide a smooth transition to meet existing grades.

10. Protect structures and pipes from damage during backfilling operations.

11. Protect existing and new site improvements during foundation construction operations. Repair damage at no additional cost to the Owner.

12. Backfill shall not be placed against walls until they are braced sufficiently to withstand, without damage, pressure from backfilling and compacting operations.

13. Use only walk-behind compaction equipment within five feet of retaining walls or sheeting. Operate compaction equipment only parallel to retaining walls or sheeting.

14. Backfill trenches as soon as practicable.

15. Any trenches or excavations improperly backfilled or where settlement occurs shall be reopened, to the depth required for proper compaction, then refilled and compacted with the surface restored to the required grade and condition at no additional cost to the Owner.

16. Compaction equipment

    a. Compaction equipment used to compact soil in open areas where space permits shall consist of self-propelled vibratory roller (minimum 20,000 lbs centrifugal force) or other similar equipment accepted by the Engineer sufficient to provide a firm, stable subgrade and achieve the required compaction.

    b. Equipment used to compact fill materials in tight access areas, such as tie rod trenches, shall consist of walk-behind vibratory drum rollers (minimum 10,000 centrifugal force) or other similar equipment sufficient to provide a firm, stable subgrade and achieve the required compaction.

    c. The Contractor shall use vibratory compaction equipment to obtain the specified compaction at all times. In some cases, additional passes or heavier equipment may be required. The gradation of some materials on-site is such that field unit weight testing methods (sand cone and nuclear density equipment) may not provide representative compaction results. In these cases, the Engineer will use his experience and judgment in evaluating if the Contractor has achieved the intent of the specification.

    d. Compaction Requirements: The minimum compaction requirement, expressed as the in-place fill dry unit weight as a percentage of the maximum dry density at optimum moisture content as determined by ASTM Test D1557, Method C, is 95%. One passing field compaction test is needed for every 30 cy of placed fill.

17. Moisture Control

    a. Fill that is too wet for proper compaction shall be harrowed, otherwise dried or treated with stabilizing agents such as lime (to hydrate excess moisture in the material) to achieve a proper moisture content to allow compaction to the required

density. If fill cannot be dried within 24 hours of placement, it shall be removed and replaced with drier material. Fill water content shall be within two (2) percent of optimum water content during placement and compaction.

b. Fill that is too dry for proper compaction shall receive water uniformly applied over the surface of the loose layer. Sufficient water shall be added to allow compaction to the required density. Fill that is too wet shall be aerated and allowed to dry sufficiently to achieve the compaction requirements.

c. In no case shall fill be placed over material that is frozen. No fill material shall be placed, spread, or rolled during unfavorable weather conditions. When work is interrupted by rain, fill operations shall not be resumed until the moisture content and the density of the previously placed fill are as specified.

18. Lift Thickness

a. Place fill in uniform horizontal layers.

b. Place in layers not to exceed 12 inches prior to compaction in thickness when utilizing heavy self-propelled vibratory compaction equipment, and 6 inches when utilizing hand-operated compaction equipment. Compact material with a minimum of four complete coverages per lift.

19. Protection of Fill

a. The Contractor shall take the necessary steps to avoid disturbance of subgrade and underlying natural soils/compacted fill during excavation and filling operations. Methods of excavation and filling operations shall be revised as necessary to avoid disturbance of subgrade and underlying soils/fill, including restricting the use of certain types of construction equipment and their movement over sensitive or unstable materials, dewatering, and other acceptable control measures. Disturbance shall include the deterioration of fill (after placement and satisfactory compaction) due to the Contractor's operations, such as moving equipment, hauling trucks, etc. All excavated or filled areas or subgrades that become disturbed during construction shall be removed and replaced with acceptable materials.

b. At the completion of Work, all ground surfaces shall be left in a firm, stable, unyielding, reasonably uniform condition, free of ruts and surface irregularities, in accordance with grading requirements shown on the Drawings.

B. Granular Fill Placement

1. Place fill through holes cut into the existing timber deck to fill the void beneath the relieving platform, as shown on the Drawings.

2. Place fill through a tremie pipe or a hopper and chute system to evenly fill between existing piles. Vibrate and/or tamp fill with rods to ensure no voids around existing piles.

C. Flowable Fill Placement

1. Place Flowable Fill through holes cut into the existing timber deck to fill the void directly beneath the relieving platform, as shown on the Drawings.

2. Place Flowable Fill through a tremie pipe. Tamp with rods to ensure even placement and no voids around existing piles. Once Flowable Fill has cured, inspect for voids below decking and fill any voids with additional Flowable Fill if required by the Engineer.

END OF SECTION

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SECTION 02410 – DEGRADABLE SLURRY COLLECTION TRENCH

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This Section includes minimum requirements for the Collection Trench and related work as constructed by the Degradable Slurry Method and as indicated on the Drawings and specified hereinafter. The Contractor shall provide and furnish all plant, labor, equipment, material and expertise for performing all operations as required to construct the collection trench.

B. The Collection Trench shall be constructed with essentially vertical trench walls which shall be supported by an engineered, degradable slurry. A gravel backfill, geotextile and recovery wells/sumps shall be placed into the trench, through the slurry. The slurry shall be degraded by the Contractor and the collection system fully developed to eliminate any residual effects of the slurry.

1.02 SPECIAL SITE CONDITIONS

A. A temporary working platform will be constructed prior to collection trench and construction. The working platform is intended to provide a stable working surface with minimal slope to reduce freeboard. The Contractor shall perform his work in a manner that minimizes potential slope instability of the working platform.

B. It is the Contractor's responsibility to protect its equipment and the elements of the constructed product from adverse effects due to cold weather and freezing.

1.03 REFERENCE STANDARDS

A. Following is a list of Standards which will be referenced in this Section. Such referenced Standards shall be considered part of these Specifications as if fully repeated herein.

API RP13B	API Recommended Practice, Standard Procedure for Field Testing Drilling Fluids
ASTMC 136	Particle-Size Analysis for Fine and Course Aggregates
ASTM F 480	Standard Specification for Thermoplastic Water Well Casings and Couplings
ASTM D 4491	Permittivity of a Geotextile
ASTM D 4751	Apparent Opening Size of a Geotextile
ASTM F 405	Standard Specification for Corrugated Polyethylene Tubing and Fittings

ASTM D 4632 Grab Tensile Strength of a Geotextile

1.04 DEFINITIONS AND ABBREVIATIONS

A. API - American Petroleum Institute.

B. ASTM - American Society for Testing and Materials.

C. Degradable Slurry Method - A modification of the slurry trench method which uses degradable slurry instead of bentonite to support narrow, vertical excavations.

D. Working Platform - A relatively level and stable surface fill on which the collection trench construction activities are conducted.

E. Degraded Slurry - Degradable slurry which through natural or artificial means has degraded to water and residual material.

F. Collection/Recovery Sumps - Vertical well casings with well screens suitable to accept a vacuum pump for the removal of liquids from the completed trench.

G. Collection Trench - The completed DNAPL recovery trench constructed by the Degradable Slurry Method.

H. Drain Activation - The process by which the degradable slurry is degraded and the collection trench is developed to permit free flow of groundwater into and within the collection trench.

1.05 SUBMITTAL S

A. General: The Contractor shall make timely submittal of all information required in this Section to the Owner's Representative. The Owner's Representative will review and may reject these submittals. The Owner's Representative may ask for revisions prior to approval. Approval of any submittal does not relieve the Contractor of the duty to perform the Work to the standards specified.

B. The Contractor shall submit evidence and references from three similar projects constructed over the last five years to document its successful use of the Degradable Slurry Method of installing collection trenches. This evidence shall show that the Contractor will have sufficient expertise, experienced personnel, proven methodologies and equipment to carry out the Work as specified.

C. Qualifications of a full-time on-site Degradable Slurry Trench Specialist shall be submitted, and approved by the Owner's Representative. The Trench Specialist shall supervise the construction, slurry preparations, slurry degradation, trench development and quality control.

D. Preconstruction Submittals

1. The Contractor shall submit a Construction Work Plan for construction of the collection trench within 15 calendar days after receipt of Notice of Award. The Work Plan shall include the following items:

    I. Degradable Slurry Method: A detailed description of the methods of construction which shall include as a minimum the excavation methods, slurry mixing and handling, trench excavation material handling and placement, backfill placement, sump placement, geotextile placement, and well pipe placement. A description of trench development procedures and criteria shall also be provided.

    II. Trench Stability: The Contractor shall evaluate the subsurface conditions and state in the Plan how trench stability will be maintained. The Plan shall include a discussion of contingent measures to be taken if trench instability is observed.

    III. Equipment: A list of major equipment by type and capacity which shall including the excavator, slurry mixer, material handler, pipe layer, geotextile placement equipment and support and transport equipment.

    IV. The plan for managing and disposing of excess slurry and slurry remaining in the trench. Plans shall include degradation, storage, and drain activation/development procedures.

    V. Methods of installation of geotextile, gravel, pipes, and sump. Include description of equipment, procedures, and methods.

2. The Contractor shall submit a quality control plan within 15 calendar days from the Notice of Award. As a minimum the Plan shall include:

    I. A list of test methods and minimum standards with which to gauge the quality of the Work during construction including as a minimum: slurry viscosity, depth measurements, control of sump plumbness, control of pipe grades, and control of geotextile overlap.

    II. The plan shall address the physical properties and manufacturers stated properties for all permanent materials including manufacturer's certifications of quality, mill certificates, and gradation test data.

    III. The plan shall state the correction procedures which will be employed in the case of substandard results.

E. Construction Submittals.

1. Materials - The Contractor shall submit data, tests, manufacturer's certificates, etc. To document the compliance of all materials to these specifications. Submittals shall be made at least to weeks prior to ordering each material or item.

2. Degradable Slurry - Manufacturer, product, properties, and Material Safety Data Sheets for the degradable slurry materials and additives. Test data shall be submitted to document the physical and chemical properties of the degradable slurry and degraded slurry.

3. Gravel - The supplier shall provide test results documenting the gradation of trench backfill prior to construction. The Contractor shall perform one additional gradation test for each 500 tons of backfill placed into the trench.

4. Well Casings - The supplier shall provide a letter of certification indicating that the material delivered to the site complies with the specified properties.

5. Geotextile - The manufacturer shall supply data sheets along with mill results from the lot of material delivered to the site. The mill results shall indicate the date shipped, lot number, test results, and roll number.

F. Daily Records - Daily records of excavated trench location and depths, and backfill location. Submit within one working day.

G. Test Results. Results of all tests required herein, including but not limited to, the slurry backfill, and soils. Submit within one working day of test completion.

H. Postconstruction Submittals: Submit as-built mark-ups and survey results for trench, pipelines, and other facilities within two weeks of completion of field work.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide all labor, materials, and equipment necessary to accomplish the Work specified in this Section.

2.02 DEGRADABLE SLURRY

A. The Contractor may use either a natural (Guar Gum) or a synthetic based slurry, such as Rantec G-150 or equivalent approved by the Owner's Representative. The slurry type used shall be compatible with the water used as a base, the ground and ground water conditions

adjacent to the trench, shall be stable for the duration of the open trench, and shall be readily "broken" at the end of its utility.

B. The Degradable Slurry shall degrade or be "broken" to a non-toxic water soluble substance once backfilling of the trench is complete. The Contractor shall submit the physical and chemical characteristics and properties of the Degradable Slurry. The slurry breaking enzyme shall be Rantec LEB_H or equivalent approved by the Owner's Representative. Substances prohibited by Local, State or Federal law shall not be contained in the Degradable Slurry. The Degradable Slurry shall not form a permanent filter cake on the trench walls which might decrease the transmissivity of the collection trench/soil interface. Unused Degradable Slurry shall degrade to a water solution which shall contain only non-toxic residual material.

C. The slurry for supporting the trench shall consist of a stable suspension of natural or synthetic polymer in water. It is the responsibility of the Contractor to ensure that the slurry meets the necessary properties and to monitor the slurry and the trench during excavation. Slurry density shall be a minimum 63 pcf. Slurry viscosity shall be a minimum 60 marsh funnel seconds. The viscosity, pH and filtrate loss of the slurry shall additionally be monitored by the Contractor to determine when breakdown of the slurry begins.

2.03 WATER

A. The owner will provide potable water for preparation of the degradable slurry.

B. It is the responsibility of the Contractor to ensure that the slurry resulting from mixing water and polymer meets the standards of this Specification.

C. Water for preparation of the slurry shall be prepared and tempered to provide a suitable base prior to forming the slurry.

2.04 ADDITIVES

A. Admixtures of softening agents, preservatives, dispersants, or retarders may be added to the slurry and water to permit efficient use of the polymer and proper workability of the slurry. The Degradable Slurry may be modified as required for successful trench excavation. Any additives used must be degraded prior to completion of trench development. Chemical and physical properties and characteristics of any proposed additives shall be in accordance with Local, State and Federal laws and shall be submitted to the Owner' Representative.

2.05 RECOVERY WELL

A. Recovery well casing shall be eight inch diameter Schedule 80 PVC pipe. The well casing shall be slotted from the bottom of the well to one foot below the interface of the ordinary backfill and the crushed/washed gravel. The casing shall be factory slotted with 0.125 inch slots and

plugged on the bottom. The top of the well shall be fitted with a protective metal casing at least 2 ft in length. The top of the protective casing shall be fitted with a removable or hinged cover.

B. Backfill around recovery well screen with New York State Department of Transportation Item #703-0201-3A, crushed/washed gravel. Durable and clean washed gravel containing no more than 15% calcium carbonate and meeting the following gradation:

US Standard Sieve	
2”	100
1-1/2”	90-100
1”	0-15

C. Ordinary Fill: Materials excavated during trench construction may be reused as backfill above the crushed/washed gravel.

D. Granular Bentonite: Place minimum one foot thick dry granular bentonite seal above ordinary fill, around recovery well casing.

E. Sand: Place minimum one foot thick No. 0 quartz sand above granular bentonite, around recovery well casing.

2.06 OBSERVATION WELL

A. Observation well casing shall be eight inch diameter Schedule 80 PVC pipe. The well casing shall be slotted from the bottom of the well to one foot below the interface of the ordinary backfill and the crushed/washed gravel. The casing shall be factory slotted with 0.125 inch slots and plugged on the bottom. The top of the well shall be fitted with a protective metal casing at least 2 ft in length. The top of the protective casing shall be fitted with a removable or hinged cover.

B. Backfill around observation well screen with New York State Department of Transportation Item #703-0201-3A, crushed/washed gravel. Durable and clean washed gravel containing no more than 15% calcium carbonate and meeting the following gradation:

US Standard Sieve	
2”	100
1-1/2”	90-100
1”	0-15

C. Ordinary Fill: Materials excavated during trench construction may be reused as backfill above the crushed/washed gravel.

D. Granular Bentonite: Place minimum one foot thick dry granular bentonite seal above ordinary fill, around observation well casing.

E. Sand: Place minimum one foot thick No. 0 quartz sand above granular bentonite, around observation well casing.

2.07 TRENCH BACKFILL

A. Crushed/Washed Gravel: Installed in the bottom of the trench as shown. New York State Department of Transportation Item #703-0201-3A, crushed/washed gravel. Durable and clean washed gravel containing no more than 15% calcium carbonate and meeting the following gradation:

US Standard Sieve	
2”	100
1-1/2”	90-100
1”	0-15

B. Materials excavated during trench construction may be reused as backfill above the crushed/washed gravel.

2.08 GENERAL EQUIPMENT

A. The Contractor shall furnish necessary plant and equipment for construction of the facilities shown on the Contract Documents. The equipment shall be of a type and capacity to complete the Work in an efficient manner, and shall be maintained in operable condition at all times. The live load surcharge attributable to the equipment shall be considered by the Contractor in trench stability and shall not contribute significantly to instability of the trench.

2.09 TRENCH EXCAVATION EQUIPMENT

A. Equipment for excavating the slurry trench shall be approved earth moving equipment such as a hydraulic excavator (backhoe) and/or clamshell capable of performing the Work indicated on the Drawings and/or as specified herein. The equipment shall be capable of excavating at least 5 ft. deeper than the maximum depth shown on the drawings. It shall be capable of excavating the required nominal width of the trench in a single pass of the excavating equipment. Excavating equipment which cuts oversized or undersized trench widths will not be allowed.

2.10 SLURRY MIXING PLANT

A. The Contractor shall provide a slurry mixing plant containing the necessary equipment for preparing the degradable slurry including a high-speed/high-shear colloidal mixer capable of producing a stable suspension of degradable slurry in water. Pumps, valves, hoses, storage supply lines and other equipment shall be provided as required to adequately supply degradable slurry to the trench. Hydration ponds shall not be permitted.

2.11 QUALITY CONTROL EQUIPMENT

A. Contractor's Equipment: Provide all equipment necessary for Contractor's quality control testing. Minimum quality control testing by the Contractor is specified hereinafter. Provide any additional equipment necessary for any additional testing the Contractor elects to do and as needed to perform testing outlined in the Contractor's Quality Control Plan. All equipment shall be maintained in good working order, and shall meet the requirements of the applicable test standards cited herein.

B. Equipment for use by the Owner's Representative: Provide the following equipment for use by the Owner's Representative during the Work. Equipment shall be furnished to the Owner's Representative not less than 5 working days prior to initial slurry mixing for the project. All equipment shall be in good working order. and shall be maintained in good working order by the Contractor at its own expense. The Owner's Representative will take ordinary and reasonable care of Contractor-furnished equipment, and will return all such equipment to the Contractor at the completion of the Work in the condition received, less normal wear and tear inherent to the Work.

Item No.	Item	Quantity
1.	Marsh Funnel Set (API RP 13B)	1
2.	Mud Balance (API RP 13B)	1
3.	Slurry Sampler, capable of obtaining 1 U.S. quart or more of slurry from any given depth in the trench or from the slurry storage facilities, with necessary rods, poles, etc.	1
4.	Trench depth measuring device of appropriate length for the Work, with projecting markers at one-foot intervals.	1

PART 3 - EXECUTION

3.01 GENERAL

A. The collection trench shall be constructed to the elevations, lines, grades, and cross-sections shown on the Drawings and in accordance with these Specifications, unless otherwise directed by the Owner's Representative. The Contractor is responsible for construction staking using survey control provided by the Owner.

3.02 WORKING PLATFORM

A. Construct a working platform at the ground surface to provide a flat and stable surface from which trench construction is staged. The elevation and grade of the working platform shall be determined by the Contractor, but must be approved by the Owner's Representative. The working platform may be flush with, above, or below the preexisting ground surface at the Contractor's option.

B. To provide for ground stability near the surface and above the slurry level, the working platform shall have at least two and one-half feet of cohesive soil at the ground surface. The cohesive soil shall extend at least 5 feet from centerline on both sides of the trench. The cohesive soils shall not ravel, slough, or cave into the excavation and shall be stable for all construction activities. If present, existing in-place soils meeting these requirements may be utilized, alternatively construct using borrow materials.

3.03 SURVEYING

A. Set-up a laser or similar survey baseline from which ground surface and trench bottom elevations can be rapidly measured at any point along the trench alignment. Provide and operate all equipment for a fully operational system including but not limited to the laser, survey rod, and sensor. The survey system shall be used to determine trench bottom elevations during construction.

3.04 EXCAVATION

A. Trench excavation shall be maintained in an open condition by the degradable slurry method. Excavation shall be conducted in a manner which provides for a continuous trench width to the required depth along the centerline of excavation. The trench shall be constructed without undue interruption until complete.

B. Trench depth criteria are presented on the drawings. The Owner's Representative may direct the Contractor to stop excavation or deepen the trench based on depth measurements and examination of soils. The actual depth of the trench will be determined by the Owner's representative based on-site evaluation of available subsurface information, observation of the behavior of the excavation equipment, and of the excavated material. The Contractor shall suspend excavation activities when requested by the Owner's Representative so that these observations and evaluations can be made. The Contractor may frequently be asked to sample trench bottom materials near the required bottom depth. The Owner's Representative will observe these samples and may require a trench bottom depth or elevation based on the samples. The Contractor shall obtain these samples with the excavation equipment or other means at no additional cost to the Owner. Furthermore, the Contractor shall comply with the required trench bottom elevations and depths as determined by the Owner's Representative.

C. Trench spoils shall be placed in the designated stockpile areas shown on the Drawings.

3.05 MIXING AND PLACING SLURRY

A. The degradable slurry shall be prepared by mixing water and polymer. No slurry shall be made within the trench. The degradable slurry shall be prepared in the mixing plant and hydrated in a tank with circulation until the resulting slurry appears homogenous and meets quality control standards. Additives may be added to the slurry at the mixing plant. The slurry shall be constantly agitated until introduced into the trench. Slurry shall be supplied to the trench through pipelines which shall be extended as necessary to supply the excavation.

B. To begin trench, after the initial 3 feet of soil has been excavated and stockpiled, slurry shall then be introduced into the trench. The level of the slurry in the open trench shall be maintained within 18 inches of the top of the working platform to maintain trench stability until the placement of filter fabric, recovery wells, observation wells and backfill material is complete. Dilution of slurry by surface water shall be prevented. The quality of the slurry shall be maintained at all times, included periods of work stoppage.

3.06 TRENCH STABILITY

A. The Contractor shall be responsible for maintaining the stability of the excavated trench for its full length and depth and shall be responsible for maintaining slurry densities and levels within limits specified in the approved Work Plan and Quality Control Plan. The Contractor shall control surcharges from excavation and backfilling equipment, waste, berm construction, backfill stockpiles, and any other loading situations that may affect trench stability. It is the Contractor's responsibility to ensure that any stockpiles do not affect the open trench stability and that open trench stability is maintained at all times. The Contractor shall have sufficient personnel, equipment, and materials ready to react to observed trench instabilities at any time, weekends, and/or holidays included. In the event of failure of the trench walls prior to completion of backfilling, the Contractor shall re-excavate the trench to the satisfaction of the Owner's Representative and take corrective action to prevent further deterioration.

3.07 TRENCH BOTTOM CLEANING

A. The Contractor shall clean the trench bottom immediately prior to geotextile installation. The cleaning procedure shall show evidence of a clean bottom ahead of the geotextile installation and shall not delay the general progress of the Work.

B. The Owner's Representative will review trench bottom conditions. The Contractor shall obtain the approval of trench bottom conditions prior to starting geotextile, pipe, and gravel placement for each trench segment. Trench bottom conditions shall be evaluated with successive soundings at the same location, probing, sampling, or other methods approved by the Owner's Representative at intervals of 10 ft. or less.

C. After each segment of trench bottom is cleaned, the Contractor shall maintain the bottom conditions and isolate the segment from the active trench excavation areas until placement of the geotextile and backfill. Isolation shall be with the use of bulkheads or weirs or similar devices which restrict slurry circulation through the cleaned segment.

D. As an alternative to trench bottom cleaning, the Contractor may at the Contractor's option, over excavate to accommodate the accumulation of debris in the trench bottom. the amount of over excavation shall be equal to the amount of accumulation such that the backfill is placed on the smooth grade and to the elevations shown. The amount of over excavation and debris accumulation shall generally not exceed 12 inches and shall not exceed 18 inches at any location. Over excavation and accumulation of debris is not permitted at the sumps, and the sump bottoms shall be cleaned as specified previously. Furthermore, the true trench bottom

including over excavation shall have a smooth profile which slopes smoothly to the sumps and drains to the sumps such that there are no reverse grades or depressions.

3.08 GEOTEXTILE

A. The geotextile shall be installed in panels as wide as practical in order to minimize overlapping joints. Minimum panel width shall be 17.5 ft and the overlap of each successive panel shall be not less than four feet. Each panel shall provide continuous cover of both sides and the bottom of the trench. Geotextile panels shall be installed immediately prior to placement of backfill material and shall be inserted in such a manner as to prevent tares, folds or uncovered areas. As construction proceeds toward the recovery well locations, the panel overlap shall be increased as necessary such that the recovery well sump is located in the center of a particular geotextile panel. After completion of the backfilling operation, excess textile shall be cut away and removed. Depth measurements shall be made to verify that the fabric was placed on the trench bottom. Where the fabric is found to be over the trench bottom, it shall be removed and a new geotextile installed the Contractor at no additional expense to the Owner.

B. The geotextile fabric shall be installed with rigid frame or similar rigid device which holds the geotextile in place prior to placement of the backfill. The use of weights at the ends of the geotextile will be permitted only with a demonstration to the Owner's Representative that the system works. The geotextile shall be spread to within six inches of the specific trench width at the trench bottom and at both ends of the geotextile panel.

3.09 RECOVERY WELL AND OBSERVATION WELLS

A. The recovery well and observation well shall be installed at the locations indicated on the Drawing. Install temporary observation wells at each end of the trench, and elsewhere at the Contractor's option to monitor trench fluid levels throughout development. The wells shall not deviate outside the center 1 ft zone of trench width over their entire depth. The plumbness of the wells shall be maintained within 1.5 percent of vertical relative to the depth. Backfill evenly around well casings from the bottom up using tremie methods or other approved methods to avoid nonuniform lateral loading on the casings.

3.10 BACKFILLING

A. Backfilling of the trench shall commence as soon as practical after the trench is begun and be conducted continuously or in panels to minimize the area of trench supported only by slurry.

B. The backfill shall be installed in the trench, through the slurry, by equipment which minimizes segregation of the gravel and the creation of voids. Rodding and/or jetting equipment shall be available, if needed, to correct any defects in the backfill placement. The requirement for tremie placement may, at the discretion of the Owner's Representative, be eliminated if the Contractor can demonstrate acceptable backfill placement without the tremie.

C. The Contractor shall backfill continuously from the beginning of the trench in the direction of the excavation to the end of the trench with the exception of backfill around wells or discrete panels. The backfill shall be placed into the trench in a manner that avoids trapping pockets of slurry and segregation of the gravel.

D. Backfill around wells and risers using methods which prevent the unbalanced loading on the vertical elements. Such methods shall include but not be limited to placing backfill in a uniform cone starting from the bottom of the trench and working up keeping the top of the cone several feet above the advancing backfill slope. Backfill placed below the slurry shall be placed with tremie or other methods which prevent segregation.

E. Backfill at geotextile panel interfaces and overlaps using methods which maintain the geotextile in its proper location. Prevent the geotextile from folding or lifting at the overlap and prevent backfill from intruding beneath the geotextile. Methods shall include but not be limited to introducing backfill first at the center of each panel then advancing to the end, and restraint devices which hold the ends in place.

3.11 COLLECTION TRENCH ACTIVATION AND DEVELOPMENT

A. Collection trench activation/development shall be an essentially closed-loop process using methods approved by the Owner's Representative. After completion of backfilling, the slurry shall be degraded to water and residual material. Slurry will be circulated between the recovery wells and surface of the permeable backfill during the degradation process. Slurry modifiers shall be added as necessary to destroy the viscosity and filtrate properties of the slurry. The broken slurry shall be oxygenated and pH adjusted to promote slurry degradation and drain activation. Slurry degradation materials and techniques and trench development procedures shall be applied appropriately to ensure adequate degradation of the slurry behind the geotextile. Broken slurry shall be filtered to create a development liquid that is essentially water. Water shall be flushed through the trench backfill material in order to remove residual material and to ensure satisfactory hydraulic conductivity through the trench media. Flushing shall continue until the water is clear and the trench hydraulic conductivity has stabilized. Flushing shall comprise at least three pore volumes within the recovery trench.

B. The collection trench shall be developed by cyclical surging and drawdown. The observation wells shall be monitored and uniform drawdown of groundwater levels in the vicinity of the collection trench, shall be one of the development criteria. The water level in existing wells external to the trench shall be monitored and development shall proceed until a satisfactory hydraulic connection between the trench and natural ground has been demonstrated.

C. After backfill with Crushed/Washed Gravel to near the top of the Working Platform as shown, carefully fold and overlap the geotextile across the top of the trench. Overlap by at least 18 inches. Trim extra geotextile neatly and avoid bunches and wads.

3.12 SLURRY DISPOSAL

A. All slurry and slurry byproducts shall be placed in the sediment dewatering area shown on the Drawings. Degradable slurries shall be broken prior to stockpiling.

3.13 EXISTING FACILITIES

A. The Contractor shall accommodate existing site operations during construction.

B. The Contractor shall take precautions as it deems necessary to protect existing facilities including but not limited to wells and piezometers during all construction activities. Facilities damaged by subcontractors, employees of the Contractor or as a result of construction activities performed by the Contractor shall be repaired or replaced by the Contractor as directed by the Owner's Representative at no additional cost to the Owner.

3.14 AS-BUILT SURVEY

A. During the period when the trench, or section of trench, is open, survey the trench centerline location. Survey points shall be made at the ends, all angle points, curves, deviations from a straight line and at intervals not exceeding 25 feet. Tie survey into site coordinate system. Survey shall be accurate to within 0.1 ft.

3.15 CLEANUP

A. Soil excavated from the trench shall be stockpiled of in the areas shown on the Drawings.

B. Remove from the site all unused materials, or obtain permission of Owner to leave at location chosen by Owner. Remove all equipment from site.

C. Restore the ground surface at the trench to the original topography. Backfill any cuts with Ordinary Fill placed and compacted in accordance with Section 02200, "Earthwork." Restore drainage and prevent areas which could pond water.

3.16 QUALITY CONTROL

A. General: The Contractor shall be responsible to ensure that all work is performed to the standards established, herein, subject to review and inspection by the Owner. All quality control records, routine tests, observations, and measurements shall be available for inspection by the Owner's Representative. The Contractor shall bear the cost of all specified tests.

B. Quality Control Plan: Develop, implement and follow a quality control plan for all work components. As a minimum the plan shall include those items required in the submittal section of this specification.

C. Degradable Slurry: The slurry used in trenching shall be tested each shift in accordance with ARI RP 13B to ensure the ability of the slurry to stabilize the trench. The following tests shall be performed at the indicated minimum frequencies:

Viscosity	4 per shift
Density	4 per shift
pH	4 per shift
Filtrate Loss	1 per shift

Samples of the slurry shall be obtained from multiple levels of the trench and from the mixing plant for testing. Equipment and personnel for performing these tests shall be supplied by the Contractor.

The degraded slurry and water in the trench shall be tested by the Contractor to demonstrate that the slurry has been broken. The Contractor shall test and monitor the viscosity and pH of the slurry to verify degradation. In addition, the Contractor shall pump and flush the trench until the pore volume of the trench has been circulated at least three times.

D. Excavation: The Contractor shall make measurements of the trench depth at least every 10 lineal feet. All depth measurements shall be made from the working platform to the bottom of the trench. The Contractor shall generate and maintain on-site an as-built profile of the trench depth.

E. Geotextile Placement: The Contractor shall verify that the geotextile was placed to the fullest depth of the trench. This verification shall be made at least once for each panel of geotextile.

F. System Performance: The Contractor shall verify the continuity of the system by pumping from the lowest sump and observing an immediate drawdown in other sumps and wells in the system. Additional temporary observation wells may be added by the Contractor, as needed, for this test at no additional cost to the Owner. Tests shall be performed in the presence of the Owner's Representative.

G. Records: Records shall be maintained by the Contractor for all testing, measurements, observations, and inspections. Quality Control Reports shall be submitted to the Owner's Representative each day on a form acceptable to the Owner. These reports shall list all test results, measurements, and observations made on the work for that day.

H. Quality Assurance. The Owner reserves the right to perform additional tests, using his own forces, on the slurry and backfill. The Owner's testing will in no way relieve the Contractor of the responsibility to perform tests as necessary to meet this Specification.

END OF SECTION