Basis of Design Report
Crystal Cleaners Site (360053)

Village of Pelham
Westchester County, New York

Prepared for

New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, New York 12233-7017

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April 2021
Version: DRAFT
EA Project No. 16025.11

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/kg	Microgram(s) per kilogram
µg/L	Microgram(s) per liter
ALS	ALS Environmental Laboratories
AWQS	Ambient Water Quality Standards
bgs	Below ground surface
BOD	Basis of Design
CFR	Code of Federal Regulations
COC	Constituent of concern
CY	Cubic yard(s)
DER	Division of Environmental Remediation
DCE	cis-1,2-dichloroethane
DPW	Department of Public Works
EA	EA Engineering, P.C. and its affiliate EA Science and Technology
EPA	U.S. Environmental Protection Agency
ft	Foot (feet)
GPR	Ground penetrating radar
HPT	Hydraulic profiling tool
in.	Inch(es)
MIP	Membrane interface probe
MNA	Monitored natural attenuation
MTBE	Methyl tertiary butyl ether
No.	Number
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYCRR	New York Codes Rules and Regulations
O&M	Operation and maintenance
PCE	Tetrachloroethene
PDI	Pre-Design Investigation
PID	Photoionization detector
ppb	Part(s) per billion

LIST OF ACRONYMS and ABBREVIATIONS (continued)

ppm	Part(s) per million
RA	Remedial action
RAO	Remedial action objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial design
ROD	Record of Decision
RI	Remedial investigation
SF	Square feet
SCO	Soil Cleanup Objective
SI	Site investigation
Site	Crystal Cleaners Site
SSDS	Sub-slab depressurization system
SVI	Soil vapor intrusion
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
trans-1,2-DCE	trans-1,2-dichloroethene
VC	Vinyl chloride
VOC	Volatile organic compound
WA	Work assignment

1. INTRODUCTION

The New York State Department of Environmental Conservation (NYSDEC) issued a Work Assignment (WA) to EA Engineering, P.C. and its affiliate EA Science and Technology (EA) to perform a pre-design investigation (PDI) and complete remedial design (RD) activities for the Crystal Cleaners Site (Site) in Pelham, Westchester County, New York (**Figure 1**). The WA is being conducted under the NYSDEC State Standby Engineering Services Contract (WA Number [No.] D009806-11).

This Basis of Design Report (BOD) provides the foundation used to develop a Contractor Scope of Work (SOW) and Construction Drawings to execute the remedy specified in the Record of Decision (ROD) (NYSDEC 2016). The Contractor SOW and Construction Drawings are presented in a separate submittal. It is anticipated that the remedial action (RA) will be completed by a NYSDEC Standby Remedial Contractor and that the RA will be performed in two phases. Phase I includes the excavation of contaminated soils and treatment of groundwater at the onsite area in the vicinity of the Crystal Cleaners property. Phase II will include the treatment of the offsite groundwater plume located in the vicinity of Manning Circle. This report evaluates existing conditions at the Site and provides the design assumptions that have been used to develop the design for Phase I.

The report is organized as follows:

- ***Section 1 – Introduction***

- ***Section 2 – Site Description and History***—Provides a brief description of the Site, operational history, previous investigations, and the selected remedy as defined by the ROD (NYSDEC 2016).

- ***Section 3 – Existing Conditions***—Presents a complete site characterization and discusses results of the PDI activities conducted at the Site.

- ***Section 4 – Basis of Design***—Presents the design assumptions to be used for preparation of contract specifications, Construction Drawings, and regulatory requirements for the RA. In addition, changes to the selected remedy as defined by the ROD are described.

- ***Section 5 – Drawings and Specifications***

- ***Section 6 – References***—Sources of information and data utilized to write this report and document the design process.

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2. SITE DESCRIPTION AND HISTORY

This section outlines a brief description of the Site, operational history, and previous investigations.

2.1 SITE DESCRIPTION

The Crystal Cleaners Site is located at 113 Wolfs Lane in the Village of Pelham, Westchester County, New York (**Figure 1**). The surrounding area is urban with commercial establishments and residences nearby. The site is home to an active dry cleaning business, operational since 1997, and adjacent to several commercial businesses along Wolfs Lane. A property owned by the Village of Pelham Department of Public Works (DPW) is located immediately to the west of the dry-cleaning building, but at an elevation approximately 10 feet (ft) lower (**Figure 1**).

2.2 SITE HISTORY AND PREVIOUS INVESTIGATIONS

2.2.1 Adjacent Properties

The Crystal Cleaners Site is located north of the former Pelham Residence Voluntary Cleanup Program site located at 195 Sparks Avenue. The Voluntary Cleanup Program site is immediately south and adjacent to the Village of Pelham DPW property. A site investigation (SI) was conducted at the Pelham Residence site from 1997 through 2000 and included the removal of underground storage tanks (USTs), and installation and sampling of monitoring wells. Groundwater data obtained as part of the Pelham Residence site SI indicated high concentrations of tetrachloroethene (PCE) (1,300 micrograms per liter [µg/L]), trichloroethene (TCE) (22 µg/L) and cis-1,2-dichloroethane (DCE) (36 µg/L). Given the direction of groundwater flow and upgradient location, Crystal Cleaners was identified as a possible source of contamination.

Nine USTs were discovered and removed in 1998 from a property north of Crystal Cleaners (101 Wolfs Lane). All USTs contained petroleum products (gasoline, used oil, hydraulic fluid, and fuel oil). An estimated 135 tons of petroleum contaminated soil was removed concurrently with UST removal at 101 Wolfs Lane.

2.2.2 2008 Site Investigation

NYSDEC conducted a site characterization of Crystal Cleaners in 2008 (Earth Tech 2009). The field investigation was conducted to determine the existence of contamination at the Site and to identify the nature of the contamination. NYSDEC determined that contamination present at the Site is a significant threat to the public health and the environment based on exceedance of class GA groundwater criteria. Soil vapor concentrations were elevated compared to the New York State Department of Health (NYSDOH) guidance (2006) matrices and indicate a potential threat to human health. The source appeared to be Crystal Cleaners Site since the elevated levels of PCE and TCE were detected downgradient of the Site and no other potential sources of PCE and TCE contamination were identified. Based on these findings, NYSDEC reclassified the Site as Class 2 on the Registry of Inactive Hazardous Waste Disposal Sites.

NYSDEC conducted a soil vapor intrusion (SVI) study at four structures located near the Crystal Cleaners Site. The samples were collected in February 2009. Levels of TCE detected in indoor and sub-slab air at two structures indicated the need for mitigation to minimize current or potential exposures associated with SVI. Levels of PCE detected in sub-slab and indoor air samples collected at three structures indicated the need for mitigation. A sub-slab sample was not collected at the fourth structure at the owner's request (Structure B03). The level of PCE detected in the indoor air sample at the fourth structure indicated the need to take reasonable and practical actions to identify the source for the detected PCE and reduce exposures. Following review of the data by NYSDEC and NYSDOH and discussions with the property owners, sub-slab depressurization systems (SSDS) were installed at two buildings.

2.2.3 Remedial Investigation and Supplemental Soil Sampling

A remedial investigation (RI) was conducted by AECOM to determine the sources and location of contamination within the site and its threat to human health or the environment (AECOM 2014). An addendum to the RI was prepared in 2015, which documents additional soil sampling at the Village of Pelham DPW (AECOM 2015). Sampling associated with the RI and supplemental soil sampling included:

- Direct-push soil sampling
- Well installation and groundwater sampling
- Soil vapor sampling
- Soil vapor intrusion sampling.

2.2.3.1 Soil Sampling

Direct-push sampling was conducted west of the Site on DPW property, along Manning Circle, and along Brookside Avenue to characterize the extent of soil contamination. PCE was detected in three of the six RI samples located directly to the west of the Crystal Cleaners building. One PCE detection of 17,000 micrograms per kilogram (µg/kg) on the DPW property exceeded the unrestricted use (UU) soil cleanup objective (SCO) of 1,300 µg/kg. Since dry cleaners typically use PCE-based solvents, PCE is considered a source contaminant and the constituent of concern (COC). Additional soil sampling was completed in April 2015 to further delineate soil on the DPW property. The sample results, which were collected from between 5 and 6 ft below ground surface (bgs), ranged in concentration from 2,400 to 10,000 µg/kg PCE.

Additionally, soil samples were collected at four temporary well points along Manning Circle and Brookside Avenue. PCE was detected at low concentrations (2 µg/kg to 6µg/kg) below the 1300 µg/kg UU SCO in three of the four samples. DCE was detected below the 250 µg/kg unrestricted use SCO in the two of the four soil samples. Acetone was detected at concentrations exceeding the UU SCO at one of the points on Brookside Avenue; however, because the acetone concentrations are lower in soil near the Site, it was concluded during the RI that the exceedance is unlikely to be associated with the Site.

AECOM attempted to collect a soil boring on the elevated area immediately adjacent to the Crystal Cleaners facility using a hand auger, but no exposed soil was present that would permit soil collection.

2.2.3.2 Groundwater Sampling

Nine overburden and five bedrock wells were installed to determine the extent of the groundwater contamination in the overburden and bedrock. Three phases of groundwater sampling were conducted between 2011 and 2012. Well locations are shown on **Figure 2**. Volatile organic compound (VOC) sample concentrations in groundwater are presented in Table 3 of the RI Report (AECOM 2014).

The VOCs detected in the overburden wells at concentrations exceeding the class GA groundwater criteria are the chlorinated aliphatics PCE, TCE, DCE, and vinyl chloride (VC). The VOCs detected in the bedrock wells at concentrations exceeding the class GA groundwater criteria are the chlorinated aliphatics PCE, TCE, DCE, VC, trans-1,2-DCE, and 1,2-dichloroethane. Since dry cleaners typically use PCE based solvents, PCE is considered a source contaminant. The remaining chlorinated organic compounds are likely to have been an impurity in the dry-cleaning solvent or other chemicals used in operations or result from the degradation or dechlorination of PCE.

Methyl tertiary butyl ether (MTBE) was detected above the class GA criterion in bedrock wells MW-C11, MW-C15, and MW-C16. This parameter is likely to originate from another source since MTBE is almost exclusively used as a fuel additive in motor gasoline and is not associated with dry-cleaning operations. MTBE may be associated with Pelham Residence site (including the DPW) or the 110 Wolfs Lane site, both of which stored petroleum products.

The chemicals of concern in the overburden groundwater are PCE, TCE, DCE, and VC. The chemicals of concern in the bedrock groundwater are: PCE, TCE, DCE, VC, trans-1,2-DCE, and 1,2-dichloroethane.

2.2.3.3 Soil Vapor/Soil Vapor Intrusion Sampling

Three temporary soil vapor points were installed and sampled to determine extent of soil vapor contamination and determine if vapor intrusion sampling was needed. PCE, TCE, chloroform, and benzene were detected above U.S. Environmental Protection Agency (EPA) generic screening levels. As such, SVI sampling was conducted in seven nearby structures.

The SVI data were also compared to the soil vapor/indoor air matrices in the 2006 NYSDOH guidance (NYSDOH 2006). Based on the guidance, the recommendations for the structures were as follows: take reasonable and practical actions to identify sources and reduce exposures for three of the buildings (B01, B05, and B06); and mitigate for B01, B04, and B07. No recommendation could be made for B03 based on the guidance because a sub-slab result was not available for this structure. A SSDS is in operation at one structure.

2.2.3.4 Conclusions

A summary of the RI conclusions includes:

- PCE exceeded applicable SCOs in soil on the DPW property to the west of the Site. Soil closer to or beneath the Crystal Cleaners Site may be impacted, but this area was not sampled and is a possible source area.

- A contaminant distribution map was developed for PCE in the overburden wells (**Figure 3**). The areas with concentrations greater than 5 µg/L approximates the horizontal extent of the groundwater plume exceeding the class GA groundwater criterion for PCE. The highest concentrations of VOCs are centered on the DPW property. The highest detection of PCE was collected in a temporary well along Manning Circle. The concentrations decrease to non-detect to the west at MW-C05 and MW-C06 and to the southwest at wells MW-C12 and MW-C13. The area at the southern end of Manning Circle was bounded by temporary well samples collected on Brookside Avenue. PCE was not detected in the groundwater sample from TWP-13 and was approaching the class GA criterion of 5 µg/L in the sample from TWP-12 (17 µg/L). The PCE concentrations at well MW-14 and temporary wells TWP-1 through TWP-7 exceed the class GA criterion for PCE. The extent of the plume is bounded towards the east, because groundwater was not observed in the overburden in the area approaching Wolfs Lane and overburden may not be present to the east due to the shallow bedrock.

- A similar contaminant distribution map was developed for PCE in the bedrock wells (**Figure 4**). The highest concentration of PCE was detected on the DPW property. The PCE concentrations in bedrock are unbounded vertically and horizontally. The levels are well above the class GA criterion and the groundwater is likely to migrate through fractures in the bedrock. The extent of contamination cannot be confidently predicted from this information.

- The PCE SVI distribution approximates the overburden groundwater distribution. The highest concentrations of PCE are centered on the DPW property. The concentrations decrease to the south and west of the Site.

2.3 GEOLOGY/HYDROGEOLOGY

The Site is located in an area of Westchester County that is characterized by a thin surficial layer of glacial till and stream deposited (fluvial) sediments overlying shallow metamorphic and igneous bedrock. Fill, sand, and gravel were identified in the surface soils within the study area. Rocks and boulders were encountered during drilling activities. The depth to bedrock surface varies across the study area from 8 ft bgs at MW-C01 to 47 ft bgs at MW-C11. Based on review of rock cores, the bedrock in the study area is Manhattan schist. The surface of the bedrock beneath the DPW property is highly fractured. Competent rock is found below 5 ft of the bedrock surface. At MW-C15, more than 10 ft of unfractured rock was encountered beneath the top of rock.

The regional groundwater flow is assumed to mimic the surface topography, which slopes from the north and east to the south and west towards the Hutchinson River. Groundwater elevations collected in November 2012 are shown on **Figure 5** for overburden wells and **Figure 6** for bedrock wells. It is likely that groundwater beneath the study area discharges to the Hutchinson River.

Groundwater was encountered in the overburden at depths ranging from approximately 5.5 to 20.9 ft bgs and in the bedrock wells at 7.5 to 14.1 ft bgs. Groundwater elevations measured during the February and November 2012 sampling events indicate that groundwater flow is from the northeast to the southwest/south-southwest in the overburden and bedrock wells.

2.4 RECORD OF DECISION

The selected remedy is referred to as the Soil Removal and Enhanced Bioremediation of Groundwater remedy. The elements of the selected remedy are as follows:

- ***Remedial Design***—A RD program will be implemented to provide the details necessary for the construction, operation, optimization, maintenance, and monitoring of the remedial program. Green remediation principles and techniques will be implemented to the extent feasible.

- ***Excavation***—Excavation and disposal of offsite contaminant source areas, including grossly contaminated soil; soils exceeding the protection of groundwater SCOs, as defined by 6 New York Codes, of Rules and Regulations Part 375-6.8 for those contaminants found in site groundwater above standards; and soils that may create a nuisance condition. The excavation area was estimated at approximately 770 square feet (SF). It was estimated that up to 400 cubic yards (CY) of contaminated soil will be removed. Clean fill will be brought in to replace the excavated soil or complete the backfilling of the excavation and establish the designed grades at the Site. The Site will be re-graded to accommodate installation of a cover system.

- ***Cover System***—A site cover currently is in place consisting of the existing buildings and pavement. There is no exposed surface soil. A site cover will be maintained as a component of any future site development.

- ***In-Situ Enhanced Bioremediation using Activated Carbon Injection***—In-situ enhanced biodegradation will be employed to treat contaminants in groundwater near the source and at downgradient locations. The biological breakdown of contaminants through anaerobic reductive dechlorination will be enhanced by the addition of colloidal activated carbon injections.

- ***Vapor Mitigation***—SSDS were offered to property owners of four offsite buildings in 2010 and 2012. SSDSs were subsequently installed in two of the four buildings where recommended. The owners of the two remaining buildings have not responded to offers to install SSDS. Should the owners request to have SSDSs installed in the future, the NYSDEC, in consultation with the NYSDOH, shall determine if mitigation such as SSDS or other actions are still appropriate.

- ***Engineering and Institutional Controls***—Imposition of an institutional control in the form of an environmental easement and a Site Management Plan is required.

2.5 SUMMARY OF REMEDIAL OBJECTIVES

The objective of the RA and remedial program is to restore the Site to pre-disposal conditions to the extent feasible. At a minimum, the remedy shall eliminate or mitigate all significant threats to public health and the environment presented by contamination identified at the Site through the proper application of scientific and engineering principles.

The remedial action objectives (RAOs) for this site are:

2.5.1 Groundwater RAOs

RAOs for Public Health Protection:

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.

- Prevent contact with, or inhalation of volatiles, from contaminated groundwater.

RAOs for Environmental Protection:

- Restore groundwater aquifer to pre-disposal/pre-release conditions to the extent practicable.

- Remove the source of ground or surface water contamination.

2.5.2 Soil RAOs

RAOs for Public Health Protection:

- Prevent ingestion/direct contact with contaminated soil.
- Prevent inhalation of or exposure from contaminants volatizing from contaminants in soil.

RAOs for Environmental Protection:

- Prevent migration of contaminants that would result in groundwater or surface water contamination.

- Prevent impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.

2.5.3 Soil Vapor RAOs

RAOs for Public Health Protection:

- Mitigate impacts to public health resulting from existing, or the potential for, SVI into buildings at the Site.

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3. EXISTING CONDITIONS

A PDI was implemented in June and November 2020 to further characterize soil contamination in the proposed excavation area, collect groundwater samples, and perform additional groundwater profiling.

3.1 PRE-DESIGN INVESTIGATION

In July and November 2020, EA completed PDI field activities as described in the *Pre-Design Investigation Letter Work Plan* (EA 2020). The goal of the PDI investigation was to confirm the nature and extent of site pollutants and collect information that will be used to design the selected remedy presented in the ROD. Drilling activities were conducted by EA's drilling contractor, Parratt-Wolff, Inc., of Syracuse, New York. Laboratory analysis was conducted by ALS Environmental Laboratories (ALS) in Rochester, New York.

3.1.1 Soil Borings

A total of fifteen soil borings were advanced until refusal using direct-push technology. Twelve of the soil borings were completed in the proposed excavation area to the west of the Crystal Cleaners building location, on the DPW property and three of the soil borings were completed downgradient from the Site at the south end of Manning Circle (**Figure 7**). Each macro-core sleeve was screened with a photoionization detector (PID) and logged by an EA geologist. Samples were collected from the interval with the greatest PID reading, visible staining, and/or strong odor. In the absence of these indicators, samples were collected from immediately above the groundwater interface. Soil samples were collected and analyzed for VOCs by EPA Method 8260. Select soil samples were also collected for grain-size analysis by ASTM D422 to support the in-situ bioremediation injection design. Additionally, select soil samples from within the proposed excavation area were analyzed Toxicity Characteristic Leaching Procedure (TCLP) to provide information on disposal characteristics.

3.1.2 Membrane Interface Probe/Hydraulic Profiling Tool Borings

A total of sixteen borings were completed using a membrane interface probe (MIP)/hydraulic profiling tool (HPT) to collect requisite data for the design of the in situ bioremediation. Thirteen MIP/HPT points were advanced in the DPW lot and three MIP/HPT points were completed in the Manning Circle area downgradient of the Site **(Figure 8)**. The MIP was used to create a vertical profile of the relative VOC concentrations in the subsurface soils and improve the understanding of the horizontal boundary of contamination.

3.1.3 Additional Groundwater Sampling

Groundwater samples were collected from existing Site monitoring wells (MW-C04, MW-C06, MW-C08, MW-C12, and MW-C14) using low-flow methods to verify understanding of groundwater contamination across the Site. Groundwater samples were collected and analyzed

for VOCs via EPA Method 8260; select monitoring wells were sampled for monitored natural attenuation (MNA) parameters.

3.1.4 Results of Pre-Design Investigation Sampling

While field PID screening results were generally low across the site (less than 5 parts per million [ppm]), analytical results and MIP/HPT logs indicate that the greatest VOC impacts are in the immediate vicinity of the proposed excavation area on the DPW property.

The greatest concentration of PCE in soil during the July 2020 event was observed in sample PDI-SB-01-7-8 at 18,000 µg/kg. This concentration is in exceedance of the UU SCO. The next greatest concentration of PCE observed in samples collected during the July 2020 event was 470 µg/kg from sample PDI-SB-02-7.5-8.5, which is below UU SCO. Soil samples collected from borings during the November 2020 event confirmed elevated PCE concentrations in the vicinity of the proposed excavation. Soil collected from SB-1X and SB-8X yielded PCE concentrations of 45,000 µg/kg (45 ppm) and 460 µg/kg (0.46 ppm), respectively. Additionally, the concentration of acetone exceeded the UU SCO in PDI-SB-01-7-8 (110 µg/kg), SB-1X (780 µg/kg), and PDI-SB-02-7.5-8.5 (100 µg/kg). Soil boring sample locations with results are provided in **Figure 9** for locations at the DPW and **Figure 10** for the Manning Circle locations**.** A summary of VOC concentrations in soil is presented in **Table 1**. A summary of the grain-size analysis is presented in **Table 2**.

TCE and DCE in groundwater were found in exceedance of Ambient Water Quality Standards (AWQS) in MW-C04 (210 µg/L and 130 µg/kg, respectively) and MW-C14 (17 µg/L and 5.7 µg/kg, respectively). PCE was detected in all groundwater samples collected during the PDI with the highest concentrations coming from MW-C04 (2,200 µg/L) and MW-C14 (360 µg/L). However, no standard exists for PCE in the AWQS. Groundwater sample locations and results are provided as **Figure 11**. A summary of VOC concentrations in groundwater is presented in **Table 3**. A summary of MNA parameters in groundwater is presented in **Table 4**.

Results of the TCLP analysis from four soil boring locations within the proposed excavation area indicate that material sampled is not a characteristic hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) 40 Code of Federal Regulations (CFR) Part 261. However, analysis for ignitability, corrosivity, and reactivity were not performed. Further characterization of material will be required for offsite disposal. A summary of TCLP results is presented in **Table 5**.

3.1.5 Site Topographic Survey, Infrastructure, and Utilities

A utility mark-out was completed as part of the PDI using ground penetrating radar (GPR). Several utilities and infrastructure are located near the proposed excavation area on the DPW property and in the vicinity of the proposed in-situ bioremediation injection areas on the DPW property and in Manning Circle. Locations of utilities were marked by the GPR subcontractor, Ground Penetrating

Radar Systems, LLC of Toledo, Ohio, and documented on a site survey performed by Hulbert Engineering and Land Surveying of Binghamton, New York.

Additionally, several structures on the DPW and Manning Circle property will limit access and influence the RD. Relevant structures and surface conditions were documented on the topographic survey. During the design and execution of the RA, consideration and clearances will have to be made to account for the infrastructure and overhead and underground utilities. Locations of the utilities and adjacent structures were incorporated in the Construction Drawings.

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4. BASIS OF DESIGN

4.1 RECORD OF DECISION

Through the development of the RD, some elements of the selected remedy as defined in the ROD have been modified through discussions with the Division of Environmental Remediation (DER). In the following narrative, specific ROD components are presented, and proposed deviations or further specifications are noted below them in italicized text.

1. Excavation and disposal of offsite contaminant source areas, including grossly contaminated soil, as defined in 6 New York Codes Rules and Regulations (NYCRR) Part 375-1.2(u); soil exceeding protection of groundwater SCOs as defined by 6 NYCRR Part 375-6.8 for those contaminants found in site groundwater above standards; and soils that may create a nuisance condition, as defined in Commissioner's Poly CP-51 Section G. The ROD estimated an excavation of approximately 700 SF, with 400 CY of contaminated soil removed. Clean fill meeting the requirements of 6 NYCRR part 375-6.7(d) will be brought in to replace the excavated soil/complete backfilling of the excavation and establish the design grades at the site.

   — **Required modifications of this element:**

   - *The draft design includes the excavation of approximately 215 CY of material from an excavation of approximately 720 SF. Confirmation samples will be collected from excavation sidewalls and bottom in accordance with NYSDEC DER-10 (NYSDEC 2010). Material exceeding SCOs outlined above will be excavated to the extent practicable.*

   - *Proximity of building structures and other surface structures will limit the extent the excavation may be expanded, particularly to the west and the south. In addition to requiring excavation support, excavation sidewalls will be offset a minimum of 10 ft from adjacent structures (e.g., aboveground storage tank to the south and retaining wall to the west).*

   - *Excavation area will impact an adjacent storm water conveyance structure/piping. The draft design includes the temporary removal of these structures during excavation. Stormwater piping and structures removed from the subsurface during the excavation may be reused, if not damaged, or will be replaced during restoration.*

2. A site cover currently is in place consisting of the existing buildings and pavement. There is no exposed surface soil. A site cover will be maintained as a component of any future site development, to allow for the commercial use of the Site, which will consist either of the structures such as buildings, pavement, sidewalks comprising the site development or a soil cover in areas where the upper 1 ft of exposed surface soil will exceed the applicable SCOs. Where the soil cover is required, it will be a minimum of 1 ft of soil, meeting the

SCOs for cover material as set forth in 6 NYCRR Part 375-6.7(d) for commercial use. The soil cover will be placed over a demarcation layer, with the upper 6 inches (in.) of the soil of sufficient quality to maintain a vegetation layer. Any fill material brought to the Site will meet the requirements for the identified site use as set forth in 6 NYCRR Part 375-6.7(d).

— **Required modifications of this element:**

- *The only anticipated excavation area will be the soil excavation area on the DPW property. Asphalt installed to match existing grades will be used as cover on the DPW property.*

- *Surface completion to restore injection points will match surrounding site conditions. Abandoned injection points will be backfilled with hydrated bentonite to within 6 in. of grade. The remaining annulus will be backfilled with topsoil and seeded, if surrounding area is grass. Otherwise, paved areas will be restored with cold patch.*

3. In-situ enhanced biodegradation will be employed to treat contaminants in groundwater near the source and at downgradient locations. The biological breakdown of contaminants through anaerobic reductive dechlorination will be enhanced by the addition of colloidal activated carbon injections. The carbon adsorbs to the contamination and promotes the growth of bacteria, which further stimulates biological breakdown of contaminants. The material can be delivered through injection wells or be added directly through open excavation. The treatment area is approximately 4,200 SF in size, and it is expected that approximately 4,000 pounds of material will be required to treat the contamination, depending on the selected remedial product.

— **Required modifications of this element:**

- *Temporary injection points will be installed with DPT as opposed to installation of permanent injection wells and/or adding injectate through open excavation. This will minimize disturbance to the surface and waste generation.*

- *Injections will be focused on the DPW property with the downgradient location of Manning Circle to be addressed at a later date. Access agreements with private property owners still need to be finalized by NYSDEC.*

- *The groundwater treatment area on the DPW as presented in the ROD (NYSDEC 2016) has been increased to cover a larger area of the 500 parts per billion (ppb) groundwater contour as requested by NYSDEC.*

- *Increased injection area on DPW property to also treat area around soil excavation and any migration of contaminants from potential source area (Crystal Cleaners building/property). Treatment of the excavation area will help prevent further*

migration of contaminants from this area and assist in addressing any areas potentially not addressed through excavation due to restrictions based on surrounding structures.

- *With the addition of the excavation area plus the expansion of the groundwater treatment area outlined in the ROD, the treatment area on the DPW property is approximately 4,455 SF in size (NYSDEC 2016). Discussion of the estimated quantity of material required to treat contaminated groundwater is provided in Section 4.2.2.*

4. Imposition of an institutional control in the form of an Environmental Easement and a Site Management Plan for the controlled properties that:

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

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

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

   d. Require compliance with the NYSDEC approved Site Management Plan.

5. A Site Management Plan includes the following:

   a. An Institutional and Engineering Control Plan that identifies all use restrictions and engineering controls for the Site and details the steps and media-specific requirements necessary to ensure the following institutional and/or engineering controls remain in place and effective:

      - Institutional Controls—the Environmental Easement discussed in remedy elements No. 5

      - Engineering Controls—the soil cover discussed in remedy elements No. 2.

   b. This plan includes, but may not be limited to:

      - An Excavation Plan that details the provisions for management of future excavations in areas of remaining contamination.

- A provision for further investigation and remediation should large scale redevelopment occur, if any of the onsite building is demolished, or if the subsurface is otherwise made accessible. The nature and extent of contamination in areas where access was previously limited or unavailable will be immediately and thoroughly investigated pursuant to a plan approved by NYSDEC. Based on the investigation results and NYSDEC's determination of the need for a remedy, a Remedial Action Work Plan will be developed for the final remedy for the Site, including removal and/or treatment of any source areas to the extent feasible. Citizen Participation Plan activities will continue through this process. Any necessary remediation will be completed prior to, or in association with, redevelopment. This includes the two story onsite building:

    - A description of the provisions of the environmental easement including any land use, and/or groundwater use restrictions.

    - A provision for evaluation of the potential for SVI for any future buildings developed on the Site, or for the current building if site-related COC are no longer used, including a provision for implementing actions recommended to address exposures related to SVI.

    - Provisions for the management and inspection of the identified engineering controls.

    - Maintaining site access controls and NYSDEC notification.

    - The steps necessary for the periodic reviews and certification of the institutional and/or engineering controls.

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

    - Monitoring of groundwater and soil vapor to assess the performance and effectiveness of the remedy.

    - A schedule of monitoring and frequency of submittals to NYSDEC.

    - Monitoring for vapor intrusion for any occupied existing or future buildings developed on the Site, as may be required by the Institutional and Engineering Control Plan discussed above.

d. An Operation and Maintenance (O&M) Plan to ensure continued operation, maintenance, optimization, monitoring, inspection, and reporting of any mechanical or physical components of the remedy. The plan includes, but is not limited to:

    - Procedures for operating and maintaining the remedy.

- Compliance monitoring of treatment systems to ensure proper O&M as well as providing the data for any necessary permit or permit equivalent reporting.

- Maintaining site access controls and NYSDEC notifications.

- Providing the NYSDEC access to the Site and O&M records.

4.2 DESIGN RATIONALE AND ASSUMPTIONS

4.2.1 Soil Excavation Area and Restoration

During previous investigations and the PDI, elevated concentrations of VOCs, particularly PCE, were identified in subsurface soils. Concentrations of PCE exceeded SCOs in soil borings and samples collected on the DPW property. Exceedances of PCE were observed in soil from 5 to 6 ft bgs as well as in samples collected from 7 to 8 ft bgs. Per the ROD, soil exceeding the specified cleanup goals will be excavated and removed from the Site (NYSDEC 2016). Limits of excavation were designed to be protective of adjacent structures while still removing contaminated soil.

Groundwater elevations collected from a nearby monitoring well (MW-C03) indicated that depth to groundwater is approximately 13 to 14 ft bgs. However, observations of soil borings collected during the PDI noted saturated soil approximately 8 ft bgs. Given the depth of soil contamination and potential depth to groundwater, the soil excavation will extend to approximately 8 ft bgs so as to remove contaminated media to the extent possible and to prevent water accumulation in the bottom of the excavation. EA is proposing to limit the vertical extent of excavation to soils at or above the groundwater table for this RA.

The contractor responsible for implementing the work will be required to collect soil samples and characterize the waste for disposal. While TCLP results collected during the PDI indicate that the material is not characteristic of hazardous waste as defined in RCRA (40 CFR Part 261), it is possible that the excavated material will be disposed offsite as F002 hazardous waste given that dry-cleaner waste is classified as a listed hazardous waste; unless the Remedial Contractor is able to secure a Contained-In Determination for the waste during profiling activities. For the purposes of design and estimation, it was assumed that all excavated material will be disposed of as F002 listed waste.

The proposed excavation area is shown in the drawing set provided in Appendix A and is approximately 720 SF to a depth of 8 ft bgs, a total of 215 CY of material. The excavation footprint may be expanded based on visual and olfactory evidence of impacted soil; however, this will be limited due to location of surrounding utilities and infrastructure. No dewatering is expected as the depth of the excavation will be limited by the groundwater table. However, if during the soil removal, groundwater enters the excavation, water will be removed and disposed offsite by the remedial contractor at an appropriate facility.

Given the proximity of adjacent buildings and structures, the Contractor shall employ methods of excavation support (e.g., trench boxes, or equivalent) to prevent damage to surrounding structures. All work and excavations will be conducted in accordance with Occupational Safety and Health Administration specifications (29 CFR Part 1926) and be protective of adjacent structures (e.g., Crystal Cleaners building, DPW buildings and infrastructure, subsurface utilities, etc.). Underground utilities are present in the proposed excavation area. For the stormwater conveyance piping and drop inlet located near the northern portion of the excavation, the Contractor shall remove the piping during excavation and reinstall/reconnect the stormwater piping in kind during restoration. The drop inlet and conveyance piping shall be re-installed at the existing elevations and slope.

It is not anticipated that personnel will be required to work within the excavation footprint; however, if personnel are to work within the excavation footprint, the Remedial Contractor shall follow specifications for sloping and benching, or excavation support outlined in 29 CFR Part 1926 Subpart P.

Prior to backfilling the excavation area, documentation samples will be collected in accordance with NYSDEC DER-10 (NYSDEC 2010). A demarcation layer of 4-ft orange safety fencing, or equivalent, will be installed on the excavation sidewalls and bottom.

The excavation will be restored in accordance with the Village of Pelham specification for Street Opening provided in **Appendix B** and as described herein. If the excavation is dry, the Remedial Contractor shall backfill the excavated areas first with 3 ft of certified clean common fill. Should water be present in the bottom of the excavation, 1-in. washed stone originating from a virgin source shall be placed in the excavation and extend 1 ft above the water level. On top of the common fill, 24 in. of clean graded sand will be placed and compacted in 12-in. lifts. The replacement stormwater piping (15-in. corrugated plastic pipe) shall be placed so that at least 4 in. of graded sand are above and below the pipe. The remaining annulus will be backfilled with New York State Department of Transportation Item 304.02 Type 2 subbase to within 11 in. of final grade. All imported materials shall be certified clean or from a virgin source, meeting requirements of NYSDEC DER-10 5.4(e) (NYSDEC 2010) and 6 NYCRR Part 375.67 (d)(1)(iii)(c) (NYSDEC 2020). The excavation will be temporarily covered with poly sheeting and secured. Injections will be performed within the restored excavation area prior to final surface completion with concrete and asphalt. Injection details are described in Section 4.2.2.

Once injections are completed, 8 in. of concrete meeting the requirements of New York State Department of Transportation Section 608 and have a compressive strength not less than 3,000 pressure per square inch will be installed on top of the Type 2 subbase. The restoration of the surface will be completed with a 3-in. asphalt top coat of New York State Type 6, or equivalent.

4.2.2 Injection Design

Per the ROD, areas of groundwater contamination exceeding 500 ppb will be treated by in-situ bioremediation and injection of carbon substrate. Additionally, it is proposed that injections are performed in the vicinity of the excavation area following backfill to prevent further migration of

contaminants from this area and assist in addressing any areas potentially not addressed through excavation due to restrictions based on surrounding structures. Due to access restrictions and private property owner prohibitions on intrusive activities on Manning Circle, it is proposed that the downgradient location of groundwater contamination is addressed through a separate mobilization at a later date. Further design and development of the remedy to be employed at the downgradient area will be presented in a separate BOD report.

Injection areas were determined based on historical groundwater concentrations and verified by groundwater sampling conducted as part of the PDI. The proposed injection areas are also limited by site constraints including the locations of surface structures and underground and overhead utilities. The treatment area is approximately 4,455 SF in size, and it is expected that approximately 90,000 gallons of contaminated groundwater will be treated in the injection areas.

The volume of water to be treated in the injection areas was estimated using the approximate surface area and estimated "thickness" of groundwater in the treatment areas. Onsite at the DPW property, it was assumed that depth to water was 13.2 ft bgs based on historic gauging and that bedrock was located approximately 22 ft bgs based upon historic boring logs. Soil at the Site is generally fine to medium sand (based upon grain-size analysis and PDI soil boring logs); porosity of material was estimated at 30 percent, resulting in an estimated groundwater volume of 90,000 gallons.

EA consulted with suppliers of injectable carbon substrates. As is typical with in-situ remediation products, each company has proprietary formulated products, resulting in no two companies being able to provide identical products or injections methodologies. Each company was given all the site data for their professionals to review and propose the most appropriate product to meet project requirements. Copies of EA's solicitation and vendor response are provided in Appendix C. Final volumes of product and injection spacing will be subject to input from the vendor selected by the Contractor. It was determined that between 3,200 and 9,200 pounds of injectable carbon would be required (depending on the selected vendor) to treat the contamination. In accordance with the ROD, the injectable product shall reduce groundwater concentrations on COCs though anaerobic reductive dechlorination and be enhance by the addition of activated carbon injections (NYSDEC 2016). The injectate selected by the Contractor shall not only be able to provide both sorption on the surface of the carbon, but also be supplemented with a product promoting degradation of PCE and other COCs.

4.3 PERMITTING/APPROVAL REQUIREMENTS

The project will be completed as part of the New York State Superfund Program. Because the project will be completed by the NYSDEC, approvals of certain NYSDEC permits may be waived. In those cases, the substantive permit requirements must be achieved in lieu of obtaining a formal permit. Permits, authorizations, and/or notifications which have been identified as potentially applicable with respect to site remediation are summarized in **Table 6**.

4.4 CONSTRUCTION DRAWINGS AND SPECIFICATIONS

A set of Draft Construction Drawings are presented in Appendix B and include the following:

- Cover sheet
- Legend, general notes, and abbreviations
- Existing conditions
- Excavation and Restoration Plan
- Groundwater plume and injection layout.

Specifications prepared to be incorporated into the RA SOW will be limited since this RA is being performed by a NYSDEC Call-Out Contractor.

Table 6 Permit/Approval Requirements

Permit/Approval	Responsible Agency	Reason Needed	Processing Time	Permit Assessment Process	Permit/Approval Required (Y/N)
Site Access/Boundaries of Work Area	NYSDEC	Permission to work on Village of Pelham DPW property and all other locations necessary for completion of work.	10 days	NYSDEC to prepare access letters for use of DPW property and other areas as required.	Yes
Street Opening Permit and Building Permit	Village of Pelham Building Department	Permission to perform work from the Village Building Department	14 days	Consultation with Village of Pelham and preparation of Street Opening and Building Permit Applications. Contractor to provide the required Construction Drawings and Work Plan in advance of work along with permit fees. Required to submit as-built drawings following completion of work.	Yes
New York State Historic Preservation Act of 1980 Consultation	New York State Office of Parks, Recreation and Historic Preservation; State Historic Preservation Office	Project completed by a state agency that could potentially impact a cultural resource.	30–90 days	Consultation with State Historic Preservation Office. Complete application for consultation, which includes project description, photographs of project site, U.S. Geologic Survey quadrangle map, and completed project cover form.	Yes
State Environmental Quality Review Compliance	NYSDEC	Project completed by a state agency	60–90 days	Not required for DER projects.	No
Stormwater Permit for Construction Activity (GP-0-15-002)	NYSDEC	Construction activity that will involve soil disturbance of 1+ acres.	60–90 days	Contractor to prepare a Stormwater Pollution Prevention Plan and submit a completed Notice of Intent.; not required for this project; disturbance is less than 1 acre.	No

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5. REFERENCES

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Figures

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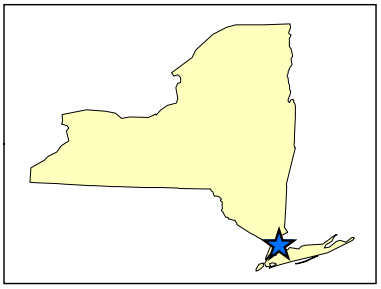

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Legend

- Crystal Cleaners Property Boundary
- Department of Public Works Property

Figure 1
Site Vicinity Map
Crystal Cleaners
Basis of Design Report
Pelham, New York

Map Date: 4/13/2021
Projection:
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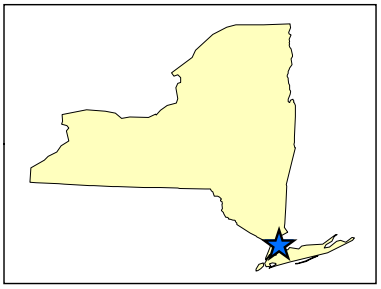

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Legend

- Site Location
- Bedrock Well
- Co-Located Overburden/Bedrock Well
- Overburden

Figure 2
Monitoring Well Network
Crystal Cleaners
Basis of Design Report
Pelham, New York

Map Date: 3/24/2021
Projection:
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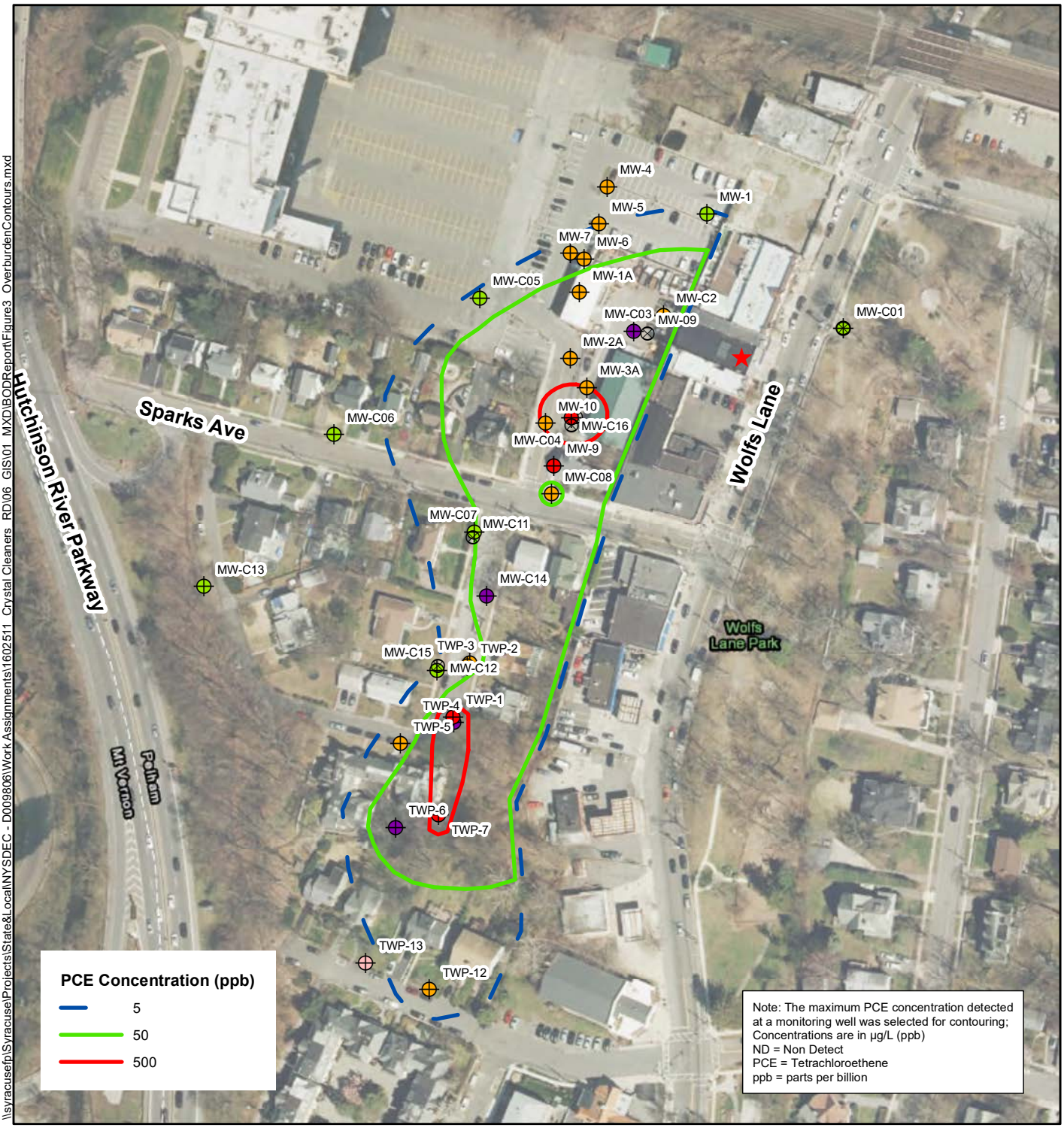

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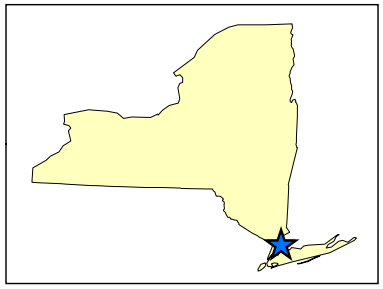

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Legend

- Site Location
- Bedrock
- Bedrock/Overburden (ND)
- Overburden (>5)
- Overburden (>50)
- Overburden (>500)
- Overburden (ND)
- Overburden (ND, 10U)

Figure 3
Overburden Groundwater Contamination Contours
Crystal Cleaners
Basis of Design Report
Pelham, New York

Map Date: 4/13/2021
Projection:
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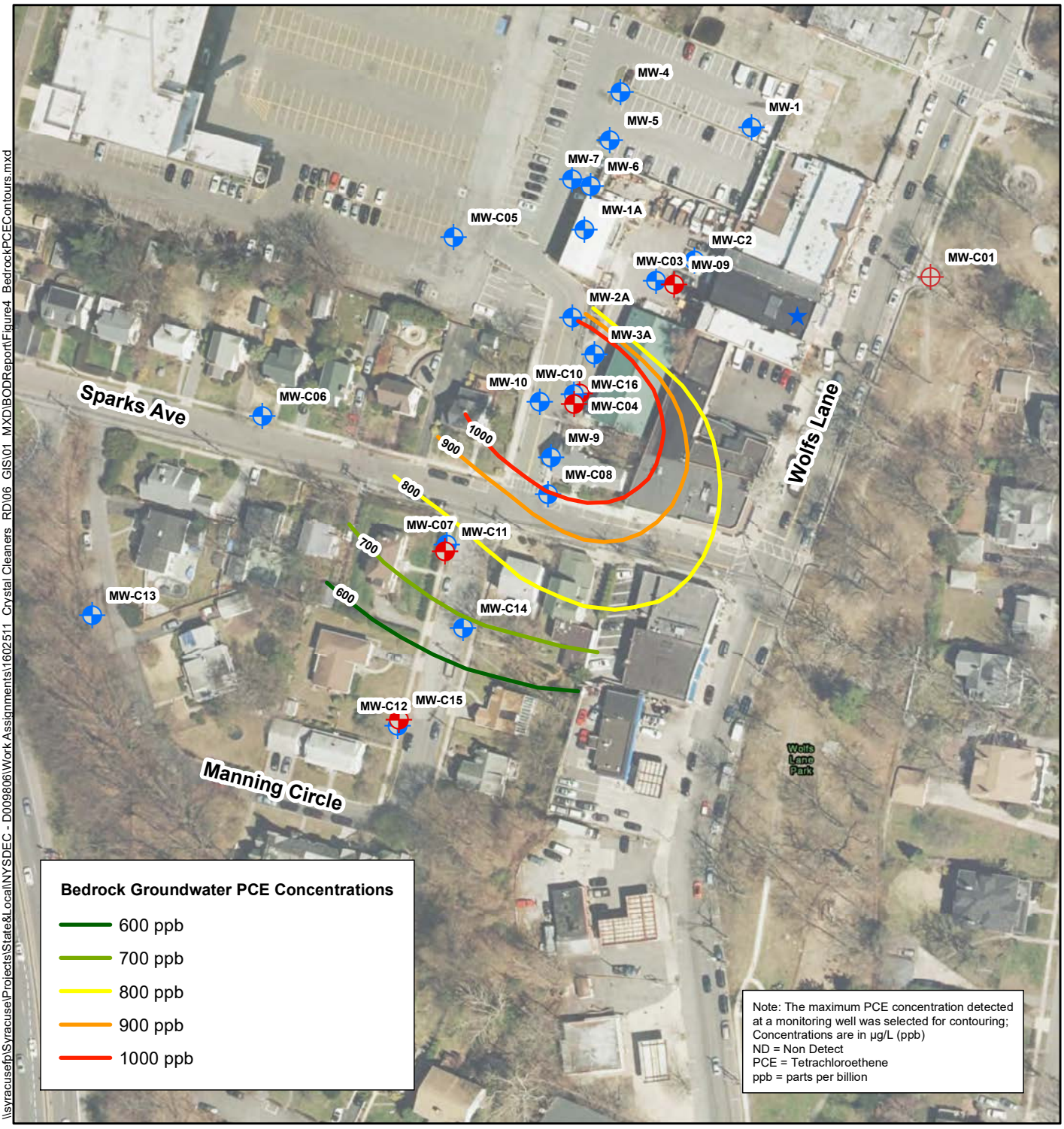

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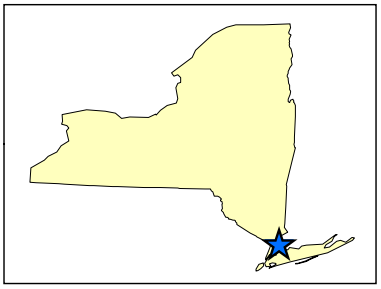

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Legend

- Site Location
- Bedrock Well
- Co-Located Overburden/Bedrock Well
- Overburden Well

Figure 4
Bedrock Groundwater Contamination Contours
Crystal Cleaners
Basis of Design Report
Pelham, New York

Map Date: 4/13/2021
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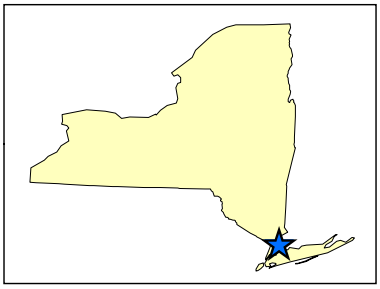

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Legend

- Site Location
- Groundwater Elevation Contour

Well Type

- Bedrock Well
- Co-Located Overburden/Bedrock Well
- Overburden

Figure 5
Overbuden Groundwater Elevations
Crystal Cleaners
Basis of Design Report
Pelham, New York

Map Date: 3/25/2021
Projection:
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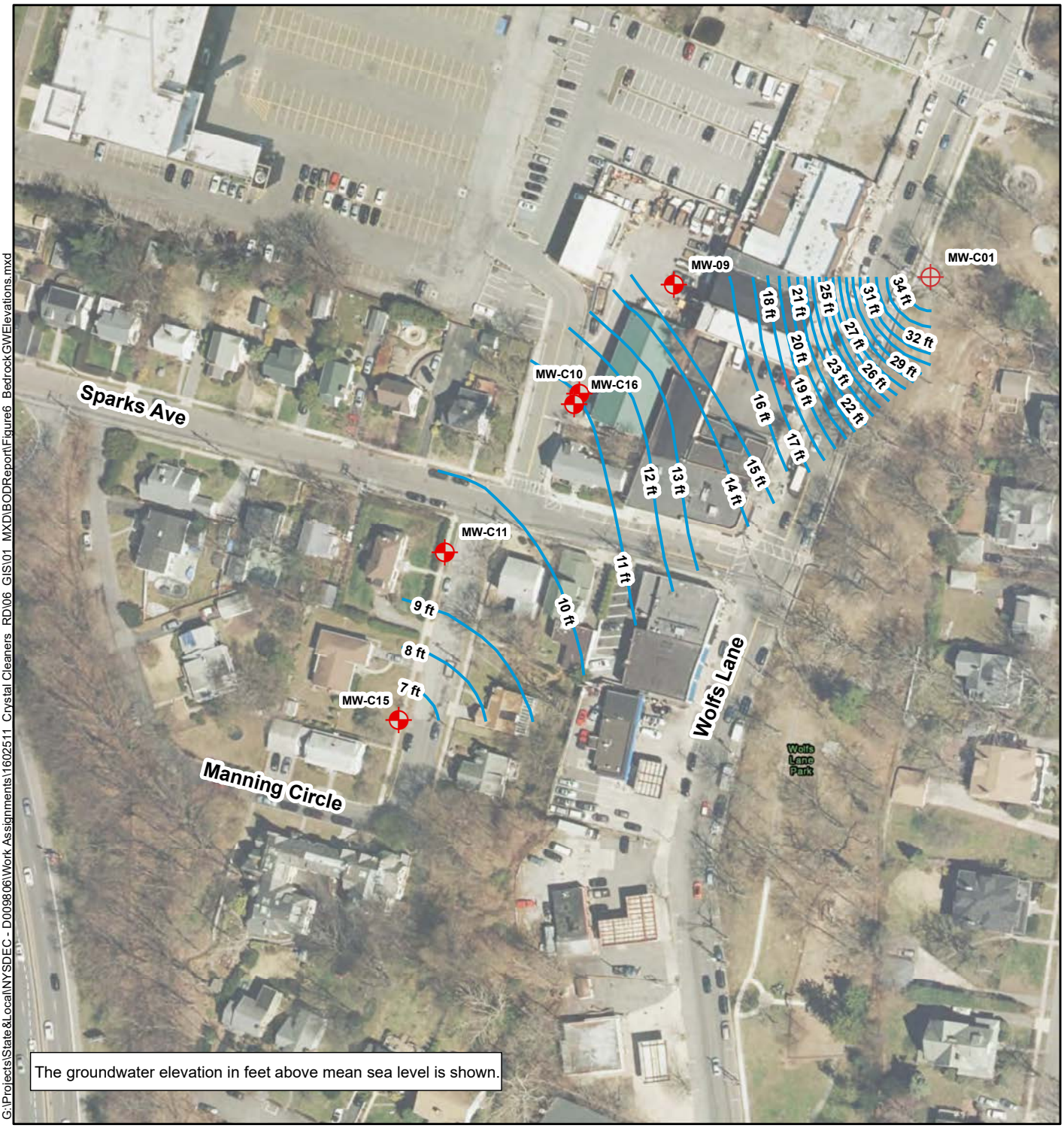

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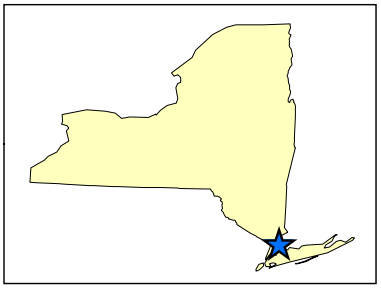

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Legend

- Bedrock Well
- Co-Located Overburden/Bedrock Well
- Bedrock Groundwater Elevations (November 2012)

Figure 6
Bedrock Groundwater Elevations
Crystal Cleaners
Basis of Design Report
Pelham, New York

Map Date: 4/1/2021
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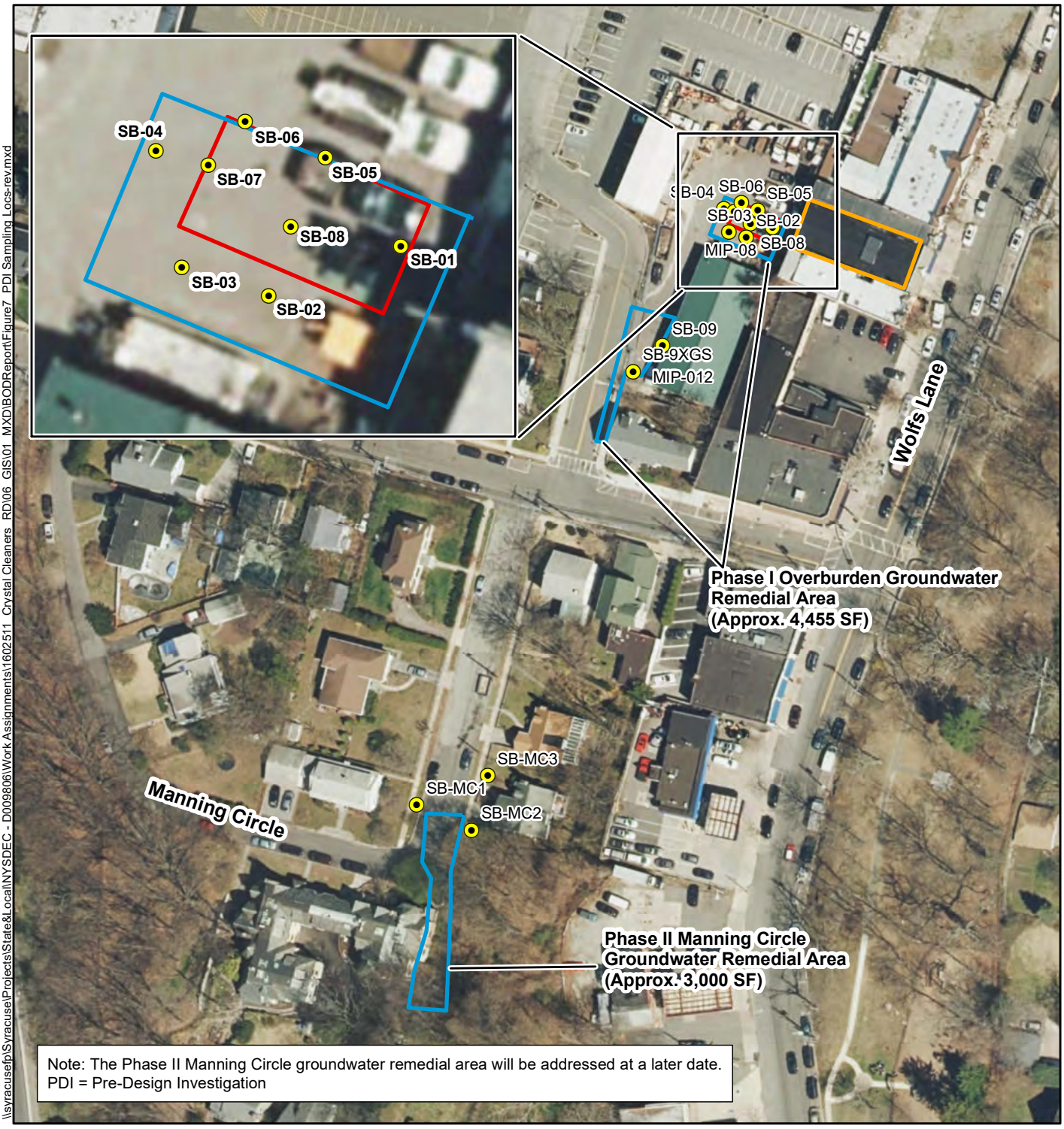

Note: The Phase II Manning Circle groundwater remedial area will be addressed at a later date.
PDI = Pre-Design Investigation

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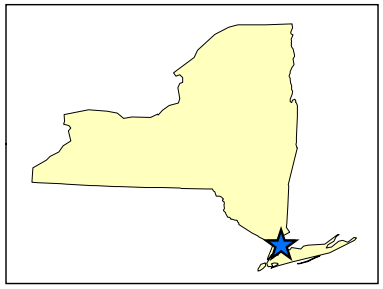

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Feet

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Legend

- PDI Soil Boring Locations
- Crystal Cleaners Property Boundary
- Proposed Excavation Area
- Overburden Groundwater Remedial Area

Figure 7
PDI Soil Boring Locations
Crystal Cleaners
Basis of Design Report
Pelham, New York

Map Date: 4/13/2021
Projection:
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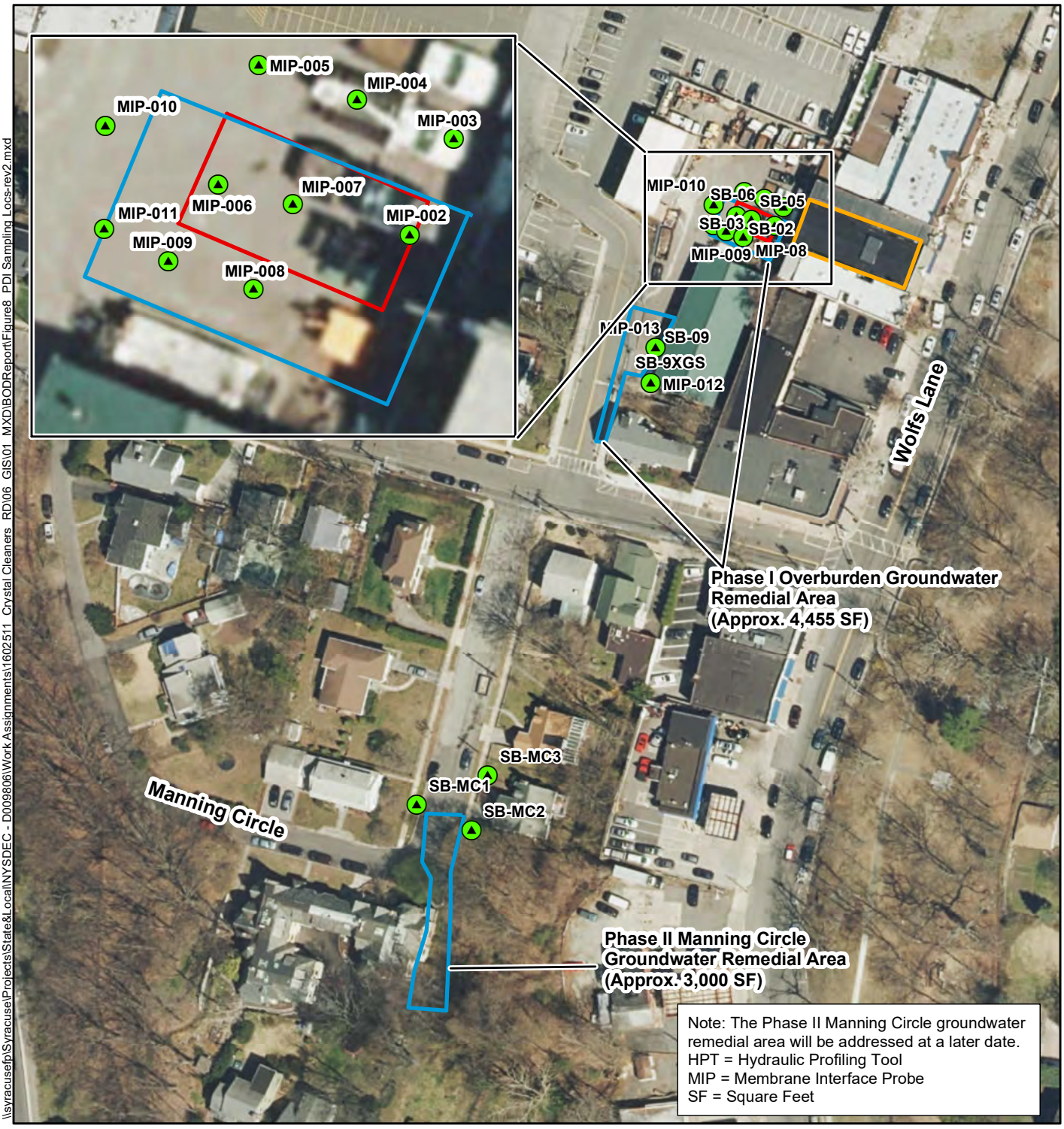

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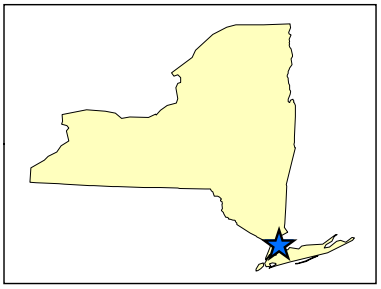

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Legend

- MIP/HPT Drilling Locations
- Crystal Cleaners Property Boundary
- Proposed Excavation Area
- Overburden Groundwater Remedial Area

Figure 8
MIP/HPT Boring Locations
Crystal Cleaners
Basis of Design Report
Pelham, New York

Map Date: 4/13/2021
Projection:
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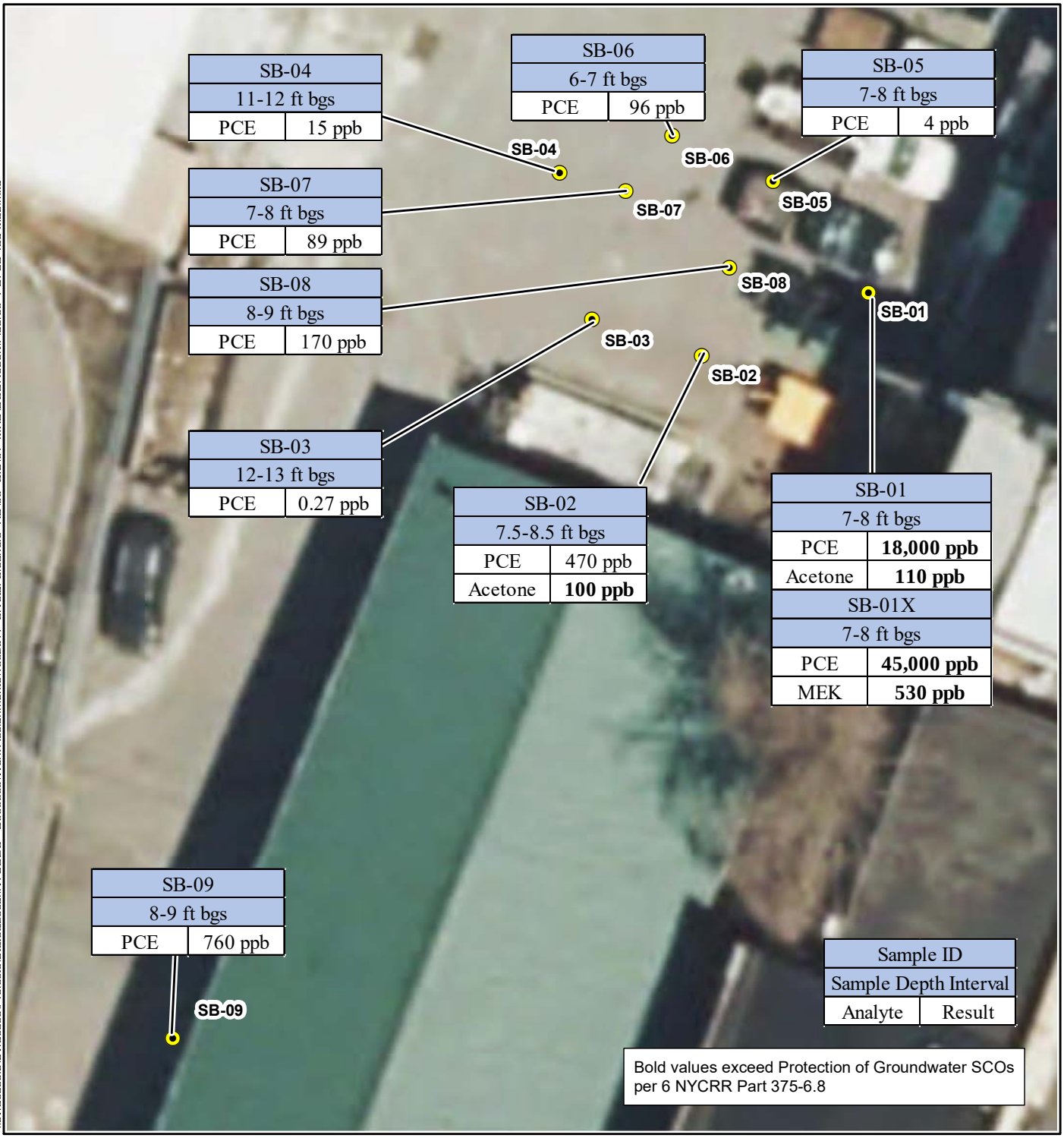

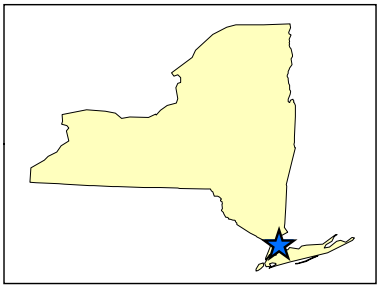

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Legend

Soil Boring Location

Note: Concentrations are presented in parts per billion (ppb)
bgs = below ground surface
ft = feet
PDI = Pre-Design Investigation
SCO = Soil Cleanup Objectives

Figure 9
PDI Soil Boring Tag Map (Onsite)
Crystal Cleaners
Pre-Design Investigation
Pelham, New York

Map Date: 4/13/2021
Projection:
NAD_1983_StatePlane_New_York_East_FIPS_3101_Feet

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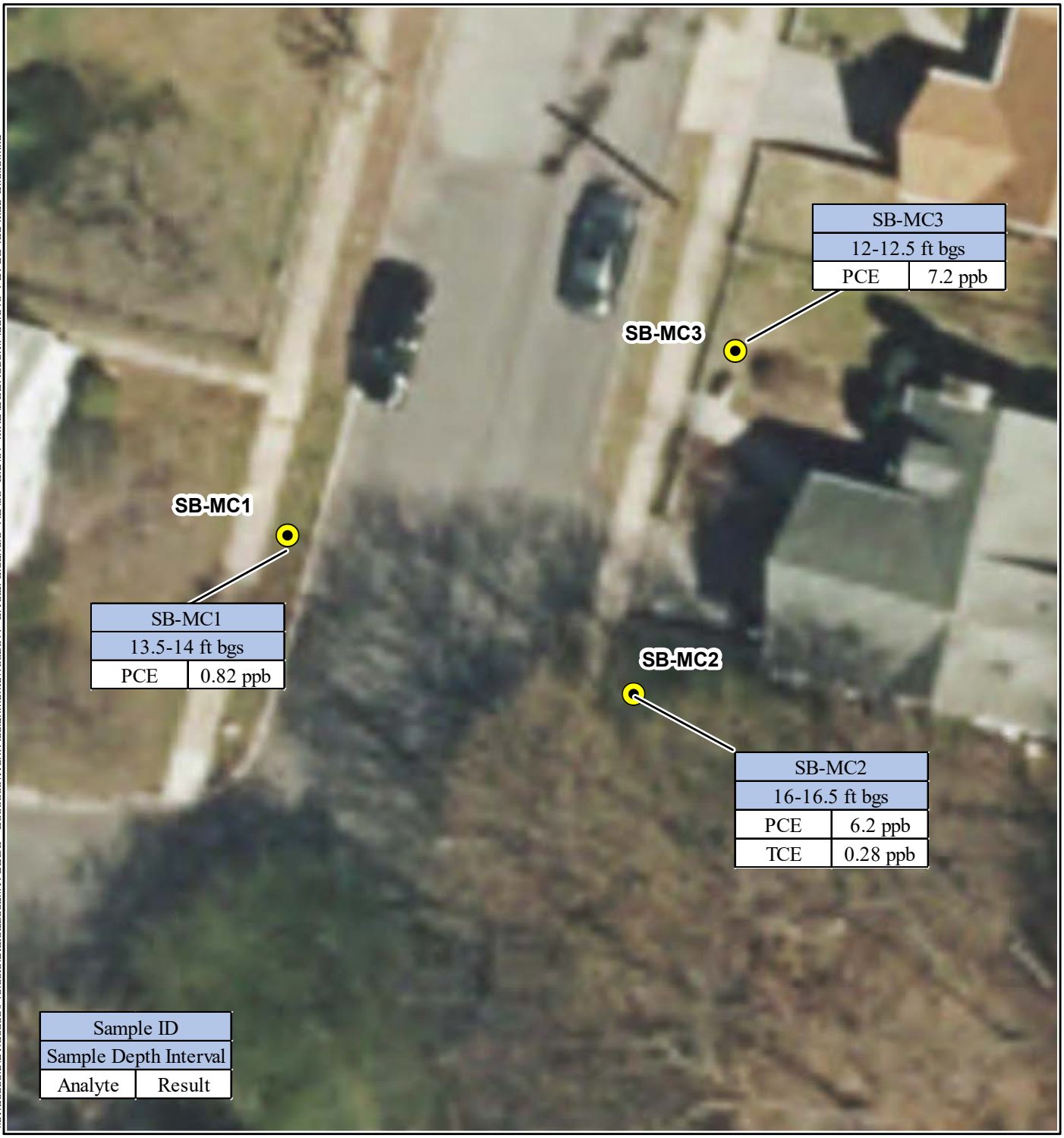

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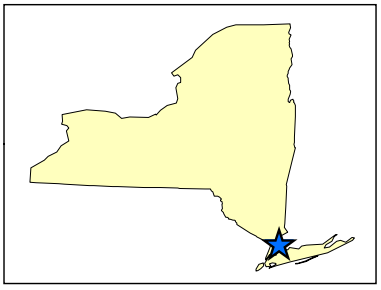

0 75 150
Feet

Legend

- Crystal Cleaners Property Boundary
- PDI Soil Boring Locations

Note: Concentrations are presented in parts per billion (ppb)
bgs = below ground surface
ft = feet
PDI = Pre-Design Investigation
SCO = Soil Cleanup Objectives

N

Figure 10
PDI Soil Boring Tag Map (Offsite)
Crystal Cleaners
Basis of Design Report
Pelham, New York

Map Date: 4/13/2021
Projection:
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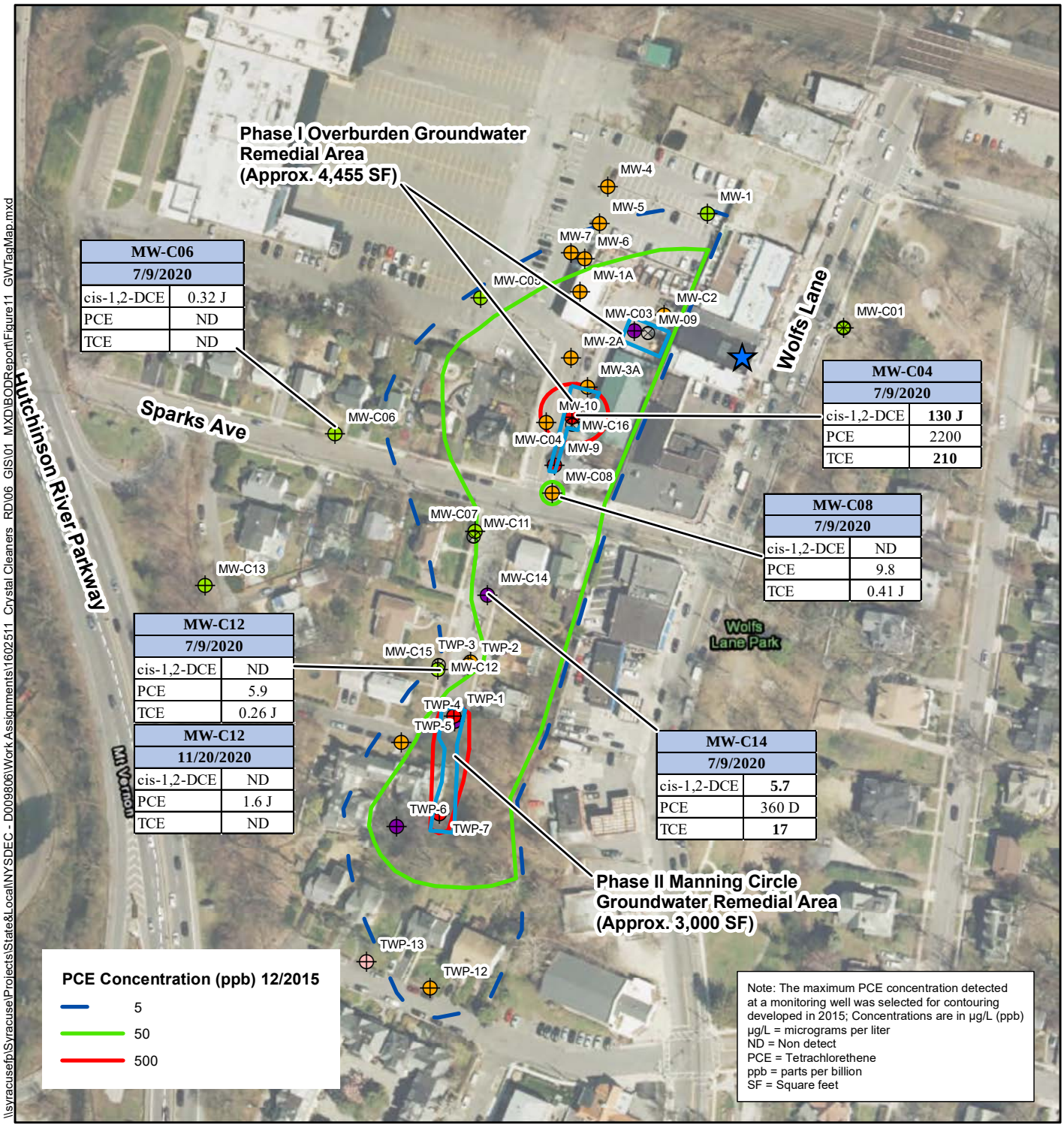
NEW YORK Department of Environmental Conservation



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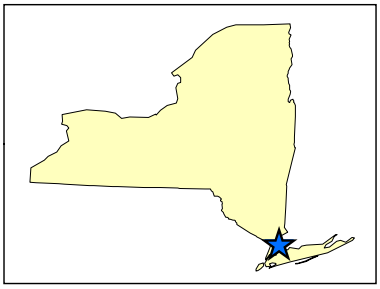

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Legend

- Site Location
- Overburden Groundwater Remedial Area
- Bedrock
- Bedrock/Overburden (ND)
- Overburden (>5)
- Overburden (>50)
- Overburden (>500)
- Overburden (ND)
- Overburden (ND, 10U)

Figure 11
Groundwater Analytical Results
Crystal Cleaners
Basis of Design Report
Pelham, New York

Map Date: 4/13/2021
Projection:
NAD_1983_StatePlane_New_York_East_FIPS_3101_Feet

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Tables

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Table 1 Summary of Votile Organic Compounds in Soil Samples

Analyte	Sample ID	PDI-SB-01-7-8	SB-1X	PDI-SB-02-7.5-8.5	PDI-SB-03-12-13	PDI-SB-Duplicate	PDI-SB-04-11-12	PDI-SB-05-7-8	PDI-SB-06-6-7	PDI-SB-07-7-8	PDI-SB-08-8-9	SB-8X	SB-MC1	SB-MC2	SB-MC3	Unrestricted Use SCOs[1] (µg/kg)
	Parent sample	NA	NA	NA	NA	PDI-SB-03-12-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	Laboratory ID	R2005991-001	R2011143-01	R2005991-002	R2005991-003	R2005991-004	R2005991-005	R2005991-006	R2005991-007	R2005991-009	R2005991-010	R2011143-02	R2011143-04	R2011143-05	R2011143-06	
	Interval (ft bgs)	7-8	7-8	7.5-8.5	12-13	12-13	11-12	7-8	6-7	7-8	8-9	8-9				
	Sample Date	7/9/2020	11/19/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	11/19/2020	11/19/2020	11/19/2020	11/19/2020	
	Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	
VOCs by EPA Method 8260C																
2-Butanone (MEK)	µg/kg	13 U	530 J	12 U	2.3 U	2.5 U	2.3 U	2.4 U	2.5 U	3.4 J	2.8 U	2.5 U	2.2 U	2.4 U	2.4 U	*120*
Acetone	µg/kg	110	780 U	100	14	14	15	33	15	34	35	5.8 U	5.2 U	5.6 U	5.7 U	*50*
Chloroform	µg/kg	1.3 U	34 U	1.2 U	0.23 U	0.25 U	0.23 U	0.24 U	0.25 U	0.27 U	0.28 U	0.39 J	0.22 U	0.33 J	0.73 J	*370*
Dichloromethane	µg/kg	18 U	470 U	18 J	3.3 U	3.4 J	4.7 J	3.6 J	4.5 J	5.2 J	5.8 J	3.5 U	0.22 U	0.24 U	0.24 U	*50*
Tetrachloroethene (PCE)	µg/kg	18,000 D	45,000 E	470	0.27 U	0.28 U	15	4 J	96	89	170	460 E	0.82 J	6.2	7.2	*1300*
Toluene	µg/kg	4.8 J	34 U	1.2 U	0.23 U	0.25 U	1.4 J	0.5 J	0.87 J	1.1 J	1.4 J	0.43 J	0.22 U	0.24 U	0.24 U	*700*
Trichloroethene (TCE)	µg/kg	5.2 J	77 J	1.3 U	0.26 U	0.27 U	0.25 U	0.26 U	0.61 J	0.35 J	0.45 J	1.3 J	0.25 U	0.28 J	0.27 U	*470*
Vinyl Chloride	µg/kg	3.0 U	77 U	2.7 U	0.53 U	0.56 U	0.52 U	0.53 U	0.57 U	0.61 U	0.63 U	0.56 U	0.51 U	0.55 U	0.55 U	*20*
cis-1,2-Dichloroethene	µg/kg	1.3 U	34 U	1.2 U	0.23 U	0.25 U	0.23 U	0.24 U	0.25 U	0.27 U	0.25 U	0.25 U	0.22 U	0.24 U	0.24 U	*250*
m,p-Xylenes	µg/kg	2.4 U	62 U	2.1 U	0.43 U	0.45 U	0.42 U	0.43 U	0.46 U	0.49 U	0.51 U	0.58 J	0.41 U	0.44 U	0.45 U	--
o-Xylene	µg/kg	1.3 U	34 U	1.2 U	0.23 U	0.25 U	0.23 U	0.24 U	0.25 U	0.27 U	0.28 U	0.25 J	0.22 U	0.24 U	0.24 U	--
Xylenes, total	µg/kg	3.7 U	96 U	3.3 U	0.66 U	0.70 U	0.65 U	0.67 U	0.71 U	0.76 U	0.79 U	0.83 J	0.22 U	0.24 U	0.24 U	*1600*
trans-1,2-Dichloroethene	µg/kg	1.3 U	34 U	1.2 U	0.23 U	0.25 U	0.23 U	0.24 U	0.25 U	0.27 U	0.28 U	0.25 U	0.22 U	0.24 U	0.24 U	*190*
trans-1,3-Dichloropropene	µg/kg	1.3 U	34 U	1.2 U	0.23 U	0.25 U	0.23 U	0.24 U	0.25 U	0.27 U	0.28 U	0.25 U	0.22 U	0.24 U	0.24 U	--

NOTES:

[1] New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation, 6 New York Code of Rules and Regulations Part 375 Environmental Remediation Programs Objectives (2006).
ID = Identification
EPA = U.S. Environmental Protection Agency
SCO = Soil Cleanup Objective
VOC = Volatile organic compound
ft bgs = Foot (feet) below ground surface
µg/kg = Micrograms(s) per kilogram
% = Percent
U = Analyte not detected above method detection limit.
E = Concentration has exceeded the calibration range for that specific analysis.
J = Result is estimated.
B = Analyte was also detected in the associated method blank.
Shaded cells indicate that the analyte was detected greater than the NYSDEC Unrestricted Use Soil Cleanup Objective.
Analytical results provided by ALS Environmental.

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Table 2 Summary of Grain Size in Soil Samples

Analyte	Sample ID	PDI-SB-09-9.5-24		SB-9GS		SB-MC2	
	Laboratory ID	R2005991-011		R2011143-003		R2011143-005	
	Interval (ft bgs)	9.5 - 24		8 - 20		12 - 20	
	Sample Date	7/9/2020		11/19/2020		11/19/2020	
	Sample Type	Soil		Soil		Soil	
Particle Size Determination by ASTM D422							
Description	**Sieve Size**	**Retained wt%**	**Passing wt%**	**Retained wt%**	**Passing wt%**	**Retained wt%**	**Passing wt%**
Gravel, Coarse	No. 3/4"	12.7	87.3	10.9	89.1	7.1	92.9
Gravel, Medium	No. 3/8"	2.6	84.7	11.6	77.8	7.5	85.5
Gravel, Fine	No. 4	7.2	77.5	8.8	68.6	7.9	77.5
Sand, Coarse	No. 10	10.7	66.9	12.5	56.1	12.7	64.8
Sand, Medium (#20)	No. 20	12.7	54.2	8.5	47.6	12.3	52.5
Sand, Medium (#40)	No. 40	16.7	37.5	20.7	27	24.7	27.8
Sand, Fine (#60)	No. 60	13.8	23.7	14.7	12.3	18.9	8.9
Sand, Fine (#140)	No. 140	12.7	11.0	7.8	4.5	6.3	2.6
Sand, Fine (#200)	No. 200	2.9	8.0	0.9	3.6	0.5	2.1

NOTES:
ID = Identification
ASTM = ASTM International
ft bgs = Foot (feet) below ground surface
% = Percent
%wt = percent weight
Analytical results provided by ALS Environmental.

Table 3 Summary of Volatile Organic Compounds in Groundwater Samples

Analyte	Sample ID	MW-C06		MW-C08		MW-C04		MW-C14		MW-C12		MW-C12		NYSDEC Ambient Water Quality Standards or Guidance Values[1]
	Laboratory ID	R2005995-003		R2005995-004		R2005995-005		R2005841-001		R2005841-003		R20011142-001		
	Sample Date	7/9/2020		7/9/2020		7/9/2020		7/7/2020		7/7/2020		11/20/2020		
	Sample Type	Groundwater		Groundwater		Groundwater		Groundwater		Groundwater		Groundwater		
VOCs via EPA Method 8260														
1,1,1-Trichloroethane (TCA)	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
1,1,2,2-Tetrachloroethane	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
1,1,2-Trichloroethane	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*1*
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
1,1-Dichloroethane (1,1-DCA)	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
1,1-Dichloroethene (1,1-DCE)	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
1,2,4-Trichlorobenzene	µg/L	0.34	U	0.34	U	8.5	U	0.34	U	0.34	U	0.34	U	*5*
1,2-Dibromo-3-chloropropane (DBCP)	µg/L	0.45	U	0.45	U	12	U	0.45	U	0.45	U	0.45	U	*NS*
1,2-Dibromoethane	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
1,2-Dichlorobenzene	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*3*
1,2-Dichloroethane	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*0.6*
1,2-Dichloropropane	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*1*
1,3-Dichlorobenzene	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*3*
1,4-Dichlorobenzene	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*3*
2-Butanone (MEK)	µg/L	0.78	U	0.78	U	20	U	0.78	U	0.78	U	0.78	U	*NS*
2-Hexanone	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
4-Methyl-2-pentanone	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
Acetone	µg/L	5.0	U	8.9	J	130	U	5.0	U	5.0	U	5.0	U	*NS*
Benzene	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*1*
Bromodichloromethane	µg/L	0.20	U	0.20	U	5.0	U	0.77	J	0.20	U	0.20	U	*NS*
Bromoform	µg/L	0.25	U	0.25	U	6.3	U	0.25	U	0.25	U	0.25	U	*NS*
Bromomethane	µg/L	0.70	U	0.70	U	18	U	0.70	U	0.70	U	0.70	U	*NS*
Carbon Disulfide	µg/L	0.42	U	0.42	U	11	U	0.42	U	0.42	U	0.42	U	*120*
Carbon Tetrachloride	µg/L	0.34	U	0.34	U	8.5	U	0.34	U	0.34	U	0.34	U	*5*
Chlorobenzene	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
Chloroethane	µg/L	0.23	U	0.23	U	5.8	U	0.23	U	0.23	U	0.23	U	*NS*
Chloroform	µg/L	0.24	U	0.24	U	6.0	U	**9.6**		0.28	J	0.24	U	*7*
Chloromethane	µg/L	0.28	U	0.28	U	7.0	U	0.40	BJ	0.37	BJ	0.28	U	*NS*
Cyclohexane	µg/L	0.26	U	0.26	U	6.5	U	0.26	U	0.26	U	0.26	U	*NS*
Dibromochloromethane	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
Dichlorodifluoromethane (CFC 12	µg/L	0.21	U	0.21	U	5.3	U	0.21	U	0.21	U	0.21	U	*NS*
Dichloromethane	µg/L	0.65	U	0.65	U	17	U	0.65	U	0.65	U	0.65	U	*5*
Ethylbenzene	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
Isopropylbenzene (Cumene)	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
Methyl Acetate	µg/L	0.33	U	0.33	U	8.3	U	0.33	U	0.33	U	0.33	U	*NS*
Methyl tert-Butyl Ether	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
Methylcyclohexane	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
Styrene	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
Tetrachloroethene (PCE)	µg/L	0.21	U	9.8		2200		360	D	5.9		1.60	J	*NS*
Toluene	µg/L	0.20	U	0.22	J	5.0	U	0.20	U	0.20	U	0.20	U	*NS*
Trichloroethene (TCE)	µg/L	0.20	U	0.41	J	**210**		**17**		0.26	J	0.20	U	*5*
Trichlorofluoromethane (CFC 11)	µg/L	0.24	U	0.24	U	6.0	U	0.24	U	0.24	U	0.24	U	*NS*
Vinyl Chloride	µg/L	0.20	U	0.20	U	6.5	J	0.20	U	0.20	U	0.20	U	*2*
cis-1,2-Dichloroethene	µg/L	0.32	J	0.23	U	**130**	**J**	**5.7**		0.23	U	0.23	U	*5*
cis-1,3-Dichloropropene	µg/L	0.20	U	0.20	U	5.0	U	0.20	U	0.23	U	0.20	U	*NS*
m,p-Xylenes	µg/L	0.20	U	0.20	U	5.0	U	0.23	U	0.23	U	0.20	U	*5*
o-Xylene	µg/L	0.20	U	0.20	U	5.0	U	0.23	U	0.23	U	0.20	U	*5*
trans-1,2-Dichloroethene	µg/L	0.20	U	0.20	U	9.7	J	0.28	J	0.2	U	0.20	U	*5*
trans-1,3-Dichloropropene	µg/L	0.23	U	0.23	U	5.8	U	0.23	U	0.23	U	0.23	U	*0.4*

NOTES:
[1]New York Code of Rules and Regulations Part 703.5 Class GA Groundwater Quality Regulations, as presented in the Division of Water Technical and Operational Guidance Series 1.1.1, 1998, as amended.
ID = Identification
µg/L = Microgram(s) per liter
U = Analyte was not detected; method detection limit indicated in parenthesi
B = Analyte was also detected in the associated method blank
J = Result is estimated.
Bold and shaded values indicate that the analyte was detected greater than the NYSDEC Ambient Water Quality Standards or Guidance Values.
If the method detection limit for a non-detect (U) result was greater than the corresponding standard or guidance value, then the result was flagged as an exceedanc
Analytical data results provided by ALS Environmental.

Table 4 Summary of Monitored Natural Attenuation Parameters in Groundwater Samples

Analyte	Sample ID	MW-C04		MW-C12		MW-C12	
	Laboratory ID	R2005995-005		R2005995-001		R2011142-001	
	Sample Date	7/10/2020		7/9/2020		11/20/2020	
	Sample Type	Water		Water		Water	
MNA Parameters							
Ethane	µg/L	0.17	U	0.17	U	0.17	U
Ethylene	µg/L	0.35	U	0.35	U	0.35	U
Methane	µg/L	0.75	U	0.75	U	0.75	U
Propane	µg/L	0.28	U	0.28	U	0.28	U
Ammonia as Nitrogen	mg/L	0.026	U	0.026	U	0.026	U
Phosphorus, Total	mg/L	0.778		0.043	J	0.124	
Chemical Oxygen Demand, Total	mg/L	5.3		9.7		5.9	
Iron, total	µg/L	8,830		3,260		22,900	
Iron, dissolved	µg/L	77.4	J	100	U	100	U
Manganese, total	µg/L	1,110		4,510		3,360	
Manganese, dissolved	µg/L	647		967		692	
Sulfide, Acid-Soluble	mg/L	1.0	U	1.0	U	1.0	U
Chloride	mg/L	284		704		475	
Nitrate as Nitrogen	mg/L	0.2	U	3.7		2.7	
Sulfate	mg/L	30.7		47.6		45.1	
Alkalinity, total as CaCO3	mg/L	120		104		117	
Biochemical Oxygen Demand (BOD)	mg/L	2.0	U	2.0	U	2.0	U
Total Organic Carbon (TOC)	mg/L	1.5		1.4		1.7	

NOTES:
MNA = Monitored natural attenuation
µg/L = Milligram(s) per liter
mg/L = Milligram(s) per liter
U = Analyte was not detected; method detection limit is shown.
J = Result is estimated.
Analytical data results provided by ALS Environmental.

Table 5 Toxicity Characteristic Leaching Procedure Analytical Results

		Sample ID	PDI-SB-07-4-6	PDI-SB-08-8-9	SB-1X	SB-8X
		Laboratory ID	3114717001	3114717002	R2011143-001	R2011143-002
		Sample Date	7/9/2020	7/9/2020	11/19/2020	11/19/2020
Analyte	**RCRA TCLP**	**Unit**	**Result**	**Result**	**Result**	**Result**
Metals (6010C)						
Arsenic	5.0	mg/L	(<0.046) U	(<0.046) U	(<0.046) U	(<0.046) U
Barium	100.0	mg/L	(<0.94) U	(<0.94) U	(<0.94) U	(<0.94) U
Cadmium, Total	1.0	mg/L	0.0067 J	(<0.94) U	(<0.0037) U	0.038
Chromium, Total	5.0	mg/L	(<0.010) U	(<0.0037) U	(<0.010) U	(<0.010) U
Lead	5.0	mg/L	0.028 J	0.027 J	(<0.011) U	0.15
Mercury	0.2	mg/L	(<0.00066) U	(<0.00066) U	(<0.00066) U	(<0.00066) U
Selenium	1.00	mg/L	(<0.037) U	(<0.037) U	(<0.037) U	(<0.037) U
Silver	5.0	mg/L	(<0.0070) U	(<0.0070) U	(<0.0070) U	(<0.0070) U
EPA Pesticides (8081B)						
gamma-BHC	--	mg/L	(<0.0001) U	(<0.0001) U	(<0.000096) U	(<0.000096) U
Clordane	0.03	mg/L	(<0.0032) U	(<0.0032) U	(<0.0016) U	(<0.0016) U
Endrin	0.02	mg/L	(<0.000060) U	(<0.000060) U	(<0.00012) U	(<0.00012) U
Heptachlor	0.008	mg/L	(<0.000080) U	(<0.000080) U	(<0.00012) U	(<0.00012) U
Heptachlor Epoxide	--	mg/L	(<0.000080) U	(<0.000080) U	(<0.000080) U	(<0.000080) U
Methoxychlor	10.0	mg/L	(<0.00020) U	(<0.00020) U	(<0.00027) U	(<0.00027) U
Toxaphene	0.5	mg/L	(<0.0106) U	(<0.0106) U	(<0.0038) U	(<0.0038) U
EPA Herbicides (8151A)						
2,4-D	10.0	mg/L	(<0.0132) U	(<0.0132) U	(<0.0132) U	(<0.0132) U
2,4,5-TP	1.00	mg/L	(<0.0018) U	(<0.0018) U	(<0.0018) U	(<0.0018) U
Volatile Organic Compounds (8260C)						
Benzene	0.5	mg/L	(<0.0080) U	(<0.0080) U	(<0.0080) U	(<0.0080) U
2-Butanone (MEK)	200.0	mg/L	(<0.060) U	(<0.060) U	(<0.060) U	(<0.060) U
Carbon tetrachloride	0.5	mg/L	(<0.0040) U	(<0.0040) U	(<0.0040) U	(<0.0040) U
Chlorobenzene	100.0	mg/L	(<0.0040) U	(<0.0040) U	(<0.0040) U	(<0.0040) U
Chloroform	6.0	mg/L	0.0227	0.0225	(<0.0040) U	(<0.0040) U
1,4-Dichlorobenzene	7.5	mg/L	(<0.0040) U	(<0.0040) U	(<0.0040) U	(<0.0040) U
1,2-Dichloroethane	0.5	mg/L	(<0.0040) U	(<0.0040) U	(<0.0040) U	(<0.0040) U
1,1-Dichloroethene	0.7	mg/L	(<0.0040) U	(<0.0040) U	(<0.0040) U	(<0.0040) U
Tetrachloroethene	0.7	mg/L	(<0.0040) U	0.0122 J	(<0.0080) U	(<0.0080) U
Trichloroethene	0.5	mg/L	(<0.0040) U	(<0.0040) U	(<0.0040) U	(<0.0040) U
Vinyl Chloride	0.2	mg/L	(<0.0040) U	(<0.0040) U	(<0.0040) U	(<0.0040) U
Semi-Volatile Organic Compounds (8270D)						
1,4-Dichlorobenzene	7.5	mg/L	(<0.0050) U	(<0.0050) U	(<0.0050) U	(<0.0050) U
2,4-Dinitrotoluene	0.13	mg/L	(<0.0052) U	(<0.0052) U	(<0.0052) U	(<0.0052) U
Hexachloro-1,3-butadiene	0.5	mg/L	(<0.0082) U	(<0.0082) U	(<0.0082) U	(<0.0082) U
Hexachlorobenzene	0.13	mg/L	(<0.0050) U	(<0.0050) U	(<0.0050) U	(<0.0050) U
Hexachloroethane	3.0	mg/L	(<0.0060) U	(<0.0060) U	(<0.0060) U	(<0.0060) U
2-Methylphenol(o-Cresol)	200.0	mg/L	(<0.010) U	(<0.010) U	(<0.010) U	(<0.010) U
3&4-Methylphenol(m&p Cresol)	200.0	mg/L	(<0.010) U	(<0.010) U	(<0.010) U	(<0.010) U
Nitrobenzene	2.0	mg/L	(<0.0050) U	(<0.0050) U	(<0.0050) U	(<0.0050) U
Pentachlorophenol	100.0	mg/L	(<0.010) U	(<0.010) U	(<0.010) U	(<0.010) U
Pyridine	5.0	mg/L	(<0.0092) U	(<0.0092) U	(<0.0092) U	(<0.0092) U
2,4,5-Trichlorophenol	400.0	mg/L	(<0.010) U	(<0.010) U	(<0.010) U	(<0.010) U
2,4,6-Trichlorophenol	2.0	mg/L	(<0.010) U	(<0.010) U	(<0.010) U	(<0.010) U
WET CHEMISTRY						
Cyanide, Reactive	--	mg/kg	(0.011) U	--	--	(0.011) U
Halogen, Total Reactive (TOX)	--	mg/kg	6.3	--	--	8.1
Ignitability	--	Deg. F	not ignitable	--	--	not ignitable
Sulfide, Reactive	--	mg/kg	7.2	--	--	10.4

Notes:
Deg. F = Degrees Fahrenheit
EPA = United State Environmental Protection Agency
mg/L = milligram(s) per liter
mg/kg = milligram(s) per kilogram
J = Estimated concentration
U = Indicates the compound was analyzed for, but not detected above the method detection limit.
Resource Conservation and Recovery Act (RCRA) Toxicity Characteristic Leaching Procedure (TCLP), October 2019, https://www.epa.gov/sites/production/files/2016-01/documents/hw-char.pdf
Analytical results provided by ALS Environmental

Appendix A

Draft Remedial Design Drawings

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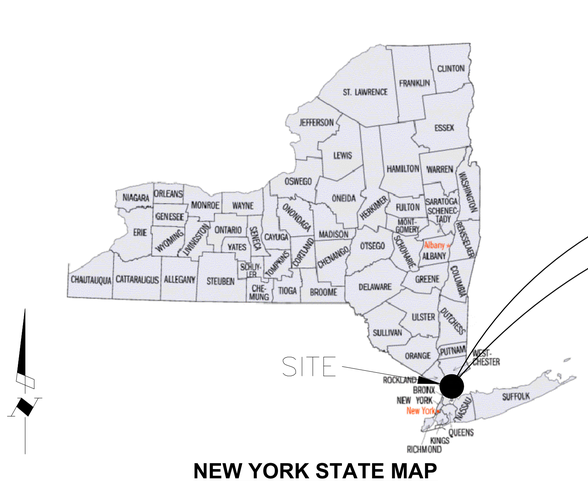
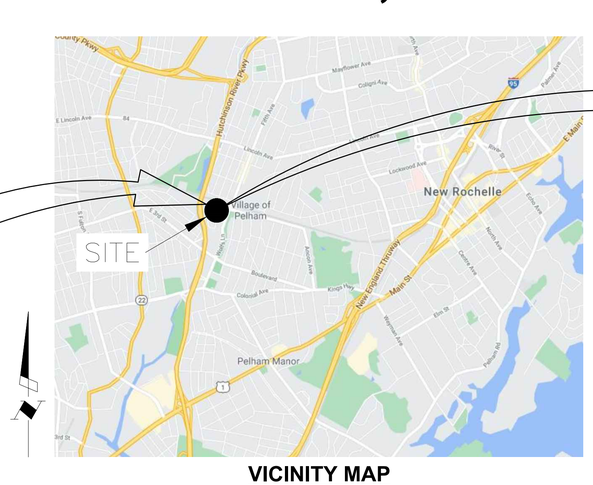
CRYSTAL CLEANERS SITE
NYS REGISTRY NO. 360053
113 WOLFS LANE
PELHAM, NEW YORK
REMEDIAL ACTION PLAN

PREPARED FOR
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ALBANY, NY



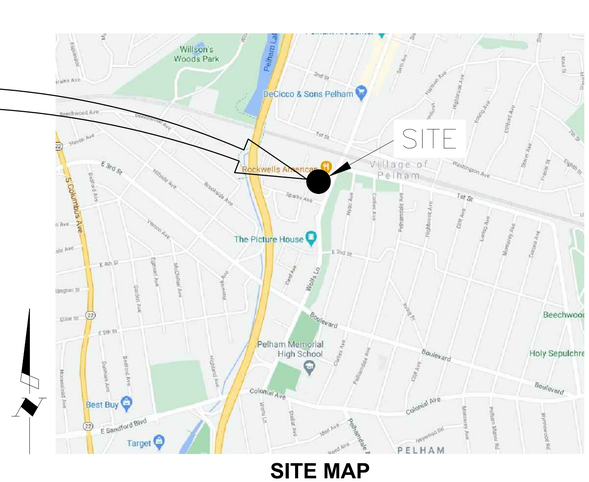
NEW YORK STATE MAP

NTS



VICINITY MAP

NTS



SITE MAP

NTS

SHEET LIST TABLE	
SHEET NUMBER	SHEET TITLE
1	TITLE SHEET
2	GENERAL NOTES & LEGEND
3	EXISTING CONDITIONS PLAN
4	EXCAVATION & RESTORATION PLANS
5	GROUNDWATER PLUME & INJECTION LAYOUT

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

NO.	DATE	DESCRIPTION
0	FEB 2021	FOR SCOPE OF WORK

REVISIONS

TITLE SHEET

CRYSTAL CLEANERS SITE
NYS REGISTRY NO. 360053
113 WOLFS LANE
PELHAM, NEW YORK

PREPARED BY:
EA ENGINEERING, P.C.
AND ITS AFFILIATE
EA SCIENCE AND
TECHNOLOGY

EA #	16025.11
FILE	16025.11-Plonset.dwg
DRAWN BY	DPA
DATE	APRIL 2021
SCALE	AS SHOWN

SEAL

SHEET # 1

LEGAL NOTES

1. ONLY BOUNDARY SURVEY MAPS WITH THE SURVEYOR'S EMBOSSED SEAL ARE GENUINE TRUE AND CORRECT COPIES OF THE SURVEYOR'S ORIGINAL WORK AND OPINION.

2. THE CERTIFICATION IS LIMITED TO PERSONS FOR WHOM THE BOUNDARY SURVEY MAP IS PREPARED, TO THE TITLE COMPANY, AND TO THE OTHER INSTITUTIONS LISTED ON THIS BOUNDARY SURVEY MAP.

3. THE CERTIFICATIONS HEREON ARE NOT TRANSFERABLE.

4. THE LOCATION OF UNDERGROUND IMPROVEMENTS OR ENCROACHMENTS ARE NOT ALWAYS KNOWN AND OFTEN MUST BE ESTIMATED. UNDERGROUND IMPROVEMENTS OR ENCROACHMENTS ARE NOT COVERED BY THIS CERTIFICATE.

5. UNDERGROUND UTILITY LOCATIONS ARE NOT GUARANTEED, NOR IS THERE ANY GUARANTEE THAT ALL EXISTING UTILITIES WHETHER FUNCTIONAL OR ABANDONED WITHIN THE PROJECT AREA ARE SHOWN ON THIS DRAWING. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL UNDERGROUND UTILITIES BY CONTACTING DIG SAFELY, NEW YORK AT 1-800-962-7962, IN ACCORDANCE WITH 16 NYCRR PART 753, (ALSO CITED AS INDUSTRIAL CODE 53 OR CODE RULE 53) BEFORE STARTING WORK AND SHALL BE RESPONSIBLE FOR ALL DAMAGE RESULTING FROM HIS WORK.

GENERAL NOTES

1. THE FOLLOWING EXCAVATION AND REMEDIAL PLAN OUTLINES THE SCOPE OF WORK ITEMS TO BE COMPLETED AT THE CRYSTAL CLEANERS SITE (SITE NO. 360063). THE ONSITE AREA LOCATED IN PROXIMITY TO 113 WOLFS LANE AND THE OFFSITE AREA IS LOCATED ON MANNING CIRCLE. ALL CONTAMINATED SOILS (AS INDICATED ON THIS DRAWING SET) ARE TO BE EXCAVATED AND DISPOSED OFFSITE. SCOPE OF WORK ALSO INCLUDES ADDITION OF COLLOIDAL ACTIVATED CARBON IN OPEN EXCAVATION AND INJECTION POINTS DEPICTED IN THE DRAWING SET. CONTRACTOR SHALL BE RESPONSIBLE FOR SECURING AND PROVIDING ALL EQUIPMENT, MATERIALS, AND PERSONNEL REQUIRED TO COMPLETE THE SCOPE OF WORK.

2. CONTRACTOR PRIOR TO START OF WORK SHALL OBTAIN ANY AND ALL REQUIRED PERMITS FROM THE TOWN OF PELHAM BUILDING DEPARTMENT AND ANY OTHER AGENCIES THAT HAVE JURISDICTION. WHICH SHALL INCLUDE THE FOLLOWING WHERE APPLICABLE:

   A. BUILDING PERMIT
   B. SOLID AND HAZARDOUS WASTE TRANSPORTER PERMITS
   C. MECHANICAL MEANS/EXCAVATION PERMIT
   D. CONSTRUCTION FENCE PERMIT
   E. STREET RIGHT-OF-WAY PERMIT
   F. STREET OPENING PERMIT

3. WORK WILL REQUIRE A STREET OPENING PERMIT FROM THE VILLAGE OF PELHAM. CONTRACTOR SHALL BE RESPONSIBLE FOR MEETING ALL PERMIT CONDITIONS AND WORK WILL BE PERFORMED IN ACCORDANCE WITH THE VILLAGE OF PELHAM STREET OPENING INSTRUCTION SPECIFICATION PROVIDED IN THE SCOPE OF WORK.

4. THE CONTRACTOR SHALL PREPARE AND SUBMIT A WORK PLAN AS SPECIFIED IN THE CONTRACTOR SCOPE OF WORK FOR APPROVAL BY THE ENGINEER AND NYSDEC PRIOR TO COMMENCING WORK ONSITE. THE WORK PLAN WILL INCLUDE, AT A MINIMUM THE FOLLOWING:

   A. PROPOSED MEANS AND METHODS AND SEQUENCE OF TASKS
   B. HEALTH AND SAFETY PLAN
   C. EROSION AND SEDIMENT CONTROL PLAN
   D. DUST CONTROL PLAN
   E. STRUCTURAL ASSESSMENT BY A LICENSED PROFESSIONAL STRUCTURAL ENGINEER OF ADJACENT STRUCTURES PRIOR TO AND AFTER WORK IS PERFORMED.
   F. CAMP
   G. VIBRATION MONITORING PLAN

4. CONTRACTOR SHALL COMPLY WITH NYSDOT WORK ZONE TRAFFIC CONTROL MANUAL, WHERE APPLICABLE, AND ALWAYS MAINTAIN SAFE AND CLEAR ACCESS AROUND AND FROM THE SITE.

5. DURING AND THROUGHOUT ALL CONSTRUCTION ACTIVITIES, CONTRACTOR SHALL IMPLEMENT AIR MONITORING AND DUST CONTROL MEASURES UTILIZING WATER SPRAY AND MISTING.

6. THE CONTRACTOR SHOULD MAKE PROVISIONS TO PREVENT STORM WATER RUN-IN INTO THE EXCAVATION. ADDITIONALLY, THE REMEDIAL CONTRACTOR SHALL MAKE PROVISIONS TO HAVE TREATMENT AGENTS AND COVER ON-SITE TO CONTAIN VAPORS, IF DETERMINED NECESSARY BY EA AND NYSDEC.

7. CONTRACTOR SHALL PREPARE A TRANSPORTATION AND DISPOSAL PLAN AS A COMPONENT OF THE WORK PLAN. IT SHALL INCLUDE RELEVANT TRANSPORTER AND DISPOSAL/TREATMENT FACILITY IDENTIFICATIONS, STATUS, METHODS OF TRANSPORTATION FOR DISPOSAL/TREATMENT, CONTINGENCY FOR SPILLS DURING TRANSPORTATION, AND SCHEDULE FOR TRANSPORTATION AND DISPOSAL. IDENTIFY FACILITY SPECIFIC REQUIREMENTS FOR WASTE PROFILE SAMPLING AND ANALYSIS TO DETERMINE ACCEPTANCE FOR DISPOSAL/TREATMENT. INCLUDE COPY OF LETTER OF COMMITMENT FROM EACH FACILITY AND COPIES OF THE FACILITY OPERATING LICENSES AND PERMITS.

8. PROVIDE TO ENGINEER AND DEPARTMENT COPIES OF WEIGH SCALE TICKETS ON APPROVED FORMS SIGNED BY AN AUTHORIZED WEIGH SCALE OPERATOR INCLUDING THE FOLLOWING INFORMATION:

   A. LOCATION, DATE, AND TIME OF WEIGHING.
   B. MEASURED WEIGHTS.
   C. VEHICLE AND CONTAINER IDENTIFICATION.
   D. SHIPMENT IDENTIFICATION NUMBER.

9. SUBMIT TO ENGINEER AND DEPARTMENT COMPLETED WASTE PROFILE FOR EACH WASTE STREAM. WASTE PROFILE WILL BE SIGNED BY ENGINEER OR AN AUTHORIZED AGENT OF THE DEPARTMENT EXCEPT FOR MATERIALS BROUGHT ONSITE BY CONTRACTOR.

10. THE CONTRACTOR SHALL IMPLEMENT ALL REQUIRED SITE LOGISTICS, TRUCK ROUTING, SAFETY ZONES, DECONTAMINATION PADS, ETC PRIOR TO START OF CONSTRUCTION.

11. ESTABLISHED SURVEY CONTROL POINTS ARE AVAILABLE FOR CONSTRUCTION PURPOSES. THE CONTRACTOR SHALL VERIFY LOCATIONS OF SURVEY CONTROL POINTS STARTING TO WORK, SAFEGUARD ALL SURVEY CONTROL POINTS DURING WORK, AND REPLACE ANY CONTROL POINTS DAMAGED OR DESTROYED DURING EXECUTION OF THE REMEDIAL ACTION.

12. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LAYOUT OF THE SITE, CONSTRUCTION AND ANY ADDITIONAL SURVEY CONTROL POINTS, LINES, GRADES, AND LEVELS NECESSARY FOR PROPER EXECUTION OF THE WORK. SURVEY CONTROL SHALL INCLUDE, BUT IS NOT LIMITED TO, MAINTAINING APPROPRIATE SLOPES, SPECIFIED THICKNESSES, SPECIFIED ELEVATIONS, AND CONSTRUCTED LOCATIONS AS SHOWN ON THE DRAWINGS.

13. THE CONTRACTOR SHALL EMPLOY A LAND SURVEYOR LICENSED IN THE STATE OF NEW YORK AND IS RESPONSIBLE FOR SCHEDULING SURVEYS TO COINCIDE WITH CONSTRUCTION ACTIVITIES. SURVEY DOCUMENTATION INCLUDES, BUT MAY NOT BE LIMITED TO:

   A. PRE-EXCAVATION SURVEY TO VERIFY SITE CONDITIONS/ELEVATIONS
   B. POST-EXCAVATION WHEN FINAL CUTS ARE MET INCLUDING:

      B.1. TOPOGRAPHIC SURVEY FOLLOWING EXCAVATION OF CONTAMINATED SOIL.
      B.2. SURVEY LOCATIONS OF POST-EXCAVATION CONFIRMATION SAMPLES

   C. BACKFILL, COMPACTION, AND RESTORATION SURVEY

      C.1. FINAL GRADING OF THE SITE AND FINAL SURFACE ELEVATIONS OR RESTORED EXCAVATION AREA TO BE PRESENTED ON AS-BUILT DRAWINGS
      C.2. DOCUMENTATION OF AS-BUILT QUANTITIES REQUIRED FOR MEASUREMENT AND PAYMENT
      C.3. LOCATION OF INJECTION POINTS AND OTHER FEATURES FOR INCLUSION ON THE AS-BUILT DRAWINGS.

14. THE CONTRACTOR SHALL CONDUCT A PRE-CONSTRUCTION AND POST-CONSTRUCTION STRUCTURAL ASSESSMENT OF SURROUNDING PROPERTIES WITH THE ASSISTANCE OF A STRUCTURAL ENGINEER AND CONDUCT VIBRATION MONITORING DURING CONSTRUCTION ACTIVITIES.

ON-SITE GENERAL NOTES

1. ABSTRACT OF TITLE - NOT PROVIDED AT THE TIME OF SURVEY AND MAY CONTAIN SPECIFIC TITLE INFORMATION. 2, CERTIFICATE OF TITLE - NOT PROVIDED AT THE TIME OF SURVEY AND MAY CONTAIN SPECIFIC TITLE INFORMATION.

2. "CONSTRUCTION, ACCESS AND UTILITY EASEMENT AGREEMENT" BETWEEN THE VILLAGE OF PELHAM AND PELPARK, LLC, RECORDED 03/01/2019 IN THE OFFICE OF THE WESTCHESTER COUNTY CLERK, DIVISION OF LAND RECORDS, DOCUMENT CONTROL NUMBER 590423177.

3. NYSGIS 2016 ORTHOIMAGERY WAS USED AS THE BASIS FOR SHOWING THE LOCATION OF CERTAIN FEATURES (EXCLUDING BOUNDARIES) WHERE GROUND MEASUREMENTS ARE NOT OTHERWISE NECESSARY TO LOCATE THOSE FEATURES TO AN APPROPRIATE AND ACCEPTABLE ACCURACY RELATIVE TO A NEARBY BOUNDARY.

4. POTENTIAL ENCROACHMENT - ONE STORY CONCRETE BUILDING FROM TMN 163.44-1-2.1 ONTO TMN 163.51-1-70 NEAR THE NORTHEAST CORNER, AS SHOWN.

ON-SITE REFERENCE DATA

1. TAX MAP - TOWN OF PELHAM, VILLAGE OF PELHAM, WESTCHESTER COUNTY, NEW YORK, MAP 163.43, DATE OF MAP 03/26/1990, LAST REVISED 01/19/2016.

2. TAX MAP- TOWN OF PELHAM, VILLAGE OF PELHAM, WESTCHESTER COUNTY, NEW YORK, MAP 163.51, DATE OF MAP 03/26/1990, LAST REVISED 01/19/2016.

3. "101 WOLFS LANE, SECTION NO. 163.44, BLOCK NO. 01, LOT NO. 2.1, VILLAGE OF PELHAM, WESTCHESTER, NEW YORK, ACCESS & UTILITY EASEMENT PLAN", PREPARED BY LANGAN ENGINEERING, ENVIRONMENTAL, SURVEYING, LANDSCAPE ARCHITECTURE AND GEOLOGY, D.P.C., DATED 10/23/2018, LAST REVISED 01/14/2019.

4. "MAP OF PELHAMVILLE, WESTCHESTER COUNTY, NEW YORK", SURVEYED BY WILLIAM BRYSON, ARCHITECT & CIVIL ENGINEER, NEW ROCHELLE, SURVEY COMPLETED 08/04/1857, FILED MAP NO. 205.

OFF-SITE REFERENCE DATA

1. TAX MAP- TOWN OF PELHAM, VILLAGE OF PELHAM, WESTCHESTER COUNTY, NEW YORK, MAP 163.51, DATE OF MAP 03/26/1990, LAST REVISED 01/19/2016.

2. "RESUBDIVISION OF LOTS 3,4,5,6,7,8,9,10,11,12,13,14, REVISED MAP OF MANNING TERRACE, PELHAM, N.Y.", PREPARED BY JOHN F. FAIRCHILD, C.E., DATED 03/24/1931, FILED IN THE OFFICE OF THE REGISTER OF WESTCHESTER COUNTY ON 01/14/1932, MAP NO. 3842.

3. "REVISED MAP OF MANNING TERRACE, PELHAM, N.Y.", PREPARED BY JOHN F. FAIRCHILD, C.E., DATED 05/02/1930, FILED IN THE OFFICE OF THE REGISTER OF WESTCHESTER COUNTY ON 05/09/1930, MAP NO. 3601.

4. "MAP OF MANNING TERRACE, PELHAM, N.Y.", PREPARED BY JOHN F. FAIRCHILD, C.E., DATED 03/17/1924, FILED IN THE OFFICE OF THE REGISTER OF WESTCHESTER COUNTY ON 03/31/1924 MAP NO. 2594.

5. "SUBDIVISION OF PROPERTY BELONGING TO THE WOLFS LANE IMPROVEMENT CO. INC., PELHAM, N.Y.", PREPARED BY JOHN F. FAIRCHILD, C.E., DATED 03/08/1923, FILED IN THE OFFICE OF THE REGISTER OF WESTCHESTER COUNTY ON 04/12/1923, MAP NO. 2495.

6. "MAP OF PELHAMVILLE, WESTCHESTER COUNTY, NEW YORK", SURVEYED BY WILLIAM BRYSON, ARCHITECT & CIVIL ENGINEER, NEW ROCHELLE, SURVEY COMPLETED 08/04/1857, FILED MAP NO. 205.

OFF-SITE GENERAL NOTES

1. ABSTRACT OF TITLE - NOT PROVIDED AT THE TIME OF SURVEY AND MAY CONTAIN SPECIFIC TITLE INFORMATION.

2. CERTIFICATE OF TITLE - NOT PROVIDED AT THE TIME OF SURVEY AND MAY CONTAIN SPECIFIC TITLE INFORMATION.

3. NYSGIS 2016 ORTHOIMAGERY WAS USED AS THE BASIS FOR SHOWING THE LOCATION OF CERTAIN FEATURES (EXCLUDING BOUNDARIES) WHERE GROUND MEASUREMENTS ARE NOT OTHERWISE NECESSARY TO LOCATE THOSE FEATURES TO AN APPROPRIATE AND ACCEPTABLE ACCURACY RELATIVE TO A NEARBY BOUNDARY.

4. POTENTIAL ENCROACHMENT - SOUTHEAST CORNER OF PLAYGROUND ON TMN 163.51-1-41 ONTO TMN 163.51-1-34 ALONG THE NORTH LINE BY UP TO 0.4 FEET.

LEGEND

- R.O.W. MONUMENTATION FOUND (AS NOTED)
- MONUMENTATION FOUND (AS NOTED)
- PROPERTY LINE
- CC — CURB CUT
- OU — OVERHEAD UTILITIES
- UU — UNDERGROUND UTILITIES (PAINT)
- UT — UNDERGROUND COMMUNICATIONS LINE (PAINT)
- GAS LINE (PAINT)
- W — WATER LINE (PAINT)
- CPP — CORRUGATED PLASTIC PIPE STORM SEWER (OBSERVED)
- PVC — POLYVINYL CHLORIDE PIPE STORM SEWER (OBSERVED)
- PLANTINGS
- FENCE LINE (AS NOTED)
- WOODS LINE
- 31 / 30 / 29 — 1' CONTOUR INTERVAL
- BASELINE POINT
- BENCH MARK
- BORING
- BUSH
- DECIDUOUS TREE (SIZE NOTED)
- UTILITY POLE
- LIGHT POLE
- ELECTRIC METER
- MISCELLANEOUS MANHOLE
- GAS METER
- GAS VALVE
- GAS PUMP
- FIRE HYDRANT
- WATER VALVE
- DRAINAGE STRUCTURE
- GATE/FENCE POST
- RD — ROOF DRAIN TO 4" PVC
- MISCELLANEOUS UTILITY
- MONITORING WELL
- SIGN (AS NOTED)
- SANITARY MANHOLE
- STORM DRAINAGE MANHOLE
- TELEPHONE MANHOLE
- ADA TACTILE WARNING TILE
- SPOT ELEVATION
- PIPE INVERT
- FF — FINISHED FLOOR

Department of Environmental Conservation

NEW YORK STATE OF OPPORTUNITY

NO.	DATE	DESCRIPTION
0	FEB 2021	FOR SCOPE OF WORK

REVISIONS

GENERAL NOTES & LEGEND

CRYSTAL CLEANERS SITE
NYS REGISTRY NO. 360063
113 WOLFS LANE
PELHAM, NEW YORK

PREPARED BY:
EA ENGINEERING, P.C.
AND ITS AFFILIATE
EA SCIENCE AND
TECHNOLOGY

EA #	16025.11
FILE	16025.11–Planset.dwg
DRAWN BY	DPA
DATE	APRIL 2021
SCALE	AS SHOWN

SEAL

SHEET # 2

ON-SITE DPW PROPERTY EXISTING CONDITIONS

GRAPHIC SCALE IN FEET (20 10 0 20 40)

OFF-SITE MANNING CIRCLE RESIDENTIAL AREA EXISTING CONDITIONS

GRAPHIC SCALE IN FEET (30 15 0 30 60)

WARNING – IT IS A VIOLATION OF NEW YORK EDUCATION LAW, ARTICLE 145, SECTION 7209.2, FOR ANY PERSON, UNLESS HE OR SHE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER OR LAND SURVEYOR, TO ALTER THIS DOCUMENT IN ANY WAY. IF ALTERED, THE ALTERING ENGINEER OR LAND SURVEYOR SHALL COMPLY WITH THE REQUIREMENTS OF NEW YORK EDUCATION LAW, ARTICLE 145, SECTION 7209.2.

NEW YORK STATE OF OPPORTUNITY
Department of Environmental Conservation

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EXISTING CONDITIONS PLAN

CRYSTAL CLEANERS SITE
NYS REGISTRY NO. 360063
113 WOLFS LANE
PELHAM, NEW YORK

PREPARED BY:
EA ENGINEERING, P.C.
AND ITS AFFILIATE
EA SCIENCE AND
TECHNOLOGY

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FILE	16025.11-Planset.dwg
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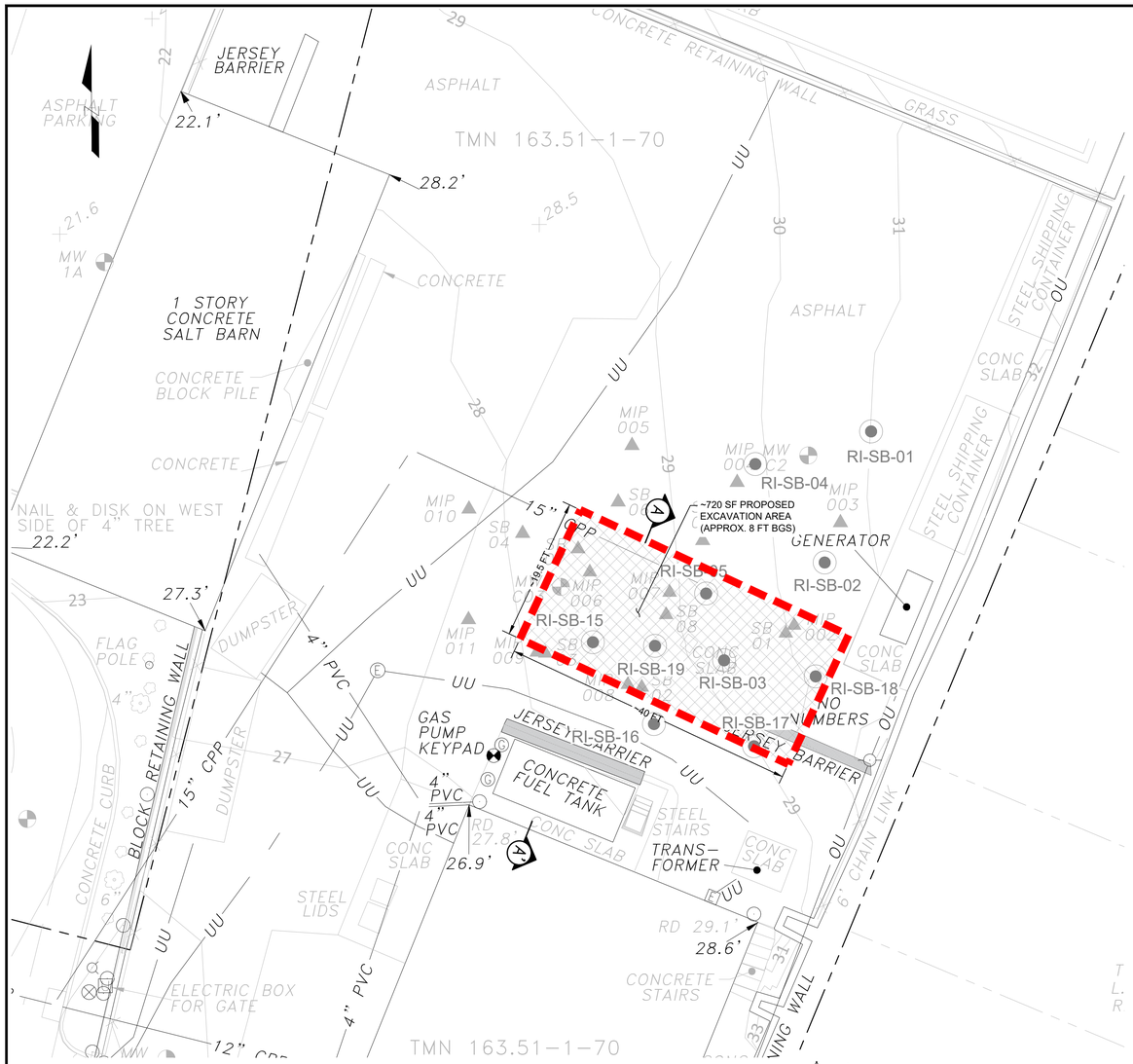
SCALE	AS SHOWN

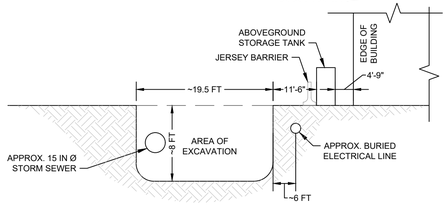
SEAL

SHEET # 3



ON-SITE DPW PROPERTY EXCAVATION PLAN

10 5 0 10 20
GRAPHIC SCALE IN FEET

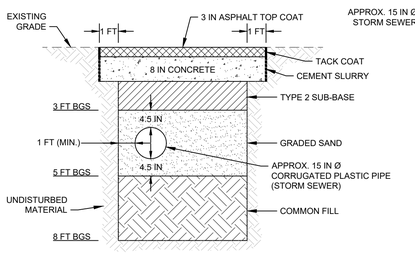


A-A' EXCAVATION CROSS SECTION

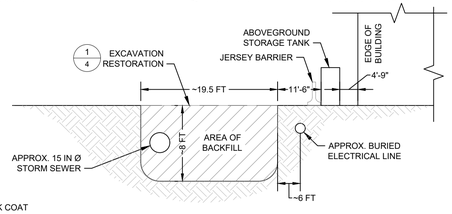
NOT TO SCALE – DIMENSION MEASUREMENTS

EXCAVATION NOTES:

1. ALL WORK AND EXCAVATIONS SHOULD BE CONDUCTED IN ACCORDANCE WITH OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION SPECIFICATIONS (29 CFR PART 1926) AND BE PROTECTIVE OF ADJACENT STRUCTURES (E.G., FORMER CRYSTAL CLEANERS BUILDING, DPW BUILDINGS, SUBSURFACE UTILITIES, ETC.).
2. THE EXCAVATION FOOTPRINT MAY BE EXTENDED BASED ON VISUAL AND OLFACTORY EVIDENCE OF IMPACTED SOIL. THE REMEDIAL CONTRACTOR MAY BE INSTRUCTED BY EA AND NYSDEC TO EXPAND THE EXCAVATION HORIZONTALLY AND/OR VERTICALLY. THE REMEDIAL CONTRACTOR SHALL MAKE PROVISIONS TO HAVE MEANS TO REMOVE IMPACTED GROUNDWATER OR CONSTRUCTION WATER IF EXCAVATION DEWATERING IS REQUIRED. ANY WATER REMOVED FROM THE EXCAVATION SHALL BE DISPOSED OFFSITE AT AN APPROVED FACILITY.
3. DEPTH OF EXCAVATION SHOULD NOT EXTEND BELOW THE WATER TABLE TO AVOID WATER ACCUMULATION IN THE EXCAVATION.
4. A 15-IN CORRUGATED PLASTIC STORM SEWER WATER CONVEYANCE PIPING AND DROP INLET IS LOCATED NEAR THE NORTHERN PORTION OF THE EXCAVATION. THE CONTRACTOR SHALL REMOVE THE PIPING AND DROP INLET DURING EXCAVATION AND REINSTALL/RECONNECT THE COMPONENTS IN KIND DURING RESTORATION.



1/4 EXCAVATION RESTORATION
SCALE:NOT TO SCALE



A-A' RESTORATION CROSS SECTION

NOT TO SCALE – DIMENSION MEASUREMENTS

ON-SITE DPW PROPERTY RESTORATION PLAN

10 5 0 10 20
GRAPHIC SCALE IN FEET

RESTORATION NOTES:

1. IF THE EXCAVATION IS DRY, THE REMEDIAL CONTRACTOR SHALL BACKFILL THE EXCAVATED AREAS FIRST WITH 3-FT. OF CERTIFIED CLEAN COMMON FILL MEETING THE REQUIREMENTS OF NYSDEC DER-10 5.4E AND 6 NYCRR PART 375 6.7 D(1)(III)(C). SHOULD WATER BE PRESENT IN THE BOTTOM OF THE EXCAVATION, 1-IN. WASHED STONE ORIGINATING FROM A VIRGIN SOURCE SHALL BE PLACED IN THE EXCAVATION AND EXTEND 1 FT ABOVE THE WATER LEVEL.
2. TWENTY-FOUR INCHES OF CLEAN GRADED SAND WILL BE PLACED ON TOP OF THE COMMON FILL AND COMPACTED IN 12-IN. LIFTS. THE REPLACEMENT STORMWATER PIPING (15-IN CORRUGATED PLASTIC PIPE) SHALL BE PLACED SO THAT AT LEAST 4-IN OF GRADED SAND ARE ABOVE AND BELOW THE PIPE.
3. THE REMAINING ANNULUS WILL BE BACKFILLED WITH NYS DOT ITEM 304.02 TYPE 2 SUBBASE TO WITHIN 11-IN. OF FINAL GRADE.
4. THE EXCAVATION WILL BE TEMPORARILY COVERED WITH POLY SHEETING AND SECURED. INJECTIONS WILL BE PERFORMED WITHIN THE RESTORED EXCAVATION AREA PRIOR TO FINAL SURFACE COMPLETION WITH CONCRETE AND ASPHALT. INJECTION DETAILS ARE DESCRIBED ON SHEET 5.
5. FINAL SURFACE COMPLETION WILL BE COMPLETED FOLLOWING INJECTIONS.
6. A CEMENT SLURRY SHALL BE APPLIED TO THE EXISTING CONCRETE PRIOR TO PLACING NEW CONCRETE. 8-IN. OF CONCRETE MEETING THE REQUIREMENTS OF NEW YORK STATE DEPARTMENT OF TRANSPORTATION SECTION 608 AND HAVE A COMPRESSIVE STRENGTH NOT LESS THAN 3,000 PRESSURE PER SQUARE INCH WILL BE INSTALLED ON TOP OF THE TYPE 2 SUBBASE.
7. TACK COAT SHALL BE APPIED TO EXISTING ASPHALT AT LEAST 30 MINUTES PRIOR TO PLACING THE NEW ASPHALT SURFACE.
8. THE RESTORATION OF THE SURFACE WILL BE COMPLETED WITH A 3-IN ASPHALT TOP COAT OF NYS TYPE 6, OR EQUIVALENT, AND COMPACTED TO ENSURE A TIGHT SURFACE CONFORMING TO ADJACENT UNDISTURBED ASPHALT SURFACE.

Department of Environmental Conservation
NEW YORK STATE OF OPPORTUNITY

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0	FEB 2021	FOR SCOPE OF WORK

REVISIONS

EXCAVATION & RESTORATION PLANS

CRYSTAL CLEANERS SITE
NYS REGISTRY NO. 360063
113 WOLFS LANE
PELHAM, NEW YORK

PREPARED BY:
EA ENGINEERING, P.C. AND ITS AFFILIATE EA SCIENCE AND TECHNOLOGY

EA #	16025.11
FILE	16025.11-Plonset.dwg
DRAWN BY	DPA
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SCALE	AS SHOWN

SEAL

SHEET # 4

ON-SITE DPW PROPERTY GROUNDWATER PLUME & INJECTION LAYOUT

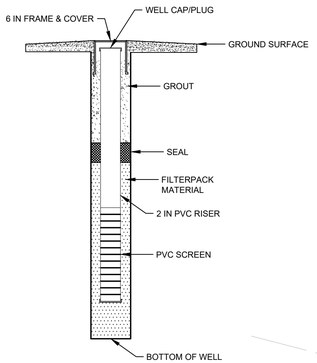
20 10 0 20 40
GRAPHIC SCALE IN FEET

PLUME & INJECTION LEGEND

- 5 — 5 µg/L PCE CONCENTRATION CONTOUR
- 50 — 50 µg/L PCE CONCENTRATION CONTOUR
- 500 — 500 µg/L PCE CONCENTRATION CONTOUR
- OVERBURDEN GROUNDWATER REMEDIAL AREA
- IN-SITU INJECTION POINT

INJECTION NOTES:

1. CONTRACTOR SHALL PERFORM IN SITU INJECTIONS OF COLLODIAL ACTIVATED CARBON PRODUCT INTO THE AREAS SHOWN ON THIS SHEET. THE AREAS SHOWN TOTAL ~4,455 SF. INJECTIONS SHALL TARGET OVERBURDEN GROUNDWATER, ESTIMATED TO RANGE FROM 8 FT BGS TO TOP OF BEDROCK AT 20 FT BGS.
2. INJECTION OF PRODUCT WILL BE PERFORMED USING DIRECT-PUSH TECHNOLOGY (DPT). RADIUS OF INFLUENCE (ROI) OF INJECTION POINTS SHALL BE APPROXIMATELY 5-FT. SHOULD THE CONTRACTOR'S SELECTED PRODUCT HAVE A LARGER ROI, THE NUMBER OF INJECTION POINTS MAY BE REDUCED.
3. INJECTION PRESSURES, FINAL ROIS, AND FINAL GRID LOCATIONS SHALL BE CONFIRMED WITH VENDOR SELECTED TO SUPPLY AND INJECT CARBON PRODUCT.
4. THE CONTRACTOR SHALL PROCURE ANY AND ALL PERMITS REQUIRED FROM TO PERFORM REMEDIAL INJECTIONS.
5. INJECTION POINTS SHALL BE RESTORED AS SPECIFIED HEREIN: INJECTION POINTS INSTALLED AT THE SOUTHERN END OF THE DPW PROPERTY WILL BE BACKFILLED WITH HYDRATED BENTONITE TO WITHIN 6-IN OF SURROUNDING GRADE AND THEN RESTORED WITH COLD PATCH TO MEET GRADE OF SURROUNDING ASPHALT. INJECTION POINTS INSTALLED WITHIN THE EXCAVATION AREA WILL BE BACKFILLED WITHIN 6-IN OF SURROUNDING GRADE WITH HYDRATED BENTONITE. RESTORATION OF SURFACE COVER WILL BE COMPLETED AS DEPICTED ON SHEET 4.



TYPICAL FLUSH MOUNT MONITORING WELL INSTALLATION

LEGEND

- PROPOSED MONITORING WELL LOCATION

PROPOSED MONITORING WELL INSTALLATION

20 10 0 20 40
GRAPHIC SCALE IN FEET

MONITORING WELL INSTALLATION NOTES:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR INSTALLING THREE MONITORING WELLS AS INDICATED ON THIS SHEET.
2. MONITORING WELLS WILL BE INSTALLED TO THE TOP OF BEDROCK SURFACE. BEDROCK IS ANTICIPATED TO BE APPROXIMATELY 20 FT BGS IN THE VICINITY OF MANNING CIRCLE.
3. WELLS WILL BE INSTALLED WITH A MAXIMUM OF 10-FT OF SCREEN (0.01 IN. SLOT SCREEN) AND AN APPROPRIATE LENGTH OF SCHEDULE 40 PVC FLUSH-JOINT WELL CASING TO GROUND SURFACE.
4. SAND PACK CONSISTING OF #0 US SILICA OR EQUIVALENT WILL BE INSTALLED FROM THE BASE OF THE BORING TO APPROXIMATELY 2-FT ABOVE THE TOP OF THE WELL SCREEN. A MINIMUM OF 2-FT BENTONITE SEAL WILL BE INSTALLED ABOVE SAND PACK. THE REMAINING BOREHOLES ANNULUS WILL BE TREMIE GROUTED WITH BENTONITE/CEMENT GROUT MIX TO WITHIN 0.5 BGS.
5. INSTALL PROTECTIVE FLUSH MOUNT STEEL FRAME AND COVER. FILL INNER ANNULUS BETWEEN WELL CASING AND STEEL FAME WITH COARSE SAND.
6. FLUSH MOUNT WELL COVER SHALL BE FINISHED IN A 4-FT SQUARE AND 6-IN THICK (4-FT X 4-FT X 6-IN) CONCRETE PAD CENTERED AROUND THE PROTECTIVE CASING, WITH CONCRETE SLOPED AWAY FROM THE WELL.

Department of Environmental Conservation
NEW YORK STATE OF OPPORTUNITY

NO.	DATE	DESCRIPTION
0	FEB 2021	FOR SCOPE OF WORK

REVISIONS

GROUNDWATER PLUME & INJECTION LAYOUT

CRYSTAL CLEANERS SITE
NYS REGISTRY NO. 360063
113 WOLFS LANE
PELHAM, NEW YORK

PREPARED BY:
EA ENGINEERING, P.C.
AND ITS AFFILIATE
EA SCIENCE AND TECHNOLOGY

EA #	16025.11
FILE	16025.11-Planset.dwg
DRAWN BY	DPA
DATE	APRIL 2021
SCALE	AS SHOWN

SEAL

SHEET # 5

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Appendix B

Village of Pelham
Street Opening Specifications

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VILLAGE OF PELHAM

WESTCHESTER COUNTY, NEW YORK

Street Opening Instructions

1. All work related to a street opening permit must be performed strictly in accordance with all applicable regulations of the Village of Pelham and to the satisfaction of the Village Administrator.

2. The permit shall not be assigned or transferred except upon written consent of the Village Administrator.

3. All materials used shall conform to such specifications as may be required by the Village Administrator.

4. The work site shall be promptly cleaned upon completion of the required work and all surplus excavated material and debris removed, leaving the site in a neat and orderly condition. Where top soil and/or seeded areas are disturbed, the ground surfaces shall be restored as required by the Village Administrator.

5. Suitable barricades must be maintained while excavation or other work is in progress, as may be required by the Village Administrator. All work must be performed in such a manner as to cause a minimum of inconvenience to traffic.

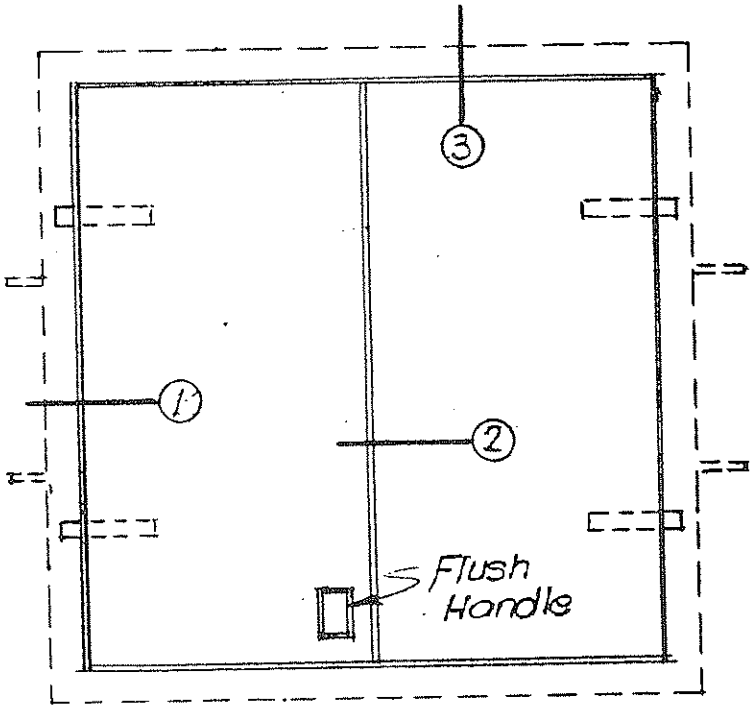
6. No back filling shall be done until the work authorized by this permit is first inspected by the Village Administrator or his authorized representative.

7. Back filling shall be completed by thoroughly tamping in such a manner as to obtain compacted back fill.

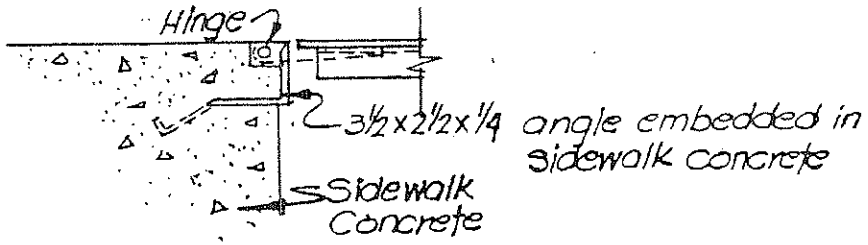
8. Immediately after back filling the excavation, an acceptable temporary resurfacing of the disturbed area shall be completed, as determined by the Village Administrator.

9. Permanent restoration of the surface of a street opening excavation shall be completed as required by the Village Administrator.

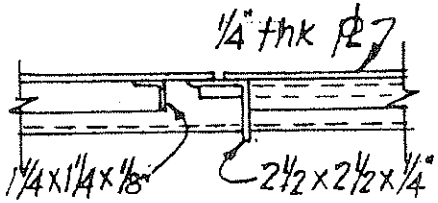
10. No permit shall be issued until the applicant has filed with the Village, evidence of suitable liability insurance, workmen's compensation, and property damage insurance, and has presented a deposit in the amount required by the Village. A Public Service corporation may, in lieu of a deposit, file with the Village of Pelham, a surety bond in an amount as determined by the Village Administrator, for the faithful performance of all permits issued to such a corporation



Plan of Sidewalk Door

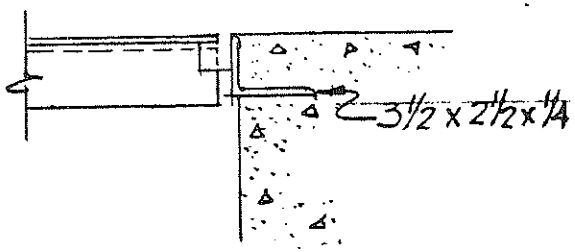


Section 1



Section 2

Scale: 1½"=1'-0"



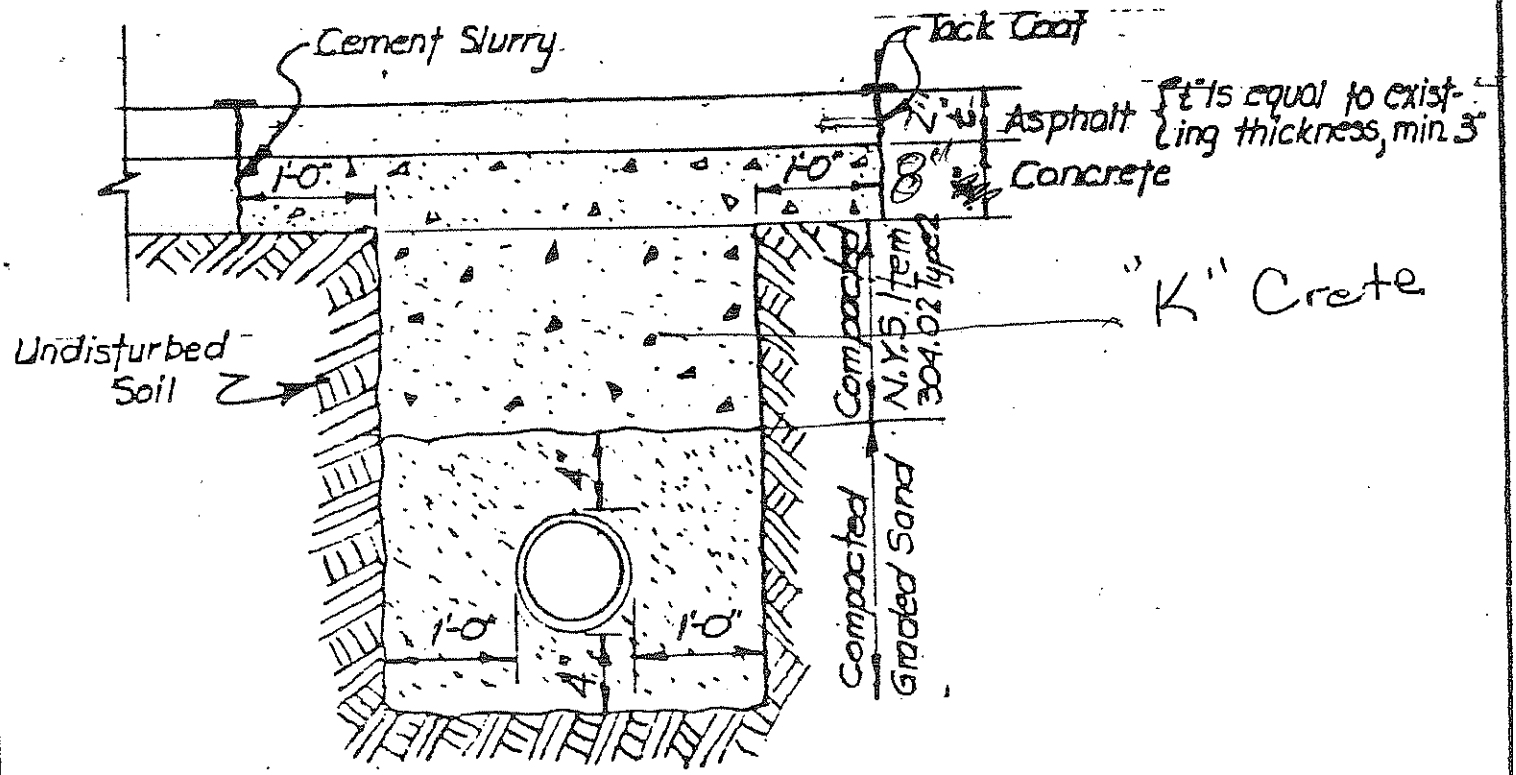
Section 3

SIDEWALK HATCHWAY
VILLAGE of PELHAM

Sheet 4 of 5

N. Grecco P.E.

Village of Pelham



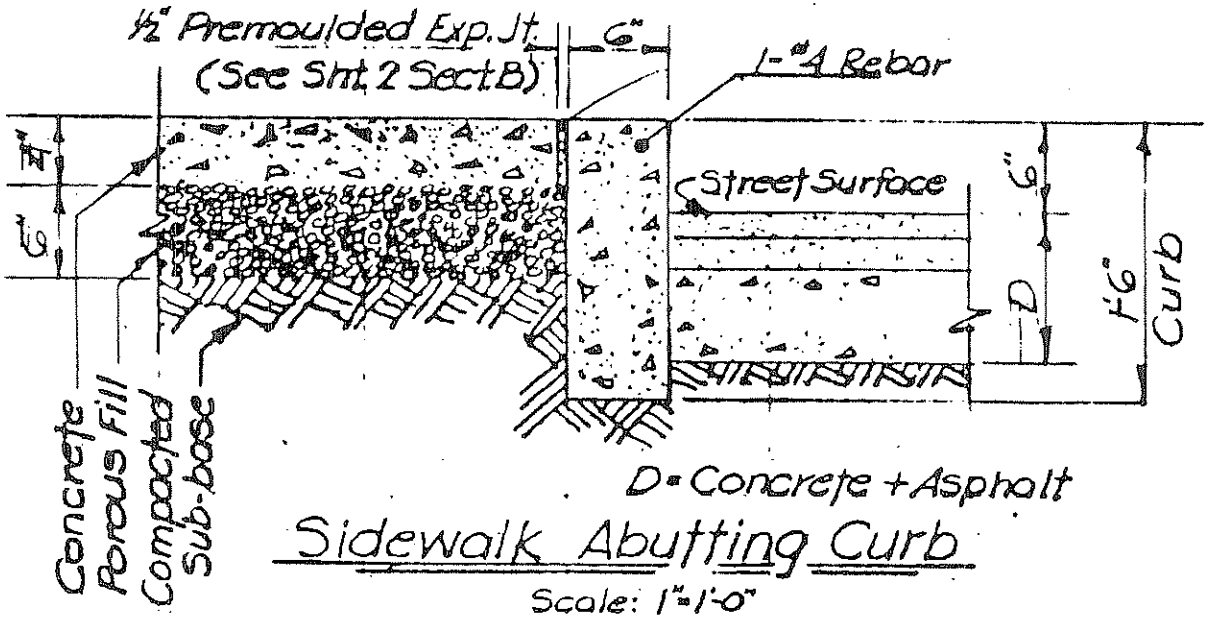
Standard Detail for Excavation & Backfilling for Utility Lines

Note:

1. Trenches over 4'-0" deep shall have sheathing.
2. At least 4" of Graded Sand shall be placed below and above pipe.
3. N.Y.S. Item 304.02 Type 2, shall be placed from top of graded sand to underside of 4" concrete slab.
4. All material shall be compacted to insure no settlement will take place. Mechanical means of compaction shall be used. Layers, not exceeding 12" shall be placed and compacted
5. A cement slurry shall be applied to the existing concrete prior to placing new concrete, f'c = 3000 psi. min.
6. Tack Coat shall be applied to existing asphalt at least 30 minute prior to placing the new asphalt wearing surface.
7. New asphalt shall be NYS Type 6 or equal compacted to produce a tight surface conforming to the adjacent pavement area.
8. Tack coat material shall be placed on all of the new patch seam.

NOTES:

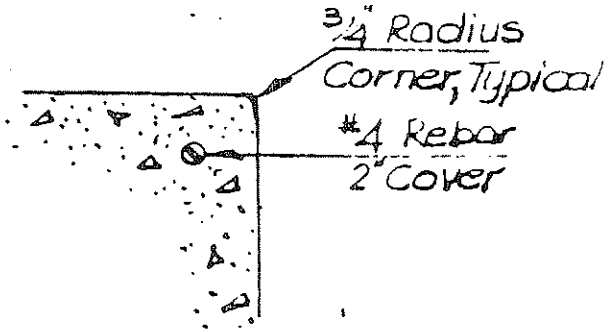
1. Concrete shall be f'c = 3000 psi stone.
2. Provide ½" premoulded Exp. Jt. every 20'.
3. Match S/W & Curb Exp. Jt. where possible.



D = Concrete + Asphalt

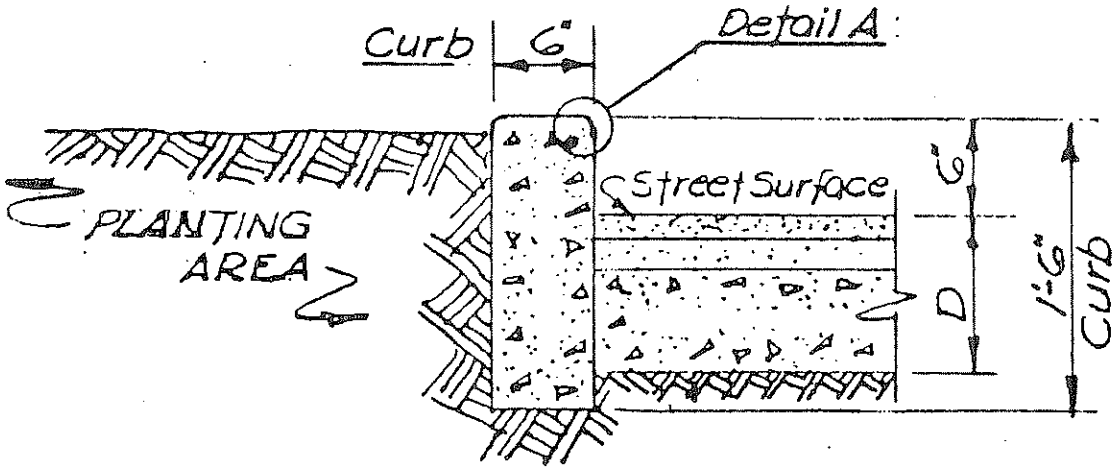
Sidewalk Abutting Curb

Scale: 1"=1'-0"



Detail A

Typical Curb Corner

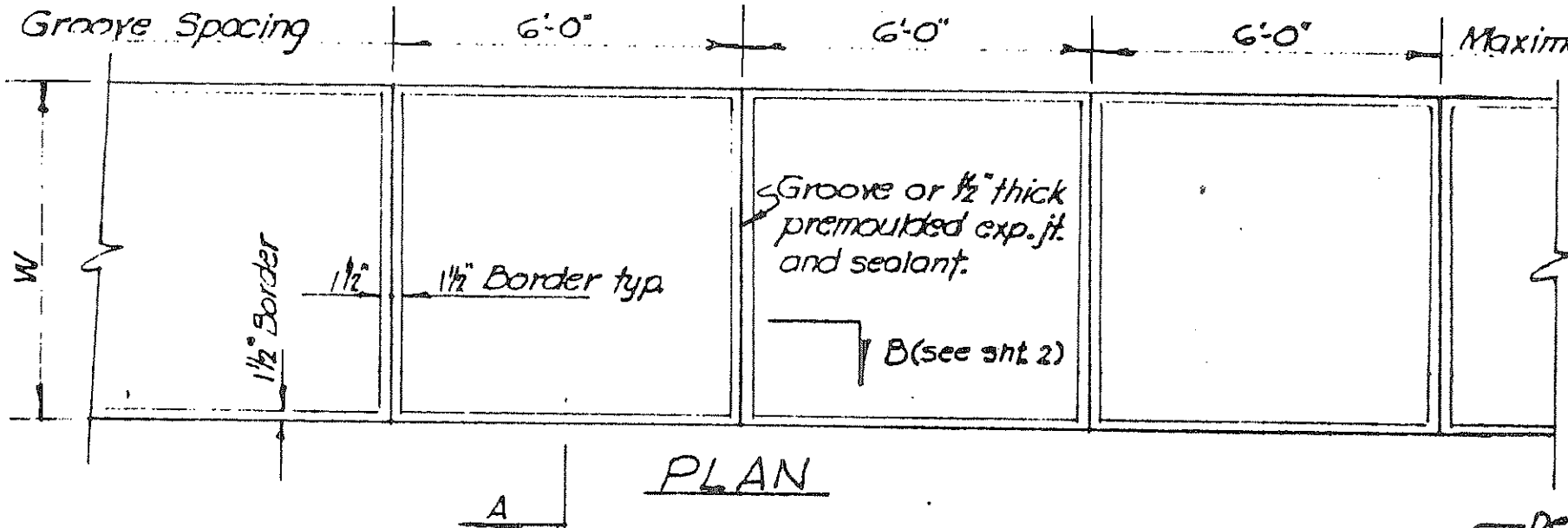


Planting Area Abutting Curb

Scale: 1"=1'-0"

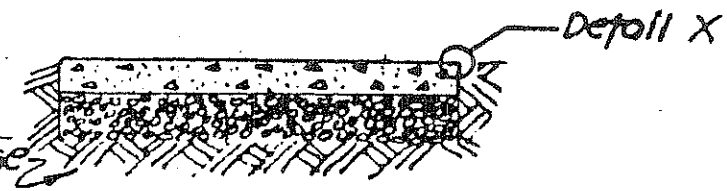
SIDEWALK STANDARD
VILLAGE of PELHAM

N. Grocche



PLAN

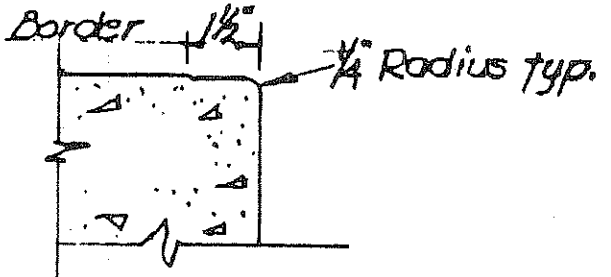
Sidewalk Type	W
Main Sidewalk	5'-0" min.
Secondary S/W	4'-0" min.



Section A (Typical S/W Section)

NOTES:

1. Expansion Joint shall be every 20'-0"±
2. Sidewalks, where "W" is greater than 15'-0", shall have an intermediate exp. jt. parallel to curb. Submit proposed layout for approval.
3. Thickness of sidewalk slab shall be 4" min.
4. Concrete shall be f'c = 3000 psi. stone.
5. Surface finish of concrete shall be Float.
6. Grooves shall be ¾" deep.
7. Spacing of grooves to be the same as adjacent sidewalk. 6'-0" is a max. space only.
8. Provide Exp. Jt. where S/W abuts vertical surfaces.



Detail X
No scale

SIDEWALK STANDARD
VILLAGE of PELHAM

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Appendix C

Carbon Vendor Responses

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PROPOSAL FOR IN-SITU TREATMENT SERVICES & PRODUCTS

CRYSTAL CLEANERS SITE
NYSDEC SITE NO. 36005
WOLFS LANE VICINITY
PELHAM, NY

FEBRUARY 23, 2021

PREPARED FOR

EA SCIENCE AND TECHNOLOGY
269 W. JEFFERSON STREET
SYRACUSE, NEW YORK 13202

ON BEHALF OF

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

ISOTEC PROPOSAL NO. 802850

In-Situ Oxidative Technologies, Inc.
11 Princess Road, Suite A
Lawrenceville, New Jersey 08648
Phone: (609) 275-8500, Fax: (609) 275-9608
www.ISOTEC-INC.com

SBA Certified Small Business

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APPENDICES

1.0 PROPOSAL OVERVIEW

In-Situ Oxidative Technologies, Inc., (ISOTEC) is pleased to offer this proposal to EA Science and Technology (EA) on behalf of the New York State Department of Environmental Conservation (NYSDEC) under Work Assignment Number (No.) D009806-11 for In-Situ Treatment Services & Products at the Crystal Cleaners Site (No. 360053) located in the Village of Pelham, Westchester County, New York.

The Record of Decision (ROD) for the site calls for in-situ enhanced biodegradation to be employed to treat contaminants in groundwater near the source and at downgradient locations. The biological breakdown of contaminants through anaerobic reductive dechlorination will be enhanced by the addition of colloidal activated carbon (or equivalent products) injections which adsorb the contamination and promote the growth of bacteria to further stimulate biological breakdown of contaminants. Primary contaminants of concern (COCs) consist of chlorinated compounds identified as tetrachloroethene (PCE) and three associated daughter products: trichloroethene (TCE), cis-1,2-dichloroethene (DCE) and vinyl chloride (VC).

EA is requesting remedial treatment estimates that fit within the ROD established for the site with amendments to be applied to the bottom of the source area excavation prior to backfilling to aid in the remediation of residual source area groundwater contamination, and also injected into two target areas with overburden groundwater PCE impacts greater than 500 parts per billion (ppb).

EA provided to ISOTEC preliminary design details regarding the estimated size and depth of the source area excavation and overburden groundwater treatment areas as well as historical and most recent soil and groundwater data available for each area. Upon reviewing the provided data, ISOTEC developed an approach that conforms to the ROD and recommended treatment consisting of an equivalent activated carbon technology for the target areas referred to as BOS 100®. The recommended approach will provide comprehensive groundwater treatment based on demonstrated results with the selected technology.

Some key aspects of the BOS 100® approach that will increase treatment effectiveness in the overburden groundwater impacted areas are listed below.

- Unique to BOS 100® is the reactive iron impregnated into the activated carbon which destroys CVOCs that sorb to carbon replenishing sorption sites for continuous “trap and treat” of CVOCs. Additional details are provided in Section 3.0.
- Use of activated carbon slurry that will not migrate upon emplacement will establish a stable target area treatment that will have much longer persistence compared to liquid carbon.
- The recommended “trap and treat” BOS 100® dosage loading is designed to have an active treatment lifetime over multiple years and possibly significantly longer for extended groundwater treatment. Incorporating more injection locations with closer spacing in our design will guarantee better contact in-situ between impacted groundwater and the injected carbon for an overall robust treatment.
- Removal of impacted source area soils in the on-site target area will also significantly reduce the potential for CVOCs migrating off-site over time.

- The in-situ remedial approach will be effective for the range of CVOC concentrations in groundwater, for site groundwater pH conditions, and for treatment of the selected areas.
- BOS 100® has been utilized to target select hot-spot treatment areas similar to the Crystal Cleaners site as well as targeting large groundwater plumes via installation of permeable reactive barriers (PRBs) to reduce CVOC concentrations to below federal Maximum Contaminant Levels (MCLs).

Additional details are provided within the proposal in sections below.

1.1.1 Site Setting

The Crystal Cleaners site is a single story commercial building located on Wolfs Lane in the Village of Pelham, New York. The site has been used as a dry cleaner for several decades. The source area and on-site portion of proposed groundwater treatment reside within the immediate property boundaries on land currently being utilized by the Village's Department of Public Works (DPW). The off-site target treatment area resides in between a residential home and apartment building off of Manning Circle.

CVOCs have been documented in the unsaturated overburden, overburden groundwater and underlying bedrock groundwater. Contamination has also been observed in soil vapor at concentrations which exceed standards, criteria or guidance (SCGs). The plume originates in the vicinity of the dry cleaner building and flows to the southwest away from the site. PCE, TCE, DCE and VC have been detected at maximum concentrations of 2,200 parts per billion (ppb), 620 ppb, 1,900 ppb and 170 ppb, respectively, during historical and more recent sampling events conducted in the on-site target area from monitoring well location MW-C04. Historical samples from other wells (MW-3A and MW-9) in that area have indicated PCE concentrations greater than 500 ppb. Concentrations from temporary well points (TWPs) located in the off-site target area (TWP-1 and TWP-7) have also indicated PCE concentrations greater than 500 ppb in samples collected back in 2012 and 2013. No recent samples have been collected in this area. In the proposed target excavation source area, soil impacts within the estimated 600 square foot (ft^2) area were recently detected as high as 18-45 milligrams per kilogram (mg/kg) for PCE from location PDI-SB-01 at a depth between 7-8 feet (ft) below ground surface (bgs). Historical soil sample location SB-03 also indicated elevated PCE impacts of 17 mg/kg at a depth between 5.0-5.3 ft bgs. CVOC impacts are also noted in the underlying bedrock but are not proposed for treatment under the current RFP issued for the site.

General subsurface lithology at the site consists of a mixture of fill, sands, silts, some clays and gravels in the overburden underlain by bedrock (schist). Depth to bedrock and groundwater varies across the site based on the elevation changes noted. In the target source excavation area, the depth to water (DTW) measured from nearby monitoring well MW-C03 is between ~14.8-14.9 ft bgs; in the on-site target groundwater treatment area the DTW was referenced as ~13.2 ft bgs with depth to bedrock at ~22.0 ft bgs; and in the off-site target groundwater treatment area the DTW was referenced as ~13.0 ft bgs with depth to bedrock at ~19.0 ft bgs.

2.0 WHY ISOTEC?

Founded in 1995, ISOTEC has over 26 years of environmental remediation experience and is among the first firms to pioneer the transformation of ISCO from a laboratory technology to field-scale applications. ISOTEC's team of engineers, geologists, and scientists offer a full suite of in-situ remediation technologies and have demonstrated successful applications using bioremediation, soil mixing reagent delivery, thermal remediation, metals remediation, and offers laboratory services to enhance projects and achieve successful outcomes. ISOTEC does not advocate any single technology or amendment line and can offer the optimal technologies/amendments to match site setting, contaminants and concentrations, objectives, and timelines. ISOTEC specializes in the combined or sequential application of various remediation technologies and amendments to achieve optimal treatment results.

- ISOTEC has experience implementing more than 1,000 field scale applications and over 500 bench scale studies with a broad suite of treatment amendments, including liquids, slurries, chemical oxidants, amendments to enhance biodegradation, including numerous large volume injections (see example projects in **Table 1**).
- ISOTEC has significant experience with target area treatment applications and permeable reactive barrier (PRB) approaches using electron donors, activated carbon amendments, chemical oxidants in a wide range of hydrogeologic environments (see **Table 1** and case studies in **Appendix A**).
- The off-site area is located within a residential neighborhood. ISOTEC has significant experience implementing remediation at active sites, including in the parking lot and drive-through lane of a fast-food restaurant, installing a PRB pilot test in a school parking lot while school was in session, in-situ chemical oxidation injection in a busy downtown area north of Boston, numerous active construction sites, and in residential neighborhoods.
- ISOTEC is committed to maintaining the highest-level health and safety protocols. ISOTEC has 26 years of performing chemical injections with zero accidents/OSHA reportable incidents safety record. ISOTEC has a Grade A rating with ISNetworld.
- The ISOTEC team for this project (including Technical Director Prasad Kakarla, Senior Remediation Engineer Paul Dombrowski, Senior Project Manager Mike Temple, Senior Scientist Scott Pittenger) will have more than 75 years of combined experience designing and implementing in-situ remediation. Our field staff will be comprised of injection specialists, including a site supervisor who has more than 10 years of focused injection experience with ISOTEC.
- ISOTEC's team of engineers, geologists, scientists, and field service technicians offer a full suite of implementation, design assistance, and data evaluation tools to projects. The team routinely supports clients in making adjustments during a remedial program based on field observations.
- One of ISOTEC's partners operates a laboratory, and through this partnership ISOTEC can offer laboratory analyses at no cost for Remedial Design Characterization and performance evaluation. This value-added service is vital to optimize remedial dosage and assess performance. ISOTEC would utilize this service for analyzing soil samples and groundwater samples from monitoring wells and injection wells before, during, and after injections. This

effort would support assessment and attainment of remedial performance and goals and help optimize the injection program.

Table 1: Relevant Project List

Site	Description
Former Manufacturing Facility, NJ	ISOTEC implemented a series of PRBs for treatment of a large, dilute plume using BOS 100®, injectable activated carbon with reactive metallic iron, for dechlorination of PCE and TCE (10 to 120 ug/L). Groundwater treatment was performed for two separate plumes with low pH groundwater using 8 permeable reactive barriers. Two years after injection PCE and TCE concentrations were reduced to EPA MCL concentrations.
Active Warehouse, Dighton, MA	ISOTEC designed and implemented a remediation approach utilizing Trap and Treat injectable activated carbon (BOS 100®) for source mass reduction of tetrachloroethene (PCE). Injections were performed inside and outside an active warehouse. ISOTEC completed a grid treatment with 175 injections points over a 19-day injection period. Three months after injection, monitoring wells within the treatment areas were all below the PCE goal with 88% to greater than 99% reduction in PCE concentrations.
Active Gasoline Service Station, Northern, NJ	ISOTEC implemented a BOS 200® Trap and Treat remediation program at an active gasoline station targeting BTEX impacts in soil and groundwater. Three separate areas totaling ~1,200 ft^2 were targeted based on a remedial design characterization (RDC) used to finalize treatment extents. Approximately 4,250 lbs. of BOS200 (along with additional gypsum) injected within 1,940 gallons or reagent slurry into a network of 48 temporary DPT locations.
NJ Department of Transportation Facility, Central, NJ	ISOTEC implemented a Trap and Treat® pilot test at a state transportation facility to address impacts of petroleum compounds and chlorinated solvents including tertiary butyl alcohol (TBA), benzene, PCE, TCE, and vinyl chloride. The pilot test reagents consist of three technologies to trap contaminant via carbon adsorption, abiotic degradation of CVOCs within BOS100®, and enhanced bioremediation.
Active Warehouse, Manchester, CT	BOS 200® source area treatment combined with 150 linear foot downgradient PRB for petroleum hydrocarbon treatment. Combined extensive remediation design characterization with design of source treatment and plume capture. A fifteen-day field program resulted in BOS 200® being installed in 38 points in the source area and 96 points in the deep barrier wall. Most of the work was completed inside an active warehouse without disruption.
Former MGP Site. Ithaca MGP Site, NY	ISOTEC injected MFR and BASP in an active roadway in an urban, residential neighborhood for treatment of petroleum hydrocarbons and LNAPL. Oxidants and dosages selected based on bench-scale studies managed by ISOTEC's Senior Remediation Engineer. ISOTEC actively collaborated with client/consultant in optimization efforts to improve performance and safety during the three rounds of injection. Three injection events were conducted over a 16-month time period within a very sensitive site setting.
Town of Orleans, MA	ISOTEC installed a Denitrification PRB demonstration test to quantify nitrate removal. PRB length was ~110 ft targeting the ~36-68 ft bgs interval. A specially designed, blend of EVO for use in high flow aquifers was injected into an active school parking lot located between the building and athletic fields while school was in session. An initial injection event installed the denitrification PRB, and a second injection extended the PRB.

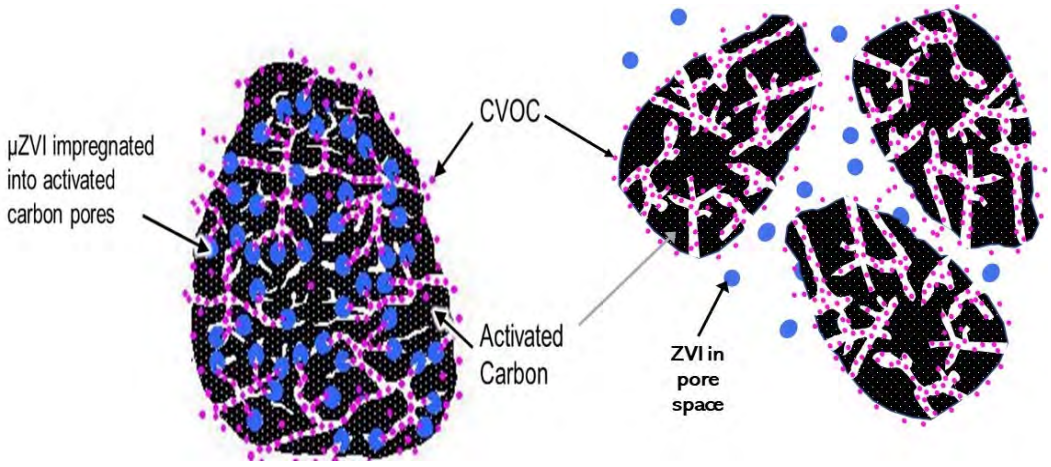
3.0 TECHNICAL APPROACH AND METHODOLOGY

The proposed remediation approach for the Crystal Cleaners site involves injectable activated carbon with abiotic dechlorination. ISOTEC's treatment approach will use a robust Trap & Treat® injectable carbon and reactive metallic iron reagent that are co-located and designed for long-term capture and management of dilute chlorinated solvents and as prevention from migrating past the installed target area barriers.

3.1 Injectable Activated Carbon & Abiotic Reductive Dechlorination

BOS 100® is an effective remediation amendment that provides many benefits compared to other in-situ remediation technologies as well as other injectable activated carbon products.

- BOS 100® combines injectable granular activated carbon and reactive, metallic iron in a single product. The food grade carbon is impregnated with metallic iron formed under reducing conditions at a temperature of ~850^{o}C, when the iron partially dissolves into the carbon forming a new and unique material with properties of both the carbon and iron.
- BOS 100® can achieve rapid reductions in parent chlorinated VOC (PCE & TCE) concentrations (days to months).
- The co-located metallic iron treats the sorbed CVOCs through abiotic dechlorination (Trap & Treat®) that does not generate partially dechlorinated daughter products (e.g., vinyl chloride).
- BOS 100® is a slurry and will not migrate from its emplacement location after injection, which can occur with liquid activated carbon amendments. Therefore, a BOS 100® application will provide consistent target area treatment for an attenuated time frame and in the case of the on-site target area, can help reduce any upgradient source area groundwater moving through the treated area to mitigate continued off-site migration of CVOC impacted groundwater.
- The co-location of iron and carbon ensures that the treatment mechanism is present when chlorinated compounds gets sorbed to the carbon. Abiotic dechlorination by the iron mineralizes contaminants freeing up sorption sites to remove more CVOCs from groundwater.
    - Alternative approaches incorporating injectable activated carbon and enhanced in-situ dechlorination require multiple, separate amendments which achieve less efficient treatment since the sorbed CVOCs are not in the same location as the treatment amendments. When CVOCs load carbon sorption sites without a treatment mechanism the system will be prematurely ineffective limiting the lifespan of the injected reagent.
    - The co-location of activated carbon and reactive iron prevents or extends the time to sorption site saturation and subsequent desorption of CVOCs over time. If desorption of CVOCs from activated carbon does occur, those CVOCs can be sorbed to nearby non-mobile activated carbon with the target area.

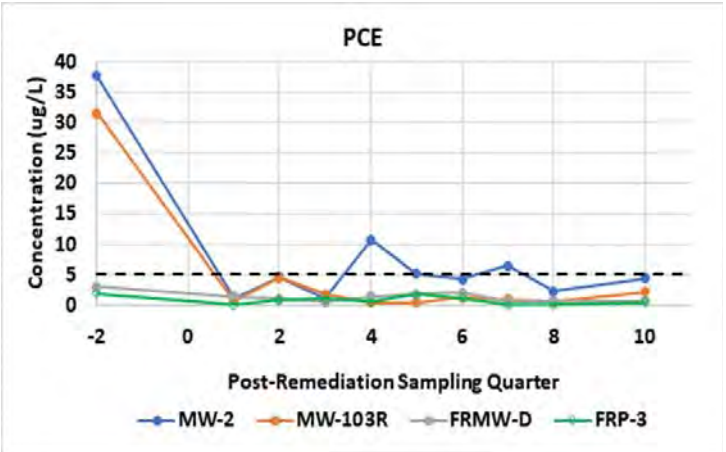


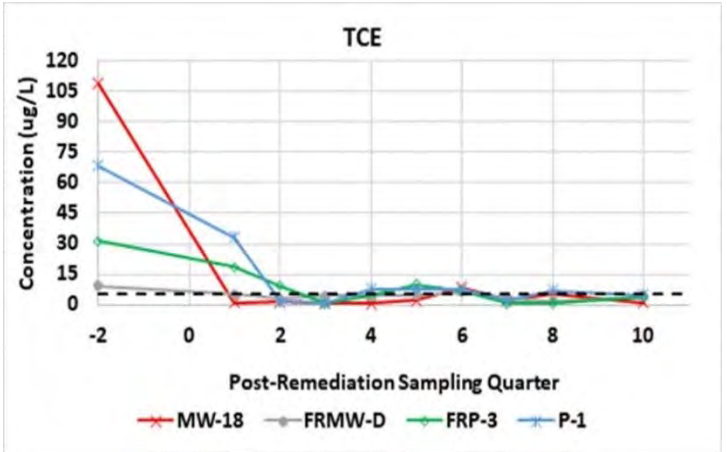
BOS 100® features reactive iron cooked onto the surface of activated carbon. CVOCs adsorb to the activated carbon and subsequently are dechlorinated abiotically by the iron. The dechlorination reactions destroy the CVOCs creating new sorption sites to remove additional CVOCs from groundwater.

Non-BOS 100® injectable activated carbon alternatives use separate activated carbon and reactive iron reagents. CVOCs either adsorb to activated carbon or react with ZVI. Sorbed CVOCs remail on the activated carbon until they are desorbed by competing organic molecules or through equilibrium with the aqueous phase. If ZVI is remaining near the activated carbon, those CVOCs may be abiotically dechlorinated.

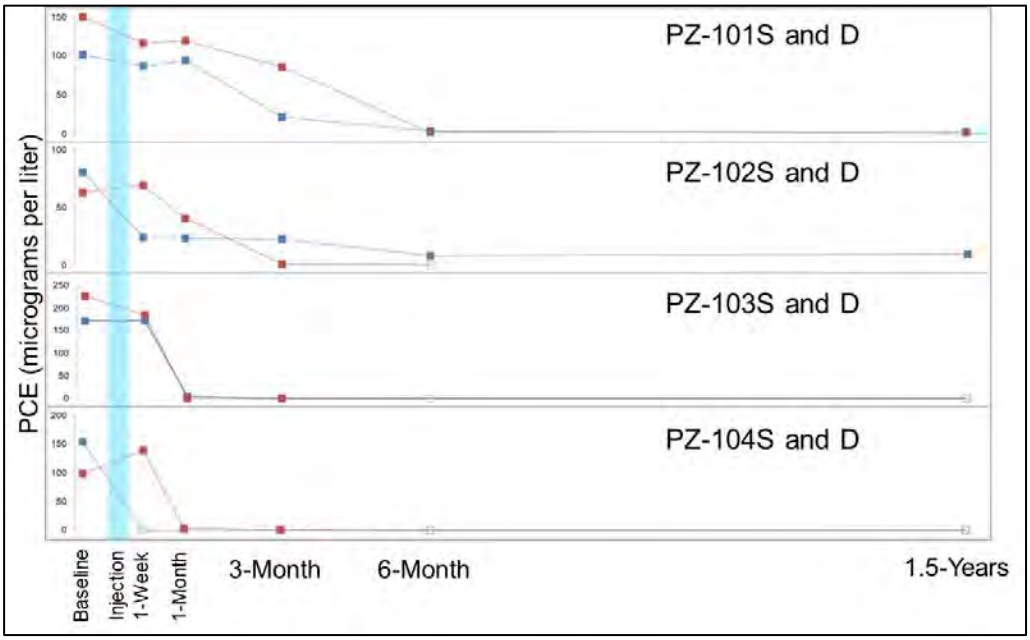
- The approach is effective for treating site contaminants in the range of detected concentrations at the site and can effectively treat low concentrations of CVOCs. The graphics below show CVOC concentrations in groundwater downgradient from BOS 100® barriers at two different sites. Reductions in CVOC concentrations in groundwater are rapid and maintained downgradient of the barrier.

Site 1 – New Jersey BOS 100® PRB





Site 2 – North Carolina BOS 100® PRB



- BOS 100® applications can be designed to ensure extended active lifetime. Therefore, there is often no need for additional injections than could be expected with other in-situ carbon amendments. Upgradient CVOCs in groundwater flowing through target treatment areas will continue to be removed and dechlorinated over many years.
- BOS 100® amendment is not sensitive to groundwater conditions (pH, oxidation-reduction potential, dissolved oxygen), in contrast with many enhanced reductive dechlorination amendments (carbon substrate electron donors, ZVI). Adsorption reactions of activated carbon for removing CVOCs from groundwater are not changed by oxidizing or reducing environments.
- BOS 100® Trap & Treat® processes have provided long-term CVOC plume management in numerous PRB applications and hot-spot targeted applications.

3.2 Remedial Design Characterization

ISOTEC recommends that a remedial design characterization (RDC) be performed prior to field implementation. The RDC is a crucial step towards developing and implementing a cost effective and successful injection project. The goal of the RDC is to develop a robust set of data that will be used to supplement and update the existing site data to:

-Determine the mass of contamination in the soil and groundwater as a function of depth and location in order to refine the preliminary injection design; and

-Determine the appropriate means of accessing the impacted area and applicable installation techniques required for future in-situ treatment.

In order to better quantify the total mass present at the site, the collection of soil samples from minimum 10-20 boring locations is recommended. There is not much soil data available for this site except for the vadose zone source area that was recently sampled. There are no saturated soil samples from the two proposed impacted areas designated for treatment, or in between the areas. In addition to the soil samples, groundwater samples should be collected (if possible) prior to abandonment of the completed boreholes. MW-C04 was recently sampled in 2020 but much of the remaining data is old and in the case of the off-site target area, were collected from temporary well points in 2012 and 2013. The remedial design characterization will extend to ~25 ft bgs (or depth of refusal which is currently assumed to be ~22 ft bgs). The scope of work associated with the characterization effort is as follows. For the purpose of this proposal, it is assumed that sample collection and shipment to RPI's laboratory will be performed by ISOTEC, or others.

Soil Sampling

--Minimum 10-20 soil borings (where site access allows) to 22-25 ft bgs will be advanced using dual tube direct push drilling. Additional borings should be advanced and samples collected if time allows. Soils will be analyzed every 2 feet starting at 12 feet bgs and from discrete intervals identified to be visibly stained or with elevated PID readings.

Groundwater Sampling

-At each of the soil boring locations, groundwater samples will be collected from temporary wells installed in the same borehole.

-The existing monitoring wells in the area of will be developed/purged and sampled.

In order to reduce the cost of the total project remediation effort, the RDC samples can be analyzed by the Remediation Products, Inc. (RPI) Group Project Support Laboratory in Golden, Colorado for volatile organic compounds (VOCs) using Method 8260B. The groundwater samples will also be sampled for Anions using Method 300.1 Ion Chromatography. The laboratory analysis is for remedial design use only and is not for regulatory compliance. **The analytical services performed by RPI Group are provided at no cost to the client.**

It will require multiple days to collect the soil and groundwater samples. The results of this characterization will be used to refine and finalize the BOS 100® loadings throughout the impacted areas. Historically, preliminary remedial designs have been reduced in overall scale both laterally and vertically by implementing an RDC. The final design loadings will vary with depth and location based on the distribution of contaminants' mass. Soil and groundwater analysis and subsequent laboratory result evaluation will require approximately 3-4 weeks to complete before implementing a Final Injection Design. The Proposed RDC sampling is intended to supplement the existing data and refine the Preliminary Design.

RDC will provide high resolution evaluation of COC locations both vertically and horizontally, which allows ISOTEC to have more spatial certainty for remediation targeting. Therefore, ISOTEC can better predict quantities of reagent and level of effort needed to achieve goals, which enables us to provide significantly tighter cost proposals. If requested, ISOTEC can supply estimated costs for the RDC which will include a drilling subcontractor and ISOTEC personnel on site for a few days to collect the samples.

4.0 TREATMENT PLAN

4.1 Site Access and Usage for Remediation

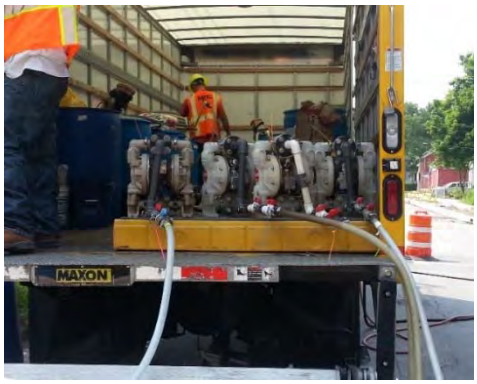
The scope of work calls for excavation of source area soils (to be completed by others) followed by placement of a suitable remedial substrate to be applied to the bottom of the excavation pit to aid in the remediation of residual groundwater contamination; and injection of colloidal activated carbon (or equivalent products) in two hot-spot areas of the site with overburden groundwater concentrations greater than 500 ppb. A detailed utility mark out will be performed (by others) in all proposed work areas prior to any excavating or drilling occurring at the site.

Based on review of the site settings, proposed treatment areas reside within an active DPW parking lot (source area excavation limits and on-site impacted overburden groundwater area) and also within a sensitive residential setting located off of Manning Circle (off-site impacted overburden groundwater area). Utmost care will be taken to minimize all impacts to the surrounding community and sensitive areas and ISOTEC will work with EA/NYSDEC to set up staging areas for trailers and injection equipment, personnel, and chemical deliveries. EA/NYSDEC will secure any required traffic control measures and access agreements to perform work in the designated areas and allow adequate room for storage of ISOTEC equipment and reagents during field activities. There are multiple fire hydrants located near the respective treatment areas and ISOTEC is assuming that access to the hydrants will be allowed for a continued water source during the proposed field work. While working in the DPW yard areas, water can also be obtained from the active building if allowed. Any costs or permitting required for access to water will obtained by EA/NYSDEC.

Because the actual off-site area is not clearly defined in the RFP documents and access for equipment and personnel is not understood, the actual staging areas to be utilized during field implementation are unknown. As such, any costs and scope of work required for site restoration are not included in this proposal and are assumed to be completed by others. ISOTEC will take steps to minimize any disturbance to grassy or landscaped areas in the active work zones to mitigate the extent of restoration efforts (if required) following the injections in this area.

Amendment Staging and Injection Set-Up. All amendments will be purchased by ISOTEC. Delivered amendments will be stored in a secure on-site staging area agreed upon by ISOTEC and EA/NYSDEC. BOS 100® solutions will be batched within ISOTEC's mobile trailer.

The trailer and associated crew will focus on injecting into one target area at a time and will re-locate the trailer to the next area when treatment in the first area is complete. At the end of each injection day, ISOTEC will roll-up all hoses and put the equipment away. ISOTEC has completed numerous projects in a similar manner where all equipment had to be kept inside the box truck/trailer, and all supplies had to be removed from the site/street at the end of the workday (Photograph to the right is from a project where ISCO was injected into 4 wells simultaneously within the street in a residential neighborhood where no residual supplies could be left at the end of the workday).



Temporary staging areas will be finalized on-site in discussion with all project related stakeholders. Ideally, the staging areas will be located near to each respective target area, but materials and equipment may be located in a box truck to maximize mobility and minimize site disruption. It is anticipated that the staging areas may need to be moved around from time to time within each area due to the extensive aerial size of the proposed target areas. To minimize the number of staging areas required, ISOTEC is assuming that injections into the source area excavation pit and on-site groundwater area will occur from the same setup area. Temporary perimeter boundaries will be established around active injection areas using a combination of delineators, caution tape/rope, cones, or temporary snow fencing. ISOTEC will supply hose ramps if needed if the injection lines need to be run across active roadways.

4.2 Source Area Excavation & Reagent Placement

The proposed plan for the impacted source area soils is for a targeted excavation of an ~600 ft^2 area. The impacted soils will be removed from the site. Excavation work and transportation and disposal of impacted soils is to be performed by others. Upon completion of the excavation down to the target depth, the ROD calls for placement of a remedial substrate (colloidal activated carbon, or equivalent) to be applied to the open pit area to aid in the remediation of residual groundwater contamination.

The extent of the proposed excavation area surrounds recently collected (July and November 2020) PDI soil boring locations SB-01, SB-05, SB-06, SB-07 and SB-08. Soil impacts in this area were recently detected as high as 18-45 mg/kg for PCE from location PDI-SB-01 at a depth between 7-8 ft below bgs. Review of the boring log from this location, as well as other nearby locations indicated that the soils were wet at depths between 7-9 ft bgs. Based on the elevated PCE concentrations noted between 7-8 ft bgs and the boring logs noting wet soils between 7-9 ft bgs in the area, the depth for excavation was determined at 8 ft bgs and appears to assume that the water table was also in this vertical interval.

The nearest monitoring well location in this area is MW-C03. Depth to water (DTW) readings from this well in 2011 and 2012 (there are no recent samples collected from this well location) indicate the top of the water table is approximately 14.8-14.9 ft bgs. It may be possible that site conditions related to depth to groundwater in this area have changed since MW-C03 was last sampled in 2012 but based on the historical DTW measurements noted, the bottom of the proposed excavation limit of 8 ft bgs would sit approximately 5-6 above the water table in this area.

Placing an amendment in the bottom of the excavation prior to backfilling has been applied at sites as a remediation practice for some time now. Typically, in these situations however, the excavation is completed down to the approximate water table/smear zone where introduced amendments can potentially interact and treat residual impacts that were not addressed during the excavation and removal of site soils. This approach is usually applied at petroleum based contamination sites where lighter impacted contaminants reside at the smear zone and shallow groundwater depths. When applied, the amendments are usually sprayed or dumped into the excavation pit and slowly mixed in with the excavator bucket (or other tooling) to maximize contact with residual remaining impacts and introduced reagents. At this site however, the contaminants are heavier CVOC compounds and the depth of the proposed excavation will not extend down to the inferred depth to water as intended, and specified in the RFP.

The proposed reagent is typically applied to saturated zone aquifers where groundwater provides a medium of transport for dissolved impacts to contact the injected/placed BOS 100® amendments. As discussed above, it appears that the placement of reagent at this site will be in the vadose zone soils above the water table. There is evidence that injection of BOS products completed in the vadose zone can act as a protective barrier for infiltration of additional contamination from shallow horizons that may eventually migrate down to the underlying groundwater, and any residual vapors remaining in the impacted vadose zone can be readily absorbed by activated carbon. Water infiltration can provide another transport mechanism (assumed to be a much slower process than if you have natural groundwater movement). If the distribution of the BOS 100® applied to the bottom of the pit is spread out and covers the extent of the hole, there is still potential added benefits related to adsorption of any residual vapors and barrier protection to the underlying groundwater if contamination from adjacent areas eventually migrates downward at the site through the placed amendment.

There are a few options for this area to be considered based on the above discussion.

- An alternative to ensure the placement of BOS 100® is applied at the smear would be to extend the excavation limits down to the water table depth noted at the site during fieldwork. Based on available information from MW-C03, the DTW in this area is ~14.8-14.9 ft bgs. This approach would incur additional soil mass to be excavated along with increased transportation and disposal costs.
- Continue with the proposed scope of work as intended and place BOS 100® amendments at the bottom of the pit to be blended in with the excavator bucket. Potential benefits would be absorption of any remaining vapors in the area by the activated carbon and also a long term barrier to prevent downward future migration of contamination from shallower horizons. It is being assumed that ~400 lbs. of BOS 100® will be applied to the open pit area over 1 day.

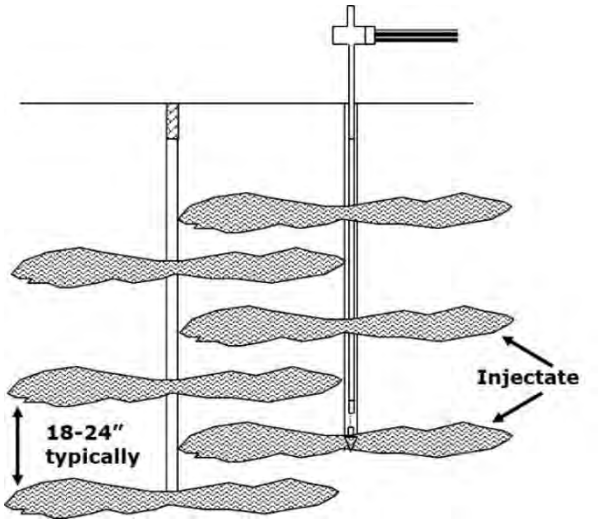
- If after further review of site data, EA/NYSDEC deems the proposed remedy in this area to be a non-effective treatment option due to the significant difference in the actual DTW from where the bottom of the excavation is planned, remove this portion of the scope of work and allow the excavation of impacted soils in the source area to be the complete remedy for this area. Although MW-C03 is located in the suspected source area, PCE groundwater data collected from this well in 2012 was only 53 ppb, which is well below the concentration of 500 ppb being addressed by the overburden groundwater remedy in the 2 target areas.

If the placement of BOS 100® is performed, it is being assumed that it will occur during the same mobilization as the groundwater injections. The mixing trailer will be positioned so that extended hose runs can reach both the excavation area as well as the on-site groundwater treatment area. Different batching/dosing will be applied to the two different areas so there will be some down time associated with cleaning out the mixing tanks before moving to the next area. ISOTEC will spray the prepared BOS 100® batches to the excavation pit. Others will be responsible for mixing the product with the backfill material once applied into the hole.

4.3 Overburden Groundwater Injection Approach

BOS 100® is injected under pressure as a slurry amendment. Pressurized injections allow for distribution of slurry reagents into the subsurface and to establish desired radius of influence to establish overlapping reactive zones within the treatment areas. Injection points within the target areas will be located on a closely spaced grid using 7.5-foot spacing.

Injection points will be installed using direct-push point technology. A top-down approach will be utilized for the BOS 100® slurry injections, with the shallow discrete interval at each location completed first. Subsequent injections within the same direct push point will follow every two-foot interval until all the proposed injection intervals within a given location are completed. Injections are delivered as a discrete interval with two-feet between each vertical interval at each point, with adjacent points having injection intervals off-set by one foot. As shown in the image to the right this top-down injection strategy is aimed at applying the amendment uniformly, throughout the entire impacted vertical interval.



ISOTEC will connect to each point via a dedicated injection point head, which will consist of an influent injection port, ball valves, quick disconnect cam fittings and a pressure gauge. Approximately 15-30 gallons of fluid applied in each discrete interval.

All temporary DPT injection points will be abandoned the same day injection activities have been completed by filling with bentonite chips and hydrating with water.

Treatment areas design details are provided in **Table 2** including both conforming and recommended dosing rates.

Table 2: Treatment Design Summary

AOC	Size (ft^2)	Interval (ft bgs)	Spacing (ft)	BOS 100® Points	Injection Days	BOS 100® (lbs.) Recommended
On-Site Area	1,400	13-22	7.5	25	4	1,300
Off-Site Area	3,000	13-19	7.5	54	6	1,900
Total	4,400			79	10	3,200

4.4 Waste Management

ISOTEC will minimize generation of decontamination waste and maximize recycling of materials. Using direct-push injection point technique, no soil is generated that will require off-site disposal. The only wastewater anticipated to be generated during proposed field work will be from decontamination of injection tooling at the end of the project. ISOTEC will containerize any decontamination water generated for future off-site disposal by EA/NYSDEC.

Wastes generated during proposed work will primarily be containers/packaging for delivery of remedial amendments. This can be disposed of as municipal waste and will be disposed appropriately as needed or at the end of the treatment program.

4.4.1 Site Restoration

Site restoration work will include removal of all site related trash following completion of the injection program (or on a daily basis as needed) and abandonment of each borehole using hydrated bentonite to the surface. ISOTEC will coordinate with EA for surface restoration for each injection point based on the area (e.g., asphalt cold patch, topsoil, grass seed). Any additional restoration related to work vehicles/drill rigs disturbing portions of the site will be the responsibility of EA/NYSDEC (if required). To the extent possible ISOTEC will minimize disturbing existing conditions at the site.

4.4.2 Performance Monitoring

Baseline, interim and post-treatment performance monitoring is assumed to be performed by EA/NYSDEC.

ISOTEC can offer additional laboratory analyses at no cost for performance evaluation through the RPI Group laboratory in Colorado (RPI is the manufacturer of BOS 100®). In addition to CVOCs, analyses will include ethane/ethene and chloride (breakdown products of CVOC). This value-added service has been used on numerous ISOTEC injection programs to provide a more thorough evaluation of remediation effectiveness.

5.0 PROJECT COORDINATION

The ISOTEC team will provide comprehensive support and services to complete the scope of work.

ISOTEC's Senior Project Manager Mike Temple and Technical Director Prasad Kakarla, P.E. will be the primary points of contact with EA and will provide office support and will directly oversee all ISOTEC field staff and subcontractors. Additional support will be provided by Senior Remediation Engineer Paul Dombrowski, P.E., who has direct experience designing and/or implementing a broad range of in-situ groundwater technologies including numerous BOS 100® and permeable reactive barrier projects.

The only subcontractor to be used on the project under the supervision of ISOTEC will be a New York licensed Direct Push Technology (DPT) drilling contractor. EA/NYSDEC will procure a separate crew for the excavation work and for a detailed utility mark out in the proposed injection areas.

ISOTEC (or ISOTEC's subcontracted driller) will contact Safe Dig New York prior to on-site drilling activities.

ISOTEC anticipates working during normal business hours from 7:00 AM to 5:00 PM, Monday through Friday. ISOTEC will conduct the injections using our specialized injection system trailer supported by a 4-5 person injection crew (including the driller).

ISOTEC will interface directly with EA/NYSDEC regarding schedules, mobilization, on-site health and safety, injection progress reporting, and overall technical strategy. Due to the sensitive site setting in a residential neighborhood, communication between ISOTEC, EA/NYSDEC and neighborhood property owners will be maintained to minimize disruption to neighborhood activities and traffic patterns.

5.1 Project Reporting

ISOTEC will record all field notes including names of all on-site personnel, hours worked, equipment used, well construction logs, boring logs, injection point ID, injection start time, injection stop time, volume, flow rate, well head pressures, any health and safety instances/meetings, deliveries that occurred, groundwater sampling activities performed, meetings attended, and any other pertinent information during each day of injections. All details will be presented in the Daily Reports submitted electronically to EA the following day. Following completion of all proposed field work a summary report will be submitted detailing all field related activities, summary of injection totals, summary of chemical shipments delivered to the site and any other pertinent information related to the injection program.

6.0 HEALTH AND SAFETY

Health and safety for ISOTEC employees, our subcontractors, site workers, and the public are a top priority to ISOTEC. ISOTEC processes are some of the safest treatment processes due to the use of stabilized reagents injected in a controlled manner to reduce the possibility of any hazard occurring. **ISOTEC has not had a significant health and safety incident in over 26 years of field application.** The injection and amendment handling processes have been designed with health and safety as a prime consideration. All members of the ISOTEC team have completed health and safety training consistent

with the Occupational Safety and Health Act (Title 29 of the Code of Federal Regulations 1910.120) with current certificates. All employees receive an annual physical, drug screening and 8-hour safety refresher course. Site supervisors complete an additional eight hours of OSHA training. The site supervisor has completed an additional eight hours of OSHA supervisor training. As with any activity, by applying safety measures, plus understanding how a process works, limits the potential for unwanted incidents to occur.

A site-specific HASP will be prepared and submitted prior to field mobilization. A detailed Activity Hazard Analysis (AHA) for major activities will be prepared to identify any potential hazards related to field implementation activities. All ISOTEC Team staff (ISOTEC and team subcontractors) will operate under this single site-specific HASP. **All ISOTEC Team staff (ISOTEC and team subcontractors) will have stop-work authority to correct or modify site operations**. The site-specific HASP and/or JHAs will be modified due to changing conditions or field modifications to improve safety.

ISOTEC will designate an on-site health and safety officer (HSO) who will be responsible for ensuring that all on-site personnel (ISOTEC, ISOTEC team subcontractors, oversight, visitors, etc.) operate according to safety policies and regulations as detailed in the HASP and task AHA. Daily health and safety tailgate meetings will be conducted by the ISOTEC HSO prior to starting each day's field activities to discuss AHA, potential hazards, and identify any new hazards that were encountered during previous day's activities. Part of the ISOTEC HSO's role will be to assess inventory of PPE, safety supplies, first aid kits, and other safety materials as part of daily activities; ISOTEC staff would bring new supplies to the site the following day, as needed.

6.1 Novel Coronavirus (Covid-19)

COVID-19 is a new respiratory disease, caused by a virus (novel coronavirus) that has not previously been encountered in humans. Reported illnesses have ranged from mild symptoms to severe illness and death for confirmed COVID-19 cases. Primary symptoms of this infection may appear 2-14 days after exposure and include fever, cough, and shortness of breath, and in severe cases, pneumonia (fluid in the lungs). ISOTEC has created operating procedures for implementing site remediation activities related to COVID-19, including an ISOTEC Coronavirus Action Plan. The ISOTEC COVID-19 procedures have been revised multiple times as additional information has become available. ISOTEC, in coordination with EA, will verify that all work is completed in accordance with all federal, state, and local guidelines and using safe work practices for the health of site workers and the general public.

7.0 LIST OF ASSUMPTIONS AND EXCEPTIONS

Besides the technical design assumptions stated above, the following items are excluded from the proposed costs, which are assumed to be the responsibility of EA or client.

- Site access, traffic control, injection permits, water supply, any required pre-clearing, and private utility mark out.
- Baseline and post-treatment performance monitoring and analysis.
- Secure staging area(s) for ISOTEC reagents and equipment.

- Disposal of any IDW.
- Regarding site restoration, ISOTEC's proposed scope of work includes backfilling each injection borehole to ~4-inches below grade with bentonite and finishing the top 4 inches with an asphalt patch, concrete patch or similar to match the surrounding ground surface. Any additional site restoration work, if required, is assumed to be completed by EA.

8.0 PROJECT COSTS

Item (description)	Quantity	Unit	Unit Cost	Cost
Injection and Placement of BOS 100® • Mobilization/demobilization of staff, equipment, and materials to the site to perform the work. • Procurement and delivery of BOS 100® reagents (3,600 lbs. total for all 3 areas) into the excavation source pit area and two overburden groundwater target areas (see **Table 2** for details) • NY State licensed driller with direct-push drill rig. • Field Implementation – includes site supervisor and 2 technicians and field injection. • Estimated 10-11 days of injections (plus one mobilization day) • Project Management, Health and Safety Plan, and Daily Reporting. • Box truck for storage of reagents and equipment. • Temporary bathroom rental.	**1**	**LS**	**$161,640**	**$161,640**
Additional Injection Days • If additional injections days are required to inject proposed amendments and/or volumes they will be billed for ~$8,950/day (as needed), which includes ISOTEC personnel, equipment, drill rig/operator.		**Day**	**$8,950**	

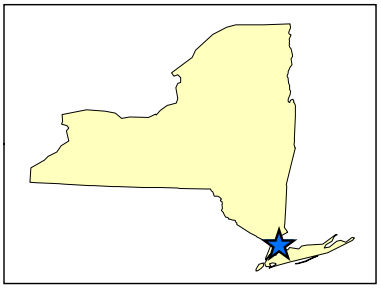
8.1 Standard Terms and Conditions

1. The above quote is not a guaranteed price to clean up the contamination noted at the referenced site. The number of ISOTEC treatments will be dependent on the amount of contamination and site geology. The higher the concentration of contamination and the tighter the geology, the greater the number of necessary treatments.
2. Treatment program reagent volumes and concentrations presented within this proposal are based on information provided by the consultant.
3. Scheduling is based on a first come first serve basis, with an authorized proposal (or subcontract) being the primary basis for scheduling, followed by payment history. ISOTEC will not schedule fieldwork without an authorized proposal (or subcontract), or outstanding receivables over 30 days.

4. Work to be performed in modified Level D personal protective equipment (PPE). Higher-level PPE requires a change order for additional costs associated with such.
5. Regulatory approval will be the responsibility of Client.
6. Site monitoring and pre- and post-treatment sampling will be the responsibility of Client.
7. Cancellation of a scheduled treatment program within 3 weeks of authorized program start will be subject to a $10,000 cancellation fee.
8. ISOTEC will require adequate and secure staging areas for chemical preparation and storage.
9. Traffic control, if required will be the responsibility of Client.
10. Access to an available nearby water source and any associated costs will be the responsibility of the client.
11. Work performed will be completed during regular business hours (Monday through Friday) between 8 AM and 5 PM. Alternative scheduling will require a change order.
12. Disposal of hazardous wastes and/or reagents collected will be handled by the client. The potential for reagent channeling along utility corridors and other preferential pathways exists with any injection program. ISOTEC is not responsible for seepage or surfacing of reagents and/or hazardous materials into any utility corridor, subsurface collection system or other preferential pathway, nor any costs associated with collection and disposal of such.
13. An initial invoice for reagent procurement will be issued upon approval and authorization of this proposal. Payment terms for this initial invoice is net 30 days. Remaining balance invoices will be submitted monthly proportional to the amount of work performed. Payment terms are net 30 days (unless other terms and conditions apply), 1.5% interest per month will be added to any outstanding balances that exceed 60 days. Price quotations are valid for 90 days. Any legal or other costs incurred in collecting delinquent amounts shall be incurred by the Client.
14. Information included within this proposal is to be considered confidential and for Client use only without written authorization by ISOTEC.
15. Without the prior consent of ISOTEC, Client and any affiliated or related companies will not for a period of 2 years from the date of this proposal and/or signed contract, directly or indirectly solicit for employment or engage as a consultant any person who is now employed by ISOTEC.

FIGURES

G:\Projects\State&Local\NYSDEC - D009806\Work Assignments\16025111 Crystal Cleaners RD\06 GIS\01 MXD\Design\Figure1 SiteLocation.mxd



0 50 100 150 200
Feet

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Legend

- Crystal Cleaners Property Boundary
- Proposed Excavation Area
- Overburden Groundwater Remedial Area

Figure 1
SITE LAYOUT AND AREAS OF CONCERN
Crystal Cleaners
Pelham, New York

Map Date: 12/7/2020
Projection:
NAD_1983_StatePlane_New_York_East_FIPS_3101_Feet

NEW YORK Department of Environmental Conservation

APPENDIX A
ISOTEC CASE STUDIES

EISD Treatment Program: PRBs to Treat PCE and CVOCs Plumes

Site

- Former Manufacturing Facility Site, New Jersey

Contaminants of Concern

- CVOCs primarily PCE and TCE.
- Large dilute plumes with PCE and TCE concentrations ranging from 2 to 120 µg/l.

Geology/ Hydrology

- Low pH groundwater regionally
- Site geology was mostly overburden sand in deep target treatment area identified as plating & solvent handling area.
- Differential layers of constituent clay, silt, and fine sand was seen in treatment area identified as firing range area.

EISD BOS 100® Treatment Program

- Multiple permeable reactive barriers (PRB) were constructed across the treatment area for effective CVOC plume reduction.
- An approach involving the pressurized injection of slurry amendments was implemented to create close grid overlapping barriers
- 6 PRBs with a total length of 750 feet were installed in the two areas.
- A total of 228 temporary DPT injection points were utilized to inject ~ 124,740 gallons of BOS 100® amendments in two major treatment areas over the course of the injection event.
- Following the construction of reactive barriers in the two treatment areas, most performance monitoring wells were reduced to low criteria for PCE and TCE

IN-SITU OXIDATIVE TECHNOLOGIES, INC.
WWW.ISOTEC-INC.COM

ISOTEC Case Study No. 93

EISD Treatment Program: Impacted Groundwater Treatment Utilizing BOS 100® PRBs

Former Manufacturing Facility Site
New Jersey

INTRODUCTION

ISOTEC was retained to implement an enhanced in-situ dechlorination (EISD) treatment program at a former manufacturing site located in New Jersey to address impacted soil and groundwater. Treatment was performed in two separate plume areas of concern: plating and solvent handling area (3.5 acres) and a firing range area (0.7 acres). Primary contaminants of concern at the site include chlorinated volatile organic compounds (CVOCs), primarily tetrachloroethene (PCE) and trichloroethene (TCE). ISOTEC developed a remedial approach for treatment of a large plume in a permeable, low-pH aquifer with a goal of attaining low drinking water criteria. The EISD remedial approach chosen for the site, BOS 100™ Trap & Treat, consisted of injecting a slurry of activated carbon impregnated with reactive iron metal, bacterial culture, and carbon substrate. BOS 100® was selected to remediate groundwater through multiple processes (adsorption to activated carbon, abiotic dechlorination). A series of permeable reactive barriers (PRBs) were placed selectively in the large dilute plumes and oriented perpendicular to groundwater flow to capture and treat CVOCs for site-wide plume reduction.

SITE BACKGROUND/GEOLOGY

Baseline concentrations of CVOCs measured prior to injection in groundwater from monitoring wells on site ranged from less than 10 to 120 micrograms per liter (µg/l). The property is an unoccupied open area with some portions currently in use for

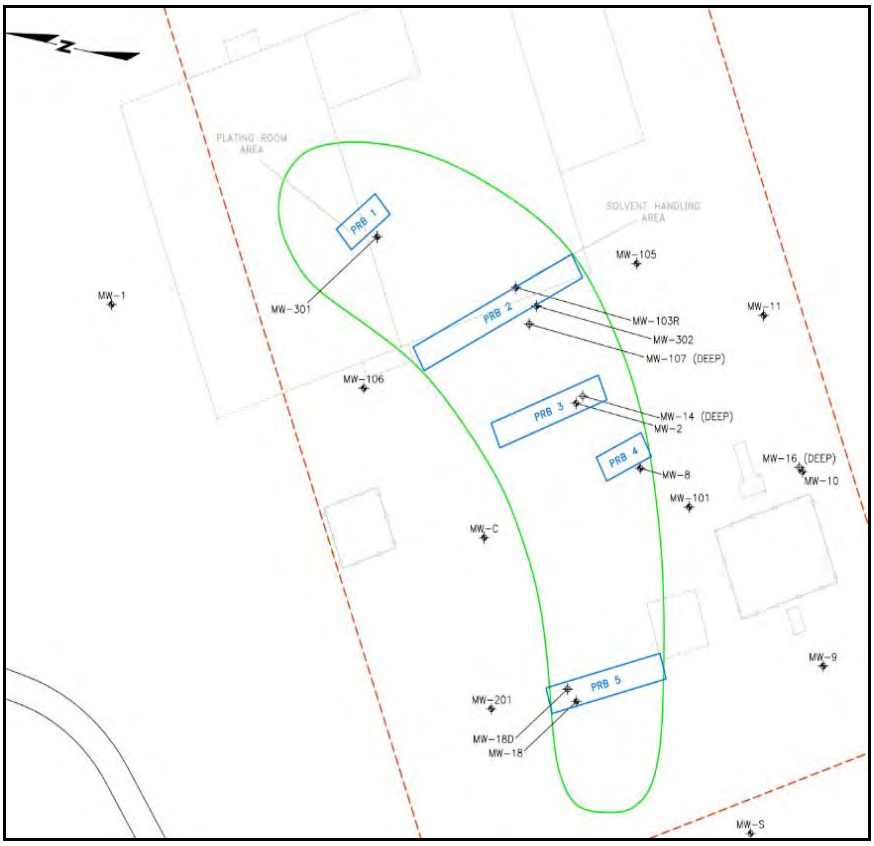
agricultural purposes, with future use proposed as residential development. Depth to groundwater ranged from 12 to 18 feet below ground surface (bgs), and site soils consists of sand in the plating and solvent handling areas. The plume thickness varied at different injection locations, and vertical target treatment zone ranged from 12 to 55 feet bgs. The soil in firing range area is heterogeneous with clay, silts, and fine sands encountered at differential depth intervals. Depth to groundwater was at ~18 bgs and the target treatment layer thickness was approximately 25 to 27 feet bgs.

ENHANCED IN-SITU DECHLORINATION TREATMENT PROGRAM AND IMPLEMEMENTATION

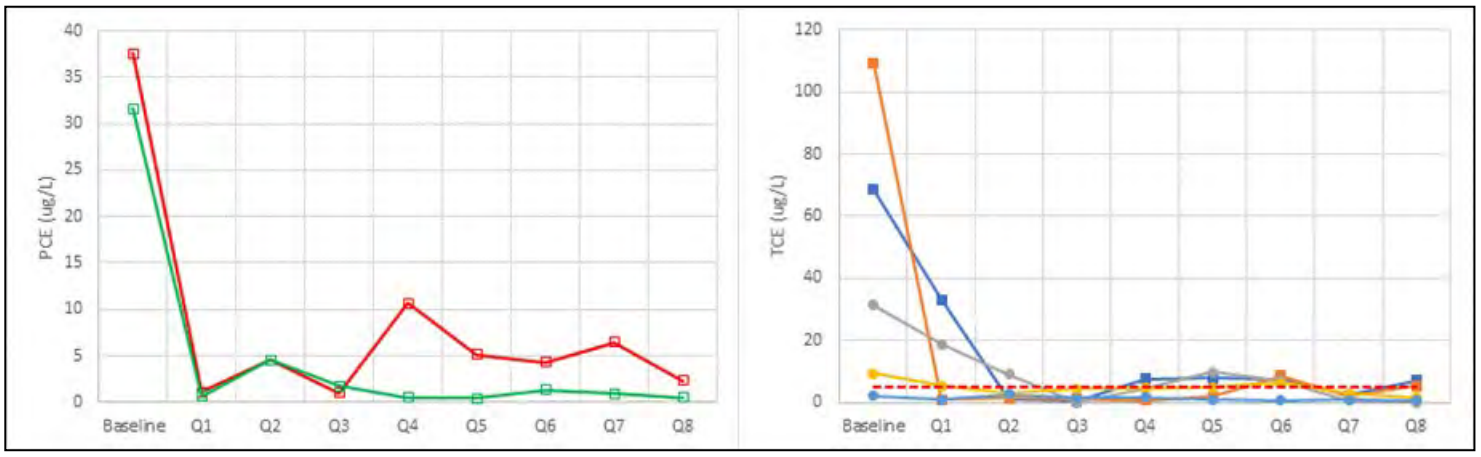
The full-scale treatment program was performed in two areas of concern over a 30-days event from November to December 2017. A total of 111,780 gallons (~31,527 lbs.) of BOS 100® were injected in plating & solvent handling area into 180 injection points to create five PRBs across an estimated area of 17,700 square feet. A total of 12,960 gallons (~3,618 lbs.) of BOS 100® were injected in fire ranging area into 48 injection wells to create a PRB across an estimated area of 2,400 square feet. The constructed reactive barriers have an extended treatment longevity for continued treatment of low concentration residual CVOCs in groundwater through sorption to activated carbon and abiotic and biotic dechlorination. Pressurized injection approach was implemented to distribute slurry reagents into the subsurface and to produce the desired radius of influence to develop overlapping reactive zones within the barriers. All injection points were temporary points installed using direct-push point technology.

CURRENT PROJECT STATUS

The overall objective was to treat CVOCs plume area and accelerate in achieving New Jersey Groundwater Quality Standards in the performance monitoring wells across the site. Groundwater samples collected at three, six, nine and twelve months after injection indicate a significant decrease in PCE and TCE concentrations compared to pre-injection period. Concentrations downgradient of treatment areas were below site cleanup levels for most of the groundwater monitoring wells with other wells downgradient of the PRBs typically showing downward trending results.



Permeable Reactive Barriers (PRBs) in plating and solvent handling area located to capture directional groundwater flow



EISD Treatment Program: PRBs to Treat PCE and CVOCs Plumes

Site

- Active Warehouse Facility, Massachusetts

Contaminants of Concern

- PCE (2,200 – 12,000 µg/L)

Geology/ Hydrology

- Low permeability silt and till

BOS 100® Treatment Program

- Grid treatment with 175 injection points
- Injections performed inside and outside active warehouse and coordinated to not disrupt operations
- Significant decrease in PCE concentrations recorded in samples collected after injection with 88 to greater than 99 percent reduction.

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ISOTEC Case Study No. 92

INJECTABLE ACTIVATED CARBON: PCE SOURCE AREA TREATMENT UTILIZING BOS 100® TECHNOLOGY

Active Warehouse Facility
Massachusetts

INTRODUCTION

ISOTEC was retained to implement groundwater remediation at an active warehouse and distribution facility utilizing BOS 100® injectable activated carbon, which consists of a slurry based activated carbon impregnated with reactive iron metal. The objective of the remediation program was source area mass reduction of tetrachloroethene (PCE) and downgradient residual PCE concentrations. The groundwater remediation was performed as part of a combined remedy program that also included soil vapor extraction.

ISOTEC supported the consultant in performing a comparative evaluation of different in-situ remediation approaches, including chemical oxidation, enhanced bioremediation, and injectable activated carbon. BOS 100® was selected based on site objectives, cost, and other site-specific factors.

SITE BACKGROUND/GEOLOGY

Past manufacturing operations at the site resulted in soil and groundwater impacts with chlorinated volatile organic compounds (CVOCs). PCE concentrations had been detected as high as 47,000 µg/L historically. Injection baseline concentrations of PCE measured in groundwater monitoring wells within the treatment area ranged from 2,200 to 12,000 µg/L. Site soils consist of dense, low permeability silt and till. Depth to groundwater is approximately 8 feet below ground surface (bgs), and the injections targeted impacted soils above an aquitard at approximately 20 feet bgs.

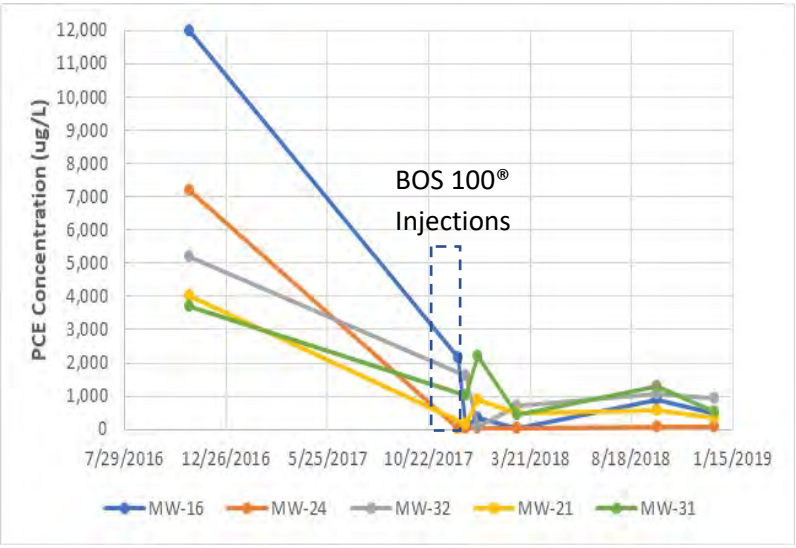
IN-SITU TREATMENT PROGRAM

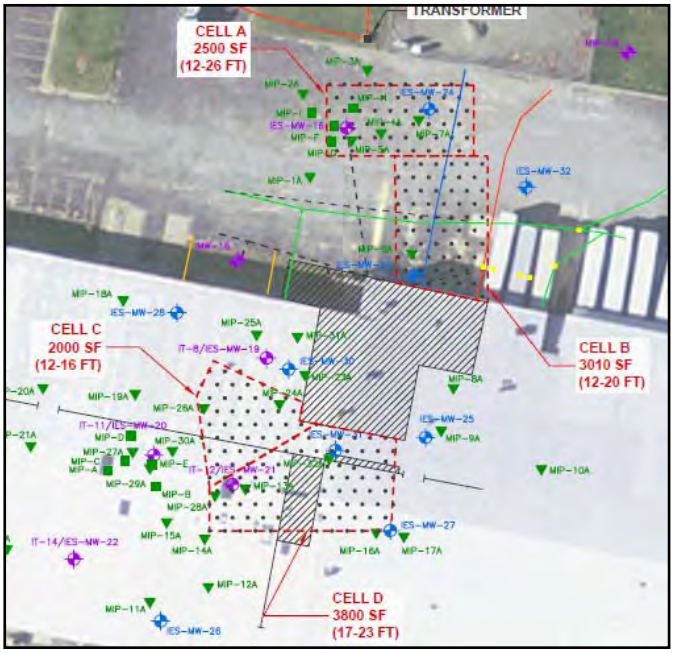
The groundwater treatment program was implemented both inside and outside an active warehouse facility over 19 injection days. ISOTEC injected BOS 100® into 90 locations outside the building

and 106 locations inside the building; with injection points divided into four subareas. All injection points were temporary points installed using direct-push point technology. ISOTEC subcontracted a concrete coring firm to efficiently core through the concrete slab for the inside points. Injection operations and sequencing was coordinated around minimizing disturbance of warehouse operations and maintaining active forklift lanes through the treatment area. A total of 16,900 pounds of BOS 100® was injected.

CURRENT PROJECT STATUS

The overall objective of remediation was to reduce PCE concentrations in groundwater to less than 1,000 µg/L in the treatment zones. Groundwater samples collected approximately three weeks after injections indicated rapid decrease in PCE concentrations. Quarterly samples collected for 12 months after injection demonstrated PCE in monitoring wells within the injection areas were all below the goal of 1,000 µg/L. Ethene was detected in multiple monitoring wells as a product of reductive dechlorination.





EISBR Pilot Program:

Site

- Denitrification Demonstration Test
  Cape Cod, MA.

Contaminants of Concern

- Nitrate

Geology/ Hydrology

- Site geology consists of mostly medium to coarse sands with gravel and silt lens.
- Depth to water at approximately 35 feet bgs.

Treatment Program

- Denitrification PRB through application of Terra Systems SRS-NR (Slow Release Substrate-Nitrate Removal) EVO and sodium bicarbonate.
- PRB length of 110 feet, consisting of 17 direct-push injection points (7 points in a single row and 10 points in a pair of rows).
- Injection interval from 36 to 68 feet bgs.
- Total solution volume injected was ~11,000 gallons.
- Field monitoring data during the injections indicated negligible change to turbidity and conductivity in downgradient monitoring wells achieving project objective to minimize migration of EVO and establish a robust PRB.

Project Status

- SRS-NR EVO is anticipated to last in the aquifer and support denitrification for 3+ years. Quarterly performance monitoring will be conducted starting in 2017 to evaluate performance including nitrate removal, EVO migration and persistence.

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ISOTEC Case Study No. 80

ENHANCED IN-SITU BIOREMEDIATION (EISBR): DENITRIFCIATION PERMEABLE REACTIVE BARRIER UTILIZING EMULSIFIED VEGETABLE OIL

Nitrate Plume Demonstration Test
Cape Cod, Massachusetts

SITE BACKGROUND

ISOTEC was retained to implement a Denitrification Permeable Reactive Barrier (PRB) demonstration test for the treatment of nitrate in groundwater using Emulsified Vegetable Oil (EVO). Septic systems are used to manage nearly 85 percent of the wastewater flow from residences and businesses on Cape Cod. As a result, nitrate emanating from septic systems travels as a plume without significant attenuation in groundwater to coastal waters. The Project represented the first to implement a "Hybrid" approach under the Cape Cod 208 Water Quality Plan, approved by both the USEPA and Massachusetts Department of Environmental Protection, which uses non-traditional technologies including PRBs. Application of EVO introduces a carbon food substrate into the subsurface to enhance activity of naturally occurring denitrifying bacteria.

Site soils consist of sandy formation with high groundwater flow velocities (1 to 2 feet per day). Gravel and clayed silt lenses exist within the subsurface. Groundwater is encountered at approximately 35 feet bgs, with the nitrate plume extending at least to 70 feet bgs.

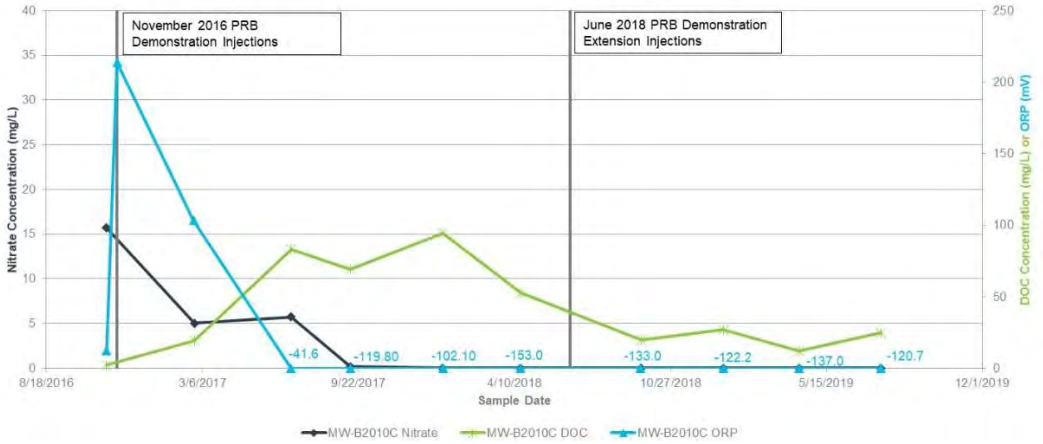
TREATMENT PROGRAM AND IMPLEMEMENTATION

The demonstration test PRB was approximately 110 feet long and consisted of 17 direct push injection points. The vertical injection interval was 36 to 68 feet bgs. This PRB was established utilizing the first ever use of a custom Terra Systems EVO solution formulated specifically for extended longevity in a permeable aquifer with high groundwater flow velocity.

Total volume of EVO injected for the PRB was ~11,000 gallons (approximately 14% effective pore volume), applied at a 4:1 ratio with sodium bicarbonate as pH buffer. Performance monitoring conducted during the injection program indicated negligible changes in turbidity or conductivity in monitoring wells 7 and 10 feet downgradient, which achieved the treatment objective to minimize migration of EVO and to establish a robust PRB.

PROJECT STATUS

PRB performance and longevity is being assessed through a quarterly monitoring program. SRS-NR EVO is anticipated to last in the aquifer and support denitrification for 5+ years. Quarterly performance monitoring to evaluate performance including nitrate removal, EVO migration and persistence has demonstrated the effectiveness to reduce nitrate to low concentrations to significantly reduce the nitrogen mass flux through a PRB for more than 4 years after injection.



ISCO Treatment Program: MGP Related Impacts

Site

- Former Manufacturing Gas Plant, Upstate, NY

Contaminants of Concern

- VOCs/ SVOCs
- PAHs
- TPH-GRO
- TPH-DRO
- NAPL

Geology/Hydrology

- Site geology consists of a very thin coarse gravel and fine sand layer located in between two confining layers of silty clay. Majority of remaining COCs were believed to be present within the thin gravel/sand layer.

ISCO Treatment Program

- MFR and BASP treatments.
- Three treatment events.
- Treatment Area = 4,900 $ft^{2.}$
- Treatment interval 9-18 ft bgs.
- Injection pathway system consisted of 43 permanent well injection locations installed in an active roadway.
- A total of 38,693 gallons of reagents were injected over the course of three events.
- Continuous air/dust monitoring was performed due to the sensitivity of the location.

Results

- MFR and BASP treatments.
- Three treatment events.

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ISOTEC Case Study No. 83

ISCO Treatment Program: MGP Related Impacts via Modified Fenton's Reagent (MFR) and Base Activated Sodium Persulfate (BASP)

Former Manufacturing Gas Plant
Upstate, New York

INTRODUCTION

ISOTEC was retained to implement an *In-Situ Chemical Oxidation* (ISCO) treatment program within the downgradient residual plume area of a former Manufactured Gas Plant (MGP) site utilizing a combination of modified Fenton's reagent (MFR) and base activated sodium persulfate (BASP) to address impacted soils and groundwater. The oxidants and dosages were selected based on bench scale testing that ISOTEC collaborated on. Target contaminants of concern (COCs) included volatile organic contaminants (VOCs), semi-volatile organic contaminants (SVOCs), poly-aromatic hydrocarbons (PAHs), total petroleum hydrocarbon gasoline range organics (TPH-GRO) and diesel range organics (TPH-DRO) and free-phase NAPL impacts.

SITE BACKGROUND/GEOLOGY

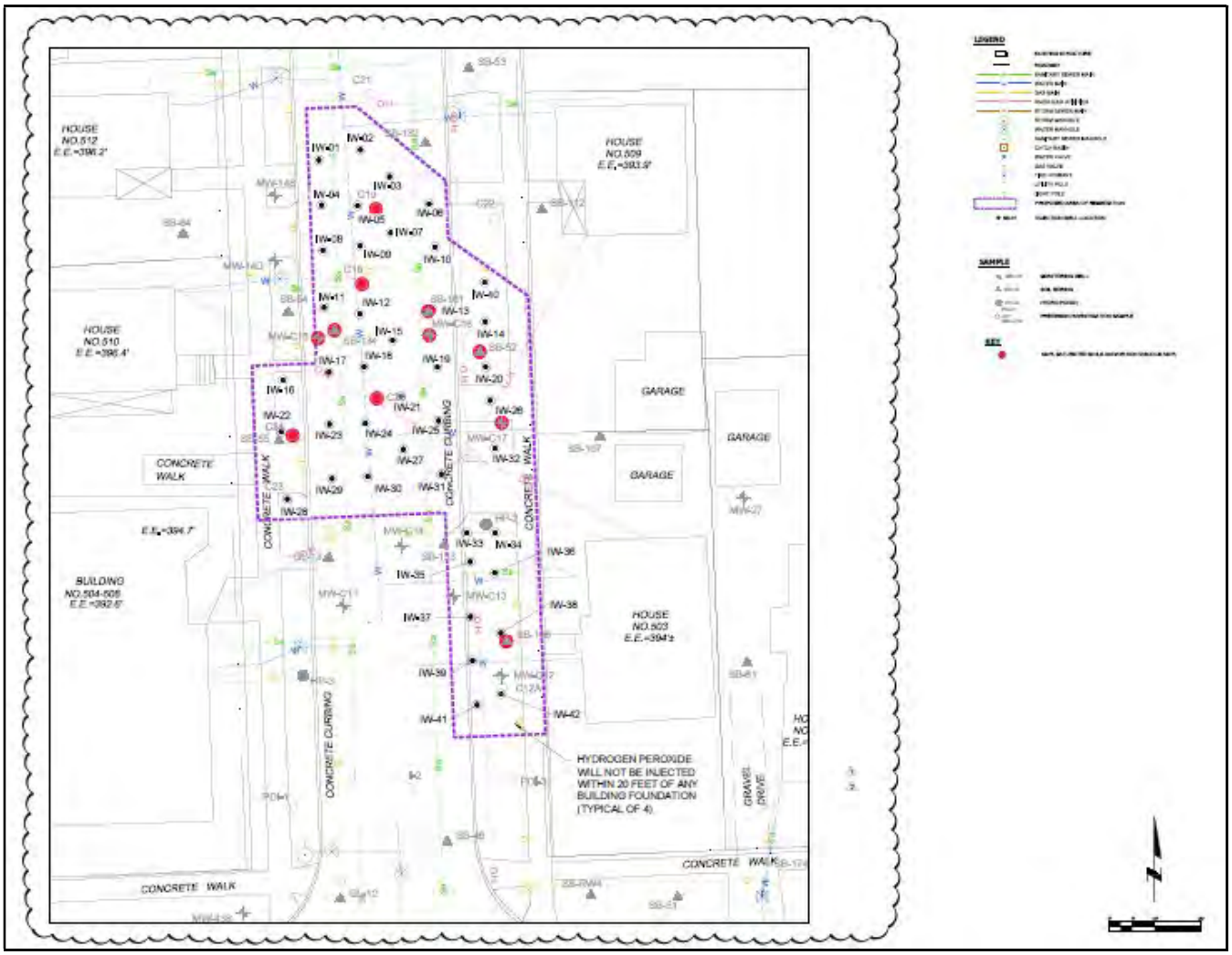
Past MGP operations at the site resulted in soil and groundwater COC impacts. The ISCO target treatment area was located on an neighborhood roadway/ sidewalk lined with residential and commercial properties. Numerous subsurface utilities existed within the target area and each proposed injection point location was initially pre-cleared down to ~5 feet (ft) below ground surface (bgs) to ensure that no lines were damaged during drilling. The treatment area was approximately 4,900 square feet (ft^2) and targeted a very narrow layer (0.5 to 4 feet) of coarse gravel/fine sand located in between two confining layers of silty clay. Injection well screens were selectively placed within the overall 9-18 ft bgs depth interval based on data collected from past soil borings and from new soil borings overseen by ISOTEC during the injection well installation. Selective placement of each well screen allowed for an effective method of delivering injected ISCO reagents where the significant mass of MGP impacts were located and traveling within the narrow coarse gravel/fine sand layer.

ISCO TREATMENT PROGRAM AND IMPLEMEMENTATION

The ISCO treatment program was implemented over three planned injection events lasting 15-20 injection days per event. A total of 43 PVC permanent injection were installed at a spacing of approximately 12 feet. Due to the sensitive site setting located within an active neighborhood roadway and along portions of the adjacent sidewalks, extreme caution and thorough planning of the injection approach was taken into account for the actual field implementation. Through coordination with the City DPW and first responders, daily road closure of the targeted area was implemented during each injection event to minimize contact between field personnel/chemicals and both pedestrian and vehicular traffic. As an added precaution, chemicals were staged within a fenced area each day/night and the injection equipment/process was staged within a box truck that contained all regents and chemicals to minimize contact with nearby residents and allowed for quicker daily equipment setup and breakdown each day. All pumps and batching were conducted from the back of a box truck with hoses out to active injection wells that were designed to allow for quick disassembly in case emergency personnel/vehicles needed to access the work zone roadway. For added precaution to protect the surrounding community, dust/air monitoring was performed every day, active injection points were covered up with poly-sheeting to prevent accidental spraying of reagents, and venting of completed injection points through a carbon knock-out drum was performed to mitigate release of impacted vapors into the breathing zone. To minimize disruption to nearby residents, the impacted work areas were opened back up each night to allow normal vehicular/pedestrian activity to commence. Modifications to the ISCO strategy, oxidant sequencing, and amendment dosages were made in collaboration with the consultant during and between events to improve remedial performance and maintain safety working in a high-profile, residential road.

Three injection events were conducted over a 16 month time period with a total of 38,693 gallons safely injected into the subsurface within a very sensitive site setting. Upon completion of the 3 full-scale injection applications, a significant reduction of total BTEX and PAHs was noted across the treatment area. Following ISCO, groundwater concentrations reduced sufficiently to transition to long-term monitoring consistent with the Record of Decision.

Site Map


HOUSE NO.512 E.E.=398.2'
HOUSE NO.509 E.E.=393.9'
HOUSE NO.510 E.E.=396.4'
HOUSE NO.503 E.E.=394'±
BUILDING NO.504-508 E.E.=392.6'
GARAGE
GARAGE
GARAGE
CONCRETE WALK
CONCRETE WALK
CONCRETE CURBING
CONCRETE CURBING
CONCRETE WALK
CONCRETE WALK
GRAVEL DRIVE
HYDROGEN PEROXIDE WILL NOT BE INJECTED WITHIN 20 FEET OF ANY BUILDING FOUNDATION (TYPICAL OF 4)
LEGEND
SAMPLE
KEY

To: Emily Cummings (EA Science and Engineering) 2/24/2021

sent via email

From: Keith M Gaskill, LPG, Sr Design Specialist
kgaskill@regenesis.com 317-800-4529

Subject: ***Preliminary Design and Cost Estimate***

Site: *Crystal Cleaners*
Pelham, NY

Applicable Product(s)	**Links to View/Download Product Information**
Bio-Dechlor INOCULUM® Plus	BDI Plus
PlumeStop® Liquid Activated Carbon™	PlumeStop
Hydrogen Release Compound®	HRC

REGENESIS is pleased to present you with this design and cost estimate for the proposed treatment at your site utilizing the remediation technologies presented above. Included within this document you will find the following attachments supporting the proposed approach:

- Map Depicting Treatment Areas
- Remedial Design and Cost Estimate
- Product Technical Sheets
- Standard Assumptions
- Terms and Conditions

Remedial Approach

We are proposing application of PlumeStop® Liquid Activated Carbon™ (PlumeStop) and Hydrogen Release Compound (HRC®) to treat residual chlorinated solvents. PlumeStop is a colloidal form of activated carbon with a surface treatment which reduces its interactions with the soil matrix. This allows it to move through soil pores leaving a coating on the soil matrix as it distributes from the injection point. This provides a very large sorption surface which will result in immediate reduction of these contaminants while concentrating contaminants to allow for more efficient and controlled remediation through destructive technologies like HRC. HRC will provide a controlled release of hydrogen to stimulate anaerobic bioremediation. As contaminants are degraded to non-toxic and non-sorptive end products, the PlumeStop sorption surface will be regenerated. This allows for further sorption and treatment of contaminants which may diffuse back into the groundwater from the soil matrix over time. Bio-Dechlor INOCULUM® Plus is added to provide a live microbial culture that is known to fully degrade these compounds.

PlumeStop was developed specifically to allow for the activated carbon particles to flow into and through contaminated aquifer flux zones in a “flooding” delivery fashion. Because PlumeStop particles are so small (1 to 2 micrometers and the size of a red blood cell) they can flow into silty soils without fracturing. Once in the formation they “paint” the aquifer and eventually become positionally stable with no occlusion of aquifer pore-space. In comparison, other carbon products use a “fine grained” activated carbon that is larger than the pore-space diameter of most soils and must be fractured at high pressures (commonly 200 to 600 psi or higher) for delivery into the

formation. Such high pressure fracturing is an uncontrolled process that frequently results in short circuiting, random fractured directions, and preferential flow into wells and utility corridors. Fractures must also be placed every 2 or 3 vertical feet which leaves ample opportunity for missed flow paths between those fractures. In comparison, PlumeStop is a liquid carbon suspension that injects under low-pressure (usually less than 60 psi) and high volumes to flood conductive zones of an aquifer and the end results is a "painting" of all conductive soils as compared to intermittent carbon seams (roughly 1 cm or smaller) as seen with other carbon injections. During PlumeStop application, real-time field verification is performed where soil cores are taken to confirm distribution and micro-adjustments to volumes and pressures are made to ensure product overlap. As a result, PlumeStop provides complete capture zones and greater design flexibility which results in much more consistent and predictable results.

The costs presented assume the proposed remediation technologies will be applied by our Remediation Services Division (RRS). RRS will provide all personnel and equipment to complete the application including subcontracting of a direct push drilling rig and operator. Please refer to the attached standard RRS' assumptions for remedial applications.

Assumptions

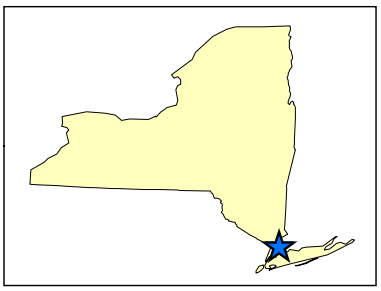
In generating this design proposal REGENESIS relied upon professional judgment and site specific information provided by others. Using this information as input, we performed calculations based upon known chemical and geologic relationships to generate an estimate of the mass of product and subsurface placement required to affect remediation of the site. The attached design summary tables specify the assumptions used in preparation of this technical design. We request that these modeling input assumptions be verified by your firm.

REGENESIS developed this Scope of Work in reliance upon the data and professional judgments provided by those whom completed the earlier environmental site assessment(s). The fees and charges associated with the Scope of Work were generated through REGENESIS' proprietary formulas and thus may not conform to billing guidelines, constraints or other limits on fees. REGENESIS does not seek reimbursement directly from any government agency or any governmental reimbursement fund (the "Government"). In any circumstance where REGENESIS may serve as a supplier or subcontractor to an entity which seeks reimbursement from the Government for all or part of the services performed or products provided by REGENESIS, it is the sole responsibility of the entity seeking reimbursement to ensure the Scope of Work and associated charges are in compliance with and acceptable to the Government prior to submission. When serving as a supplier or subcontractor to an entity which seeks reimbursement from the Government, REGENESIS does not knowingly present or cause to be presented any claim for payment to the Government.

Closing

Please feel free to contact me if you need additional information or have any questions regarding our evaluation and/or this correspondence (contact info listed above). Thank you for considering REGENESIS as part or your remedial solution for this project.

G:\Projects\State&Local\NYSDEC - D009806\Work Assignments\1602511 Crystal Cleaners RD\06 GIS\01 MXD\Design\Figure1 SiteLocation.mxd



0 50 100 150 200
Feet

N

Legend

- Crystal Cleaners Property Boundary
- Proposed Excavation Area
- Overburden Groundwater Remedial Area

Figure 1
SITE LAYOUT AND AREAS OF CONCERN
Crystal Cleaners
Pelham, New York

Map Date: 12/7/2020
Projection:
NAD_1983_StatePlane_New_York_East_FIPS_3101_Feet

NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation

Groundwater Treatment Grid Areas

REGENESIS

Project Info
Crystal Cleaners
Pelham, NY
Saturated Sand Unit
Prepared For:
Emily Cummings (EA Science and Engineering)

Target Treatment Zone (TTZ) Info	Unit	Value
Grid Treatment Areal Extent	sq ft	4,400
Top Treat Depth	ft	8.0
Bot Treat Depth	ft	20.0
Vertical Treatment Interval	ft	12.0
Treatment Zone Volume	ft^3	52,800
Treatment Zone Volume	cy	1,956
Soil Type	---	silty sand
Porosity	cm^3/cm^3	0.40
Effective Porosity	cm^3/cm^3	0.20
Treatment Zone Pore Volume	gals	157,989
Treatment Zone Effective Pore Volume	gals	78,994
Treatment Zone Pore Volume	liters	598,050
Treatment Zone Effective Pore Volume	liters	299,025
Fraction Organic Carbon (foc)	g/g	0.003
Soil Density	g/cm^3	1.6
Soil Density	lb/ft^3	100
Soil Weight	lbs	5.3E+06
Hydraulic Conductivity	ft/day	10.0
Hydraulic Conductivity	cm/sec	3.53E-03
Hydraulic Gradient	ft/ft	0.005
GW Velocity	ft/day	0.25
GW Velocity	ft/yr	91

Sources of Hydrogen Demand	Unit	Value
Dissolved Phase Contaminant Mass	lbs	5
Sorbed Phase Contaminant Mass	lbs	12
Competing Electron Acceptor Mass	lbs	119
Total Mass Contributing to H2 Demand	**lbs**	**136**

Mass Flux and HRC Demand	Unit	Value
Groundwater Mass Flux through TTZ	L/day	1,699
Stoichiometric HRC Demand	lbs	762
Mass Flux HRC Demand	lbs	773
Total HRC Demand	**lbs**	**1,535**

Application Dosing	Unit	Value
PlumeStop to be Applied	**lbs**	**9,200**
HRC to be Applied	**lbs**	**1,560**
BDI Plus to be Applied	**Liters**	**19**

PlumeStop® Application Design Summary

Saturated Sand Unit

PlumeStop	
Treatment Type	**Grid**
Treatment Areal Extent (sq ft)	4400
Spacing Within Rows (ft)	9
Spacing Between Rows (ft)	9
DPT Injection Points	**54**
Top Application Depth (ft bgs)	8
Bottom Application Depth (ft bgs)	20
PlumeStop to be Applied (lbs)	**9,200**
PlumeStop to be Applied (gals)	1,021
PlumeStop Volume Totals	
Mixing Water (gal)	43,077
Total Application Volume (gals)	**44,098**
Injection Volume per Point (gals)	817
Anaerobic Bioremediation - HRC	
HRC Application Points	**54**
HRC to be Applied (lbs)	**1,560**
HRC per point (lbs)	29
Total Application Volume (gals)	**144**
Injection Volume per Point (gals)	2.7
Bioaugmentation - BDI Plus	
BDI Plus Application Points	**54**
BDI Plus to be Applied (Liters)	**19**
BDI Plus per point (Liters)	0.4

Technical Notes

Injection Radius for Soil Coverage (ft-est.avg.)

5.7

PlumeStop Inject. Conc. (mg/L)

5,000

Special Instructions:

Assumptions/Qualifications

In generating this preliminary estimate, Regenesis relied upon professional judgment and site specific information provided by others. Using this information as input, we performed calculations based upon known chemical and geologic relationships to generate an estimate of the mass of product and subsurface placement required to affect remediation of the site.

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Prepared by: Keith M Gaskill, LPG, Sr Design Specialist
Date: 2/24/2021

Groundwater Treatment Grid Areas

REGENESIS

Purchasing Information		
Crystal Cleaners	**--**	**Saturated Sand Unit**
PlumeStop Required	**lbs**	**9,200**
HRC to be Applied	**lbs**	**1,560**
BDI Plus to be Applied	**Liters**	**19**
Estimated Tax and Freight %*	%	18%
Estimated Tax and Freight Cost	$	$16,456
Estimated Total Product Cost	**$**	**$107,875**
Estimated RRS Application Cost	**$**	**$69,056**
Total Estimated Project Cost**	**$**	**$176,931**
Estimated RRS Days to Apply	**---**	**14**

Currently Available Packaging Options

Package Type***	# of packages	lbs required
PlumeStop-2,000 lb reinf. plastic totes	4	8,000
PlumeStop-400 lb poly drums	3	1,200
HRC-40 lb HDPE Pails	39	1,560
BDI-18 Liter kegs	1	19

***Note that the combined tax and freight costs are preliminary estimates only. Please contact your local sales manager or Customer Service at 949-366-8000 to obtain a shipping quote. You will be asked to provide a ship-to address and estimated time of delivery.**

****Total Project cost is only an estimate; actual project cost may change as the final scope and/or RRS proposal are developed.**

*****Available Package Types are subject to change.**

Source Treatment Area

REGENESIS

Project Info
Crystal Cleaners
Pelham, NY
Saturated Sand Unit
Prepared For:
Emily Cummings (EA Science and Engineering)

Target Treatment Zone (TTZ) Info	Unit	Value
Grid Treatment Areal Extent	sq ft	600
Top Treat Depth	ft	8.0
Bot Treat Depth	ft	20.0
Vertical Treatment Interval	ft	12.0
Treatment Zone Volume	ft^3	7,200
Treatment Zone Volume	cy	267
Soil Type	---	silty sand
Porosity	cm^3/cm^3	0.40
Effective Porosity	cm^3/cm^3	0.20
Treatment Zone Pore Volume	gals	21,544
Treatment Zone Effective Pore Volume	gals	10,772
Treatment Zone Pore Volume	liters	81,552
Treatment Zone Effective Pore Volume	liters	40,776
Fraction Organic Carbon (foc)	g/g	0.003
Soil Density	g/cm^3	1.6
Soil Density	lb/ft^3	100
Soil Weight	lbs	7.2E+05
Hydraulic Conductivity	ft/day	10.0
Hydraulic Conductivity	cm/sec	3.53E-03
Hydraulic Gradient	ft/ft	0.005
GW Velocity	ft/day	0.25
GW Velocity	ft/yr	91

Sources of Hydrogen Demand	Unit	Value
Dissolved Phase Contaminant Mass	lbs	1
Sorbed Phase Contaminant Mass	lbs	2
Competing Electron Acceptor Mass	lbs	16
Total Mass Contributing to H2 Demand	**lbs**	**19**
Mass Flux and HRC Demand	**Unit**	**Value**
Groundwater Mass Flux through TTZ	L/day	1,699
Stoichiometric HRC Demand	lbs	104
Mass Flux HRC Demand	lbs	773
Total HRC Demand	**lbs**	**877**
Application Dosing	**Unit**	**Value**
PlumeStop to be Applied	**lbs**	**1,600**
HRC to be Applied	**lbs**	**920**
BDI Plus to be Applied	**Liters**	**19**

PlumeStop® Application Design Summary

Saturated Sand Unit

PlumeStop	
Treatment Type	**Grid**
Treatment Areal Extent (sq ft)	600
Spacing Within Rows (ft)	9
Spacing Between Rows (ft)	9
DPT Injection Points	**7**
Top Application Depth (ft bgs)	8
Bottom Application Depth (ft bgs)	20
PlumeStop to be Applied (lbs)	**1,600**
PlumeStop to be Applied (gals)	178
PlumeStop Volume Totals	
Mixing Water (gal)	7,492
Total Application Volume (gals)	**7,669**
Injection Volume per Point (gals)	1,096
Anaerobic Bioremediation - HRC	
HRC Application Points	**7**
HRC to be Applied (lbs)	**920**
HRC per point (lbs)	131
Total Application Volume (gals)	**85**
Injection Volume per Point (gals)	12.1
Bioaugmentation - BDI Plus	
BDI Plus Application Points	**7**
BDI Plus to be Applied (Liters)	**19**
BDI Plus per point (Liters)	2.7

Technical Notes

Injection Radius for Soil Coverage (ft-est.avg.)

6.6

PlumeStop Inject. Conc. (mg/L)

5,000

Special Instructions:

Assumptions/Qualifications

In generating this preliminary estimate, Regenesis relied upon professional judgment and site specific information provided by others. Using this information as input, we performed calculations based upon known chemical and geologic relationships to generate an estimate of the mass of product and subsurface placement required to affect remediation of the site.

REGENESIS developed this Scope of Work in reliance upon the data and professional judgments provided by those whom completed the earlier environmental site assessment(s). The fees and charges associated with the Scope of Work were generated through REGENESIS' proprietary formulas and thus may not conform to billing guidelines, constraints or other limits on fees. REGENESIS does not seek reimbursement directly from any government agency or any governmental reimbursement fund (the "Government"). In any circumstance where REGENESIS may serve as a supplier or subcontractor to an entity which seeks reimbursement from the Government for all or part of the services performed or products provided by REGENESIS, it is the sole responsibility of the entity seeking reimbursement to ensure the Scope of Work and associated charges are in compliance with and acceptable to the Government prior to submission. When serving as a supplier or subcontractor to an entity which seeks reimbursement from the Government, REGENESIS does not knowingly present or cause to be presented any claim for payment to the Government.

Prepared by: Keith M Gaskill, LPG, Sr Design Specialist
Date: 2/24/2021

Source Treatment Area

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Purchasing Information		
Crystal Cleaners	**--**	**Saturated Sand Unit**
PlumeStop Required	**lbs**	**1,600**
HRC to be Applied	**lbs**	**920**
BDI Plus to be Applied	**Liters**	**19**
Estimated Tax and Freight %*	%	18%
Estimated Tax and Freight Cost	$	$4,549
Estimated Total Product Cost	**$**	**$29,822**
Estimated RRS Application Cost	**$**	**$21,360**
Total Estimated Project Cost**	**$**	**$51,182**
Estimated RRS Days to Apply	**---**	**3**

***Note that the combined tax and freight costs are preliminary estimates only. Please contact your local sales manager or Customer Service at 949-366-8000 to obtain a shipping quote. You will be asked to provide a ship-to address and estimated time of delivery.**

Currently Available Packaging Options		
Package Type* **	**# of packages**	**lbs required**
PlumeStop-2,000 lb reinf. plastic totes	4	8,000
PlumeStop-400 lb poly drums	3	1,200
HRC-40 lb HDPE Pails	23	920
BDI-18 Liter kegs	1	19

****Total Project cost is only an estimate; actual project cost may change as the final scope and/or RRS proposal are developed.**

*****Available Package Types are subject to change.**

PlumeStop® Liquid Activated Carbon™ Technical Description

PlumeStop Liquid Activated Carbon is an innovative groundwater remediation technology designed to rapidly remove and permanently degrade groundwater contaminants. PlumeStop is composed of very fine particles of activated carbon (1-2µm) suspended in water through the use of unique organic polymer dispersion chemistry. Once in the subsurface, the material behaves as a colloidal biomatrix, binding to the aquifer matrix, rapidly removing contaminants from groundwater, and promoting permanent contaminant biodegradation.

This unique remediation technology accomplishes treatment with the use of highly dispersible, fast-acting, sorption-based technology, capturing and concentrating dissolved-phase contaminants within its matrix-like structure. Once contaminants are sorbed onto the regenerative matrix, biodegradation processes achieve complete remediation.

Distribution of PlumeStop in water

To see a list of treatable contaminants with the use of PlumeStop, view the Range of Treatable Contaminants Guide.

Chemical Composition

- Water - CAS# 7732-18-5
- Colloidal Activated Carbon ≤2.5 - CAS# µm 7440-44-0
- Proprietary Additives

Properties

- Physical state: Liquid
- Form: Aqueous suspension
- Color: Black
- Odor: Odorless
- pH: 8 - 10

Storage and Handling Guidelines

Storage
Store in original tightly closed container
Store away from incompatible materials
Protect from freezing

Handling
Avoid contact with skin and eyes
Avoid prolonged exposure
Observe good industrial hygiene practices
Wash thoroughly after handling
Wear appropriate personal protective equipment

PlumeStop® Liquid Activated Carbon™ Technical Description

Applications

PlumeStop is easily applied into the subsurface through gravity-feed or low-pressure injection.

Health and Safety

Wash hands after handling. Dispose of waste and residues in accordance with local authority requirements. Please review the Material Safety Data Sheet for additional storage, usage, and handling requirements here: PlumeStop SDS.

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www.regenesis.com
1011 Calle Sombra, San Clemente CA 92673
949.366.8000

HRC® Technical Description

HRC® is an engineered, hydrogen release compound designed specifically for enhanced, *in situ* anaerobic bioremediation of chlorinated compounds in groundwater or highly saturated soils. Upon contact with groundwater, this viscous, polylactate ester material becomes hydrated and subject to microbial breakdown producing a controlled-release of hydrogen for periods of up to 18-24 months on a single application.

Example of HRC

HRC enables enhanced anaerobic biodegradation by adding hydrogen (an electron donor) to groundwater and/or soil to increase the number and vitality of indigenous microorganisms able to perform the naturally occurring process of enhanced reductive dechlorination. During this process, certain naturally occurring microorganisms replace chlorine atoms on chlorinated contaminants with the newly available hydrogen effectively reducing the contaminant to a less harmful substance with the preferred and innocuous endpoints of ethene or ethane.

For a list of treatable contaminants with the use of HRC, view the Range of Treatable Contaminants Guide.

Chemical Composition

- Glycerol Tripolylactate- CAS #201167-72-8
- Glycerin- CAS #56-81-5
- Lactic acid- CAS #50-21-5

Properties

- pH - 3 (10% solution/water)
- Appearance – Viscous gel/liquid. Amber color
- Odor – Odorless

Storage and Handling Guidelines

Storage
Store away from incompatible materials
Store in original tightly closed container
Store in a cool, dry, well-ventilated place

Handling
Wash thoroughly after handling
Wear appropriate personal protective equipment
Wear eye/face protection
Provide adequate ventilation
Observe good industrial hygiene practices

HYDROGEN RELEASE COMPOUND

HRC® Technical Description

Applications

- Permanent injection wells
- Direct-push injection (barriers and grids)
- Recirculating wells
- Soil borings
- Excavation applications into soil or on top of bedrock
- Gravity feed into bedrock wells

Application instructions for this product are contained in the HRC Application Instructions.

Health and Safety

Avoid contact with eyes, skin, and clothing. Provide adequate ventilation. Wear appropriate personal protective equipment. Observe good industrial hygiene practices.

Please review the HRC Safety Data Sheet for additional storage, usage, and handling requirements.

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Bath BA1 1BT, United Kingdom

BDI PLUS® Technical Description

Bio-Dechlor INOCULUM Plus (BDI PLUS®) is an enriched natural consortium containing species of Dehalococcoides sp. (DHC). BDI PLUS has been shown to simulate the rapid and complete dechlorination of chlorinated solvents such as tetrachloroethene (PCE), trichloroethene (TCE), dichloroethene (DCE) and vinyl chloride (VC) to non-toxic end products, ethene, carbon dioxide and water.

The culture also contains microbes capable of dehalogenating halomethanes (e.g., carbon tetrachloride and chloroform) and haloethanes (e.g., 1,1,1-TCA and 1,1-DCA) as well as mixtures of these contaminants.

Species of Dehalococcoides sp. (DHC)

For a list of treatable contaminants with the use of BDI PLUS, view the Range of Treatable Contaminants Guide

Chemical Composition

- Non-hazardous, naturally-occurring, non-altered anaerobic microbes and enzymes in a water-based medium.

Properties

- Appearance – Murky, yellow to grey water
- Odor – Musty
- pH 6.0 to 8.0
- Density – Approximately 1.0 grams per cubic centimeter (0.9 to 1.1 g/cc)
- Solubility – Soluble in Water
- Vapor Pressure – None
- Non-hazardous

Storage and Handling Guidelines

Storage
Store in original tightly closed container
Store away from incompatible materials
Recommended storage containers: plastic lined steel, plastic, glass, aluminum, stainless steel, or reinforced fiberglass
Store in a cool, dry area at 4-5°C (39 - 41°F)
Material may be stored for up to 3 weeks at 2-4°C without aeration

Handling
Avoid prolonged exposure
Observe good industrial hygiene practices
Wear appropriate personal protective equipment

BDI PLUS® Technical Description

Applications

- BDI PLUS is delivered to the site in liquid form and is designed to be injected directly into the saturated zone requiring treatment.
- Most often diluted with de-oxygenated water prior to injection into either hydraulic push injection points or properly constructed injection wells.
- The typical dilution rate of the injected culture is 10 gallons of deoxygenated water to 1 liter of standard BDI PLUS culture.

Application instructions for this product are contained here BDI PLUS Application Instructions.

Health and Safety

Material is non-hazardous and relatively safe to handle; however avoid contact with eyes and prolonged contact with skin. OSHA Level D personal protection equipment including: vinyl or rubber gloves and safety goggles or a splash shield are recommended when handling this product. An eyewash station is recommended. Please review the Material Safety Data Sheet for additional storage, usage, and handling requirements here: BDI PLUS SDS.

REGENESIS®

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European Headquarters
The Tramshed, Beehive Yard
Walcot St, Bath BA1 5BB, United Kingdom

Remedial Design Assumptions and Qualifications

Cost Estimate Disclaimer: The cost listed assumes conditions set forth within the proposed scope of work and assumptions and qualifications. Changes to either could impact the final cost of the project. This may include final shipping arrangements, sales tax or application related tasks such as product storage and handling, access to water, etc. If items listed need to be modified, please contact Regenesis for further evaluation.

Shipping Estimates: Shipping estimates are valid for 30 days. All shipping charges are estimates and actual freight charges are calculated at the time of invoice. Additional freight charges may be assessed for any accessorial requested at the time of delivery. The estimate included within assumes standard shipping.

Standard delivery is between 8am -5pm Monday –Friday. *accessorial – can include, but not limited to lift gate and pallet jack at delivery, inside delivery, time definite deliveries, and delivery appointments.

Please communicate any requirements for delivery with the customer service department at the time the order is placed.

Return Policy: To initiate a return please contact your local sales manager for an RMA. A 15% re-stocking fee will be charged for all returned goods. Return freight must be prepaid. All requests to return product must be in original condition and no product will be accepted for return after 90 days from date of delivery.

Professional Judgement: In generating this estimate, REGENESIS relied upon professional judgment and site specific information provided by others. Using this information as input, we performed calculations based upon known chemical and geologic relationships to generate an estimate of the mass of product and subsurface placement required to affect remediation of the site.

REGENESIS developed this Scope of Work in reliance upon the data and professional judgments provided by those whom completed the earlier environmental site assessment(s), and in reliance upon REGENESIS' prior experience on similar project sites. The fees and charges associated with the Scope of Work were generated through REGENESIS' proprietary formulas and thus may not conform to billing guidelines, constraints or other limits on fees. REGENESIS does not seek reimbursement directly from any government agency or any governmental reimbursement fund (the "Government"). In any circumstance where REGENESIS may serve as a supplier or subcontractor to an entity which seeks reimbursement from the Government for all or part of the services performed or products provided by REGENESIS, *it is the sole responsibility of the entity seeking reimbursement to ensure the Scope of Work and associated charges are in compliance with and acceptable to the Government prior to submission*. When serving as a supplier or subcontractor to an entity which seeks reimbursement from Government, REGENESIS does not knowingly present or cause to be presented any claim for payment to the government.

RRS Assumptions and Qualifications

- Cost outlined will be valid for 60 days from date of proposal. If beyond 60 days, REGENESIS reserves the right to update cost.
- If applicable, sales tax charges for product, freight, and services are considered estimated at the time of proposal submittal. The appropriate sales tax category (i.e., product, freight, and services) and actual sales tax rate is finalized at the time of invoice and may change from date of proposal submittal.
- Client personnel will take delivery of the remediation chemistry prior to RRS mobilization and arrange for secure storage where the material will not be affected by inclement weather. During application activities, the Client will locate the product within 10 feet of the RRS injection trailer.
- Client is responsible for disposal or recycling of totes, drums, pails and pallets. All nonhazardous refuse will be collected and placed in a Client-provided on-site refuse container for disposal. RRS will collect project related refuse and empty treatment chemistry containers daily to keep the site clean.
- A high volume water source (e.g. hydrant) capable of producing at least 30 gpm will be available to RRS for the duration of the project within 300' of the project staging area, at no cost to RRS. RRS will supply 300 linear feet of 1.5 inch National Standard Thread fire hose.
- RRS will have access to the site for equipment operation and secure storage of materials and equipment throughout the duration of the project. All access to each work area location will be clear and free of obstructions. RRS also assumes the injection trailer will be staged within 80 feet of the furthest injection point location.
- Client will provide field water quality meter similar to a YSI 556 with a down-hole sensor, a water level meter, bailers and a technician while on-site for injection activities to assist RRS in assessing groundwater from monitoring wells.
- Client is responsible for securing any permits prior to mobilizing to the site.
- Client is responsible for all soil, air, and groundwater sampling and analysis.
- Client is responsible for transportation and disposal of any contaminated waste generated on-site, though we do not anticipate generating any such waste during direct push injection activities.
- For safety reasons, access to the treatment area will be limited to RRS and Client personnel.
- The remediation design and injection procedures contain the necessary precautions to minimize the likelihood of surfacing of the treatment chemistry. RRS will monitor treatment chemistry application flow rates and pressures as well as observe for signs of reagent surfacing around active injection areas. If surfacing is detected, RRS will stop or slow down injection activities at that location to stop additional surfacing and remove/vacuum up recoverable surfaced fluid. RRS is not be responsible for treatment chemistry infiltration into undesired locations beyond our visible control.

- RRS will call in a public utility locate for the injection area. Private utility locates will be the Client's responsibility. RRS is not responsible for damage to unmarked utilities and subsurface structures. Client will review as-built drawings with RRS to confirm clearance prior to advancing DPT injection tooling and marking injection point locations.
- RRS personnel will have access to the site for work up to 12 hours per day Monday through Friday (daylight hours). However, the standard workday does not exceed 10 hours with travel time Monday through Friday. A 10-hour workday does not mean 10 hours on-site and/or injection pumping. Additional charges may apply for Saturday and/or Sunday work schedules.
- Pricing and work schedule assume union labor and prevailing wages (Davis-Bacon) are not required.
- Proposal assumes standard probing and drilling will begin at ground surface. If hand augering, concrete coring, or air knife services will be required, additional charges will apply.
- RRS assumes that direct-push style drill rig can access all injection point locations and drive injection tooling to the required depth. If site conditions limit the use of the provided direct-push rig for any injection point and other drilling methods are required to complete the task, additional charges will apply.
- All traffic control requirements will be provided by the Client.
- All injection points will be closed/backfilled with bentonite to ground surface by RRS. Additional costs associated with restoration of the ground surface have not been included. If restoration of the ground surface is needed, additional charges will apply.
- Site conditions can change over time and should be monitored post injection. REGENESIS is not responsible for changing site conditions after completing the scope of work and demobilizing from the site. This includes but is not limited to changes related to borehole abandonment (i.e., swelling of backfill material), surface restoration, well conditions, and on-site utilities.
- In generating this estimate, REGENESIS relied upon professional judgment and site-specific information provided by others. Using this information as input, we performed calculations based upon known chemical and geologic relationships to generate an estimate of the mass of product and subsurface placement required to affect remediation of the site.

REGENESIS
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Terms and Conditions
Products and Services

1. PAYMENT TERMS. Net 30 Days. Accounts outstanding after 30 days will be assessed 1.5% monthly interest. Volume discount pricing will be rescinded on all accounts outstanding over 90 days. An early payment discount of 1.5% Net 10 is available for cash or check payments only. We accept Master Card, Visa and American Express.

2. **RETURN POLICY.** A 15% re-stocking fee will be charged for all returned goods. All requests to return product must be pre-approved by seller. Returned product must be in original condition and no product will be accepted for return after a period of 90 days.

3 FORCE MAJEURE. Seller shall not be liable for delays in delivery or services or failure to manufacture or deliver due to causes beyond its reasonable control, including but not limited to acts of God, acts of buyer, acts of military or civil authorities, fires, strikes, flood, epidemic, war, riot, delays in transportation or car shortages, or inability to obtain necessary labor, materials, components or services through seller's usual and regular sources at usual and regular prices. In any such event Seller may, without notice to buyer, at any time and from time to time, postpone the delivery or service dates under this contract or make partial delivery or performance or cancel all or any portion of this and any other contract with buyer without further liability to buyer. Cancellation of any part of this order shall not affect Seller's right to payment for any product delivered or service performed hereunder.

4. LIMITED WARRANTY. Seller warrants the product(s) sold and services provided as specified on face of invoice, solely to buyer. Seller makes no other warranty of any kind respecting the product and services, and expressly DISCLAIMS ALL OTHER WARRANTIES OF WHATEVER KIND RESPECTING THE PRODUCT AND SERVICES, INCLUDING ALL WARRANTIES OF MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE AND NON-INFRINGEMENT.

5. DISCLAIMER. Where warranties to a person other than buyer may not be disclaimed under law, seller extends to such a person the same warranty seller makes to buyer as set forth herein, subject to all disclaimers, exclusions and limitations of warranties, all limitations of liability and all other provisions set forth in the Terms and Conditions herein. Buyer agrees to transmit a copy of the Terms and Conditions set forth herein to any and all persons to whom buyer sells, or otherwise furnishes the products and/or services provided buyer by seller and buyer agrees to indemnify seller for any liability, loss, costs and attorneys' fees which seller may incur by reason, in whole or in part, of failure by buyer to transmit the Terms and Conditions as provided herein.

6. LIMITATION OF SELLER'S LIABILITY AND LIMITATION OF BUYER'S REMEDY. Seller's liability on any claim of any kind, including negligence, for any loss or damage arising out of, connected with, or resulting from the manufacture, sale, delivery, resale, repair or use of any goods or performance of any services covered by or furnished hereunder, shall in no case exceed the lesser of (1) the cost of repairing or replacing goods and repeating the services failing to conform to the forgoing warranty or the price of the goods and/or services or part thereof which gives rise to the claim. IN NO EVENT SHALL SELLER BE LIABLE FOR SPECIAL INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS, OR FOR DAMAGES IN THE NATURE OF PENALTIES.

7. INDEMNIFICATION. Buyer agrees to defend and indemnify seller of and from any and all claims or liabilities asserted against seller in connection with the manufacture, sale, delivery, resale or repair or use of any goods, and performance of any services, covered by or furnished hereunder arising in whole or in part out of or by reason of the failure of buyer, its agents, servants, employees or customers to follow instructions, warnings or recommendations furnished by seller in connection with such goods and services, by reason of the failure of buyer, its agents, servants, employees or customers to comply with all federal, state and local laws applicable to such goods and services, or the use thereof, including the Occupational Safety and Health Act of 1970, or by reason of the negligence or misconduct of buyer, its agents, servants, employees or customers.

8. EXPENSES OF ENFORCEMENT. In the event seller undertakes any action to collect amounts due from buyer, or otherwise enforce its rights hereunder, Buyer agrees to pay and reimburse Seller for all such expenses, including, without limitation, all attorneys and collection fees.

9. TAXES. Liability for all taxes and import or export duties, imposed by any city, state, federal or other governmental authority, shall be assumed and paid by buyer. Buyer further agrees to defend and indemnify seller against any and all liabilities for such taxes or duties and legal fees or costs incurred by seller in connection therewith.

10. ASSISTANCE AND ADVICE. Upon request, seller in its discretion will furnish as an accommodation to buyer such technical advice or assistance as is available in reference to the goods and services. Seller assumes no obligation or liability for the advice or assistance given or results obtained, all such advice or assistance being given and accepted at buyer's risk.

11. SITE SAFETY. Buyer shall provide a safe working environment at the site of services and shall comply with all applicable provisions of federal, state, provincial and municipal safety laws, building codes, and safety regulations to prevent accidents or injuries to persons on, about or adjacent to the site.

12. INDEPENDENT CONTRACTOR. Seller and Buyer are independent contractors and nothing shall be construed to place them in the relationship of partners, principal and agent, employer/employee or joint ventures. Neither party will have the power or right to bind or obligate the other party except as may be expressly agreed and delegated by other party, nor will it hold itself out as having such authority.

13. REIMBURSEMENT. Seller shall provide the products and services in reliance upon the data and professional judgments provided by or on behalf of buyer. The fees and charges associated with the products and services thus may not conform to billing guidelines, constraints or other limits on fees. Seller does not seek reimbursement directly from any government agency or any governmental reimbursement fund (the "Government"). In any circumstance where seller may serve as a supplier or subcontractor to an entity which seeks reimbursement from the Government for all or part of the services performed or products provided by seller, it is the sole responsibility of the buyer or other entity seeking reimbursement to ensure the products and services and associated charges are in compliance with and acceptable to the Government prior to submission. When serving as a supplier or subcontractor to an entity which seeks reimbursement from the Government, seller does not knowingly present or cause to be presented any claim for payment to the Government.

14. APPLICABLE LAW/JURISDICTION AND VENUE. The rights and duties of the parties shall be governed by, construed, and enforced in accordance with the laws of the State of California (excluding its conflict of laws rules which would refer to and apply the substantive laws of another jurisdiction). Any suit or proceeding hereunder shall be brought exclusively in state or federal courts located in Orange County, California. Each party consents to the personal jurisdiction of said state and federal courts and waives any objection that such courts are an inconvenient forum.

15. ENTIRE AGREEMENT. This agreement constitutes the entire contract between buyer and seller relating to the goods or services identified herein. No modifications hereof shall be binding upon the seller unless in writing and signed by seller's duly authorized representative, and no modification shall be effected by seller's acknowledgment or acceptance of buyer's purchase order forms containing different provisions. Trade usage shall neither be applicable nor relevant to this agreement, nor be used in any manner whatsoever to explain, qualify or supplement any of the provisions hereof. No waiver by either party of default shall be deemed a waiver of any subsequent default.