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FEASIBILITY STUDY

Jack's Drycleaners Site (734112) Village of Brewerton, Town of Cicero, Onondaga County, New York

Prepared for:

New York State Department of Environmental Conservation
Division of Environmental Remediation

Prepared by:

EA ENGINEERING, P.C. and Its Affiliate
EA SCIENCE and TECHNOLOGY

May 2012

Feasibility Study
Jack's Drycleaners Site (734112)
Brewerton, New York

Prepared for

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CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

AWQS	Ambient Water Quality Standard
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of concern
CVOC	Chlorinated Volatile Organic Compound
DCE	Dichloroethene
DER	Division of Environmental Remediation
EA	EA Engineering, P.C. and its affiliate EA Science and Technology
FS	Feasibility Study
GRA	General response actions
IRM	Interim remedial measure
NRCS	Natural Resources Conservation Service
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PCE	Perchloroethene (Tetrachloroethene)
RAO	Remedial action objective
RI	Remedial investigation
SCG	Standards, Criteria, and Guidance
SCO	Soil Cleanup Objectives
SVI	Soil vapor intrusion
SVOC	Semivolatile organic compound
TAGM	Technical and Administrative Guidance Memorandum
TCE	Trichloroethene
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
VC	Vinyl chloride
VOC	Volatile organic compound

1. INTRODUCTION AND PROJECT OVERVIEW

The New York State Department of Environmental Conservation (NYSDEC) issued EA Engineering, P.C. and its affiliate EA Science and Technology (EA), a Work Assignment to perform a focused feasibility study (FS) at the Jack's Drycleaners site in the village of Brewerton, town of Cicero, Onondaga County, New York (Figures 1 and 2).

1.1 PURPOSE AND SCOPE

This FS has been prepared to develop and evaluate options for remedial action. The FS will determine which option is the most appropriate, cost effective, and protective of public health and the environment at the Jack's Drycleaners site. The selected option will restore the site conditions allowing it to be designated for unrestricted use. A remedial investigation (RI) report was prepared by EA and approved by the NYSDEC in December 2010. A soil vapor intrusion (SVI) investigation was completed and was amended to the RI in May 2011.

The FS has been conducted in accordance with the most recent versions of the 1988 United States Environmental Protection Agency (USEPA) *Guidance for Conducting Remedial Investigations and Feasibility Studies under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)* (1988) and NYSDEC *Division of Environmental Remediation (DER)-10, Technical Guidance for Site Investigation and Remediation* (2010) and focuses on a limited number of remedial alternatives proven effective at addressing remediation at drycleaner sites.

1.2 REPORT ORGANIZATION

The FS report has been organized as follows:

- ***Section 1***—Introduction, Site Background, and Characterization
- ***Section 2***—Summary of Remedial Investigation and Exposure Assessment
- ***Section 3***—Development of Remedial Action Objectives
- ***Section 4***—General Response Actions
- ***Section 5***—Identification and Screening of Technologies
- ***Section 6***—Scoping and Development of Remedial Alternatives
- ***Section 7***—Detailed Analysis of Alternatives
- ***Section 8***—Recommendations
- ***Section 9***—References.

1.3 BACKGROUND

The following section provides a brief discussion of the site background for the Jack's Drycleaners site.

1.3.1 Site Location

The subject site is located at 9628 Brewerton Road in the village of Brewerton, town of Cicero, Onondaga County, New York (Figure 2). The area surrounding the site is primarily residential and commercial, with most businesses located along Brewerton Road. Located to the east and southeast of the site are several hundred feet of wooded and open land that transition to the backyards of several residential properties.

1.3.2 Property Information

Jack's Drycleaners site is currently utilized as a dry-cleaning facility and is owned by Mr. Young Kyu Shin. The parcel is approximately 0.17-acres and is zoned as commercial. According to discussions with the property owner and nearby residents, the site was historically utilized as a gasoline station in the 1950s and as a dry-cleaning facility since at least 1972. According to a review of town of Cicero assessment information for the site, the property was developed with the current 1,400 ft^2 structure in 1945. The structure was previously connected to a septic system which was located directly behind the facility. The septic system was disconnected and removed in 2009 as directed by the NYSDEC during the site investigation and interim remedial investigation. The septic system consisted of three perforated drainage tiles exiting from three different locations along the eastern wall of the building. No septic tank was encountered during excavation activities. Drainage pipe and surrounding gravel were excavated and disposed of offsite. Following septic system removal, the building was plumbed to the municipal sanitary sewer system. The site is serviced with other public utilities including natural gas, electricity, and municipal water.

A petroleum spill was reported at the adjacent property south of Jack's Drycleaners during a tank removal project. A subsurface investigation was conducted at the adjacent property in October 2006 by Nature's Way Environmental Consultants and Contractor's, Inc. (Nature's Way). Nature's Way reported the presence of volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) in soil and groundwater at concentrations exceeding NYSDEC guidance values set forth in Technical and Administrative Guidance Memorandum (TAGM) 4046.

Nature's Way was retained to complete soil excavation in the impacted areas. Excavation activities began on 27 November 2006 and were completed on 7 December 2006. Two 1,000-gal underground storage tanks (USTs) containing petroleum impacted water were uncovered. Water was removed from the USTs prior to their excavation. Approximately 1,145 tons of impacted soil were removed from the site and disposed of at the Ontario County Landfill located in Stanley, New York. Excavation sidewall and bottom soil samples indicated that concentrations of SVOCs and VOCs in soils were greater than NYSDEC TAGM 4046 guidance values.

Nature's Way was also retained to facilitate the installation of five groundwater monitoring wells on the adjacent site on 18-19 April 2007. Some of the wells were installed close to the Jack's Drycleaners property. Groundwater monitoring conducted in 2007 indicated that concentrations of chlorinated VOCs (CVOCs) were present in groundwater located at the site and appeared to be from a source area located immediately behind the Jack's Drycleaners property.

1.3.3 Physiography

The subject site is located on the U.S. Geological Survey (USGS) Brewerton, New York 7.5-minute topographic quadrangle map, dated 1978 (Figure 3). The topography at the site is generally flat, but slopes slightly to the east and southeast. Adjoining properties located to the east and southeast consist of low-lying wet areas, open grassy areas, and wooded lots.

Elevation at the site is approximately 402 ft above mean sea level. The nearest surface water feature, as noted on the topographic map is the Oneida River located approximately 0.25 mi to the northeast of the subject site. The Oneida River flows from Oneida Lake and discharges into the Seneca and Oswego rivers, and ultimately into Lake Ontario.

1.3.4 Site Geology

A review of the geologic map of New York, Finger Lakes Sheet published by the University of the State of New York, the State Education Department, dated 1970, indicates that the bedrock located at the site lies within the Silurian Clinton Group, which consists of the Herkimer Sandstone, Kirkland Hematite (grayish-red, quartzose, calcareous, hematitic dolomite), Willowvale Shale (gray to greenish-gray fossiliferous shales), Westmoreland Hematite, Sauquoit Formation (sandstone, shale), and the Oneida Conglomerate. Bedrock cores collected at the site indicate the bedrock consists of highly weathered gray shale to depths of approximately 14-25 ft across the area. Bedrock surfaces in general dip to the southeast and include a trough feature southeast of the site (EA 2010).

According to the Natural Resources Conservation Service (NRCS) in Onondaga County, the site is underlain by the Collamer silt loam, with 2-6 percent slopes. This soil is usually located within lake plains. This soil is described as being moderately well drained. It has formed from a parent material of silty and clayey glaciolacustrine deposits. The site is also underlain by the Madrid fine sandy loam, with 2-8 percent slopes. This soil is usually located within drumlinoid ridges, hills, and till plains. This soil is described as being well drained. It has formed from a parent material of loamy till derived mainly from sandstone and limestone.

Based on documented soil boring site investigations conducted in 2006, 2008, and 2009, the site is underlain by silt and clay with alternating layers of fine to coarse sand.

1.3.5 Site Hydrogeology

Based on work completed at the site and the historical data review, shallow groundwater was typically encountered between 2 and 13 ft below ground surface (bgs) at the site, and in areas east and southeast of the site. Based upon the groundwater elevation data from multiple nested wells installed on- and off-site, the overburden and shallow bedrock groundwater is part of the same aquifer. The regional groundwater flows in a southeasterly direction across the site and surrounding properties. The hydraulic gradient across the site is approximately 0.01 and the estimated (conservative low) seepage velocity is approximately 12 ft per year based on known flow path and commercial records showing that the property has been used as a drycleaners since 1972.

2. SUMMARY OF REMEDIAL INVESTIGATION AND EXPOSURE ASSESSMENT

The following sections briefly summarize the environmental impacts at the Jack's Drycleaners site. This section is organized by media and areas of potential concern. Areas of concern and the impacts associated with the environmental media are based on analytical results and their comparison with the appropriate standards, criteria, and guidance (SCGs). Analytical results used in this FS were obtained from the following:

- The NYSDEC Spill No. 06-06504 RI, SVI report, subsurface investigation, and quarterly groundwater monitoring reports prepared by Nature's Way in 2007.
- The Jack's Drycleaners Site Characterization Report prepared by EA in 2008.
- The Jack's Drycleaners RI prepared by EA in 2010.

The potential areas of concern discussed are soil, soil vapor, and groundwater.

2.1 SOIL

Volatile Organic Compounds

According to the adjacent property subsurface investigation (Nature's Way 2006), and EA's Jack's Drycleaners site characterization (2008) and RI (2010), elevated VOC concentrations were detected in subsurface soils located on the Jack's Drycleaners property. In November and December 2006, NYSDEC contracted Nature's Way to excavate and dispose of underground tanks and impacted soil relating to petroleum compounds detected at the southern portion of the property. Confirmatory sampling indicated that the extent of soil impacts from petroleum compounds were significantly reduced by source removal in this area.

Chlorinated VOCs were detected in soil borings installed immediately behind Jacks Drycleaners. The septic system for the property was located in this area and was removed as part of the interim remedial measure (IRM) activities conducted in September 2009. The septic system was identified as the likely source of soil and groundwater impacts onsite. Impacted soil was excavated from this area down to approximately 2 ft below the water table (12 ft bgs). Confirmatory soil samples were collected on the bottom and the walls of the excavation. Bottom samples contained concentrations of CVOCs, but were less than than Part 375 Unrestricted Use and Protection of Groundwater SCGs. Side wall samples contained concentrations of trichloroethene (TCE), *cis*-dichloroethene (DCE), and tetrachloroethene (PCE), but were less than Unrestricted Use and Protection of Groundwater SCGs. Soil borings located further down-gradient did not contain concentrations of CVOCs. VOCs in soil are no longer considered a media of concern on the site.

Semivolatile Organic Compounds

SVOCs were identified during the UST investigation and removal completed by the NYSDEC in 2006-2007. Impacted soil was excavated from the area and disposed. Based on confirmatory samples collected at the site, soil impacts were successfully remediated in this area. SVOCs in soil are no longer considered a media of concern for this site.

2.2 SOIL VAPOR

A limited soil vapor investigation was completed in 2010 at the buildings located adjacent to the site (EA 2010). High water table conditions limited the investigation in some areas. Soil vapors were not detected in buildings adjacent to the site. A SVI investigation was completed downgradient of the groundwater plume in 2011. SVI evaluations were conducted at eight structures within the study area. A total of 23 air/vapor samples were collected during the SVI evaluations in March and April 2011. Samples were analyzed for VOCs by USEPA method TO-15. CVOCs were detected in samples collected from the structures. However, the CVOCs detected within soil vapor/crawlspace air, indoor air, and outdoor air, no compounds were detected in concentrations greater than the applicable New York State Department of Health (NYSDOH) air guideline values for PCE, TCE, or methylene chloride. In addition, when compared to the NYSDOH Soil Vapor/Indoor Air Matrices I and II, the concentrations of CVOCs detected within the structures evaluated do not indicate a need to monitor and/or mitigate any of the structures (EA 2010). Soil vapor is not considered a media of concern for off-site properties.

Sub-slab vapor sampling was also conducted for the on-site building and indicated an elevated PCE concentration of 1,100 $\mu g/m^3$. Further evaluation and potential installation of a mitigation system is to take place only if there is a future change in the current use of the on-site building. Details of this will be included in a Site Management Plan following the implementation of the selected remedy.

2.3 GROUNDWATER

Groundwater at the site was generally encountered between 4 and 5 ft bgs, but can fluctuate from 1.5 to 12 ft bgs depending on seasonal conditions. Groundwater within 500 ft down-gradient of the site has been impacted by dissolved phase CVOCs (EA 2008 and 2010). The *Ambient Water Quality Standards (AWQS) and Guidance Values and Groundwater Effluent Limitations* (NYSDEC 1998) was used during the RI/FS and will be used when developing alternatives.

Groundwater flows southeast across the site. The source area was identified as the septic system and leach field located directly behind Jack's Drycleaners. The dissolved-CVOC plumes highest concentrations are located in the area of the former septic system and decrease in concentration as groundwater flows across the site. CVOC impacts were observed as far down-gradient as monitoring well MW-15, approximately 500 ft from the source area. Groundwater data collected in July 2011 indicate that concentrations in groundwater are decreasing since the IRM was completed in 2009.

Volatile Organic Compounds

Groundwater at the site and down-gradient of the site is impacted with VOCs. The majority of compounds detected and ones in the highest concentration are CVOCs. Other compounds including benzene, toluene, and xylene have been detected in groundwater samples and are likely the residual impacts of the petroleum spill evaluated in 2006-2008. Based on the relative concentrations and known source areas, CVOCs including PCE, TCE, DCE, and vinyl chloride (VC) are identified as the contaminants of concern (COCs) in this FS. Highest concentrations were detected in monitoring wells located near the former source area. PCE, TCE, DCE and VC are detected in concentrations greater than AWQS as far as 500 ft down-gradient of the source area. A groundwater plume map for data collected in July 2011 illustrates the extent of the groundwater plume at the site (Figures 4A and 4B).

3. DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

Goals for the remedial program have been established through the remedy selection process stated in NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation, May 2010. The remedial goal for all remedial actions is considered to be the restoration of the site to the pre-disposal/pre-release conditions to the extent practicable and legal. Remedial action objectives (RAOs) are defined as the medium specific or operable-unit specific cleanup objectives to provide protection of public health and the environment. The RAOs are based on contaminant-specific SCGs.

3.1 CLEANUP STANDARDS, CRITERIA, AND GUIDANCE

COCs at the Jack's Drycleaners site were determined based on the frequency of detections exceeding SCGs and the range of concentrations in groundwater samples. COCs are PCE, TCE, *cis*-1,2-DCE, *trans*-1,2-Dichloroethene (*trans*-1,2-DCE), and VC. Cleanup standards for groundwater are presented in the following table.

FREQUENCY OF DETECTION OF VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER ANALYTICAL DATA - APRIL 2007 TO JULY 2011

Parameter List USEPA Method 8260B	Range of Concentrations (µg/L)	Frequency of Detection	Frequency Exceeding SCGs	NYSDEC Ambient Water Quality Standard Class GA (µg/L)
1,1,1-Trichloroethane	0.86 - 2.9	2/67	0	5
1,1-Dichloroethane	0.72 - 2.3	6/67	0	5 (s)
1,1-Dichloroethene	0.62 - 6.2	11/67	1	5 (s)
1,2-Dichlorobenzene	ND - 0.54	1/67	0	3
Chloroethane	1.1 - 42	17/67	6	5 (s)
Chloroform	0.61 - 10.8	10/67	1	7 (s)
cis-1,2-Dichloroethene	1.3 – 10,300	**36/67**	31	5 (s)
Tetrachloroethene	0.96 – 41,300	**41/67**	34	5
trans-1,2-Dichloroethene	0.6 - 190	**22/67**	15	5
Trichloroethene	1.5 – 4,470	**34/67**	28	5 (s)
Vinyl chloride	0.99 – 2,100	**25/67**	22	5 (s)

NOTE: ND = Non-Detect.
NYSDEC Division of Water Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards (Class GA), June 1998

3.2 REMEDIAL ACTION OBJECTIVES

The medium-specific Remedial Action Objectives (RAOs) for groundwater at Jack's Drycleaners site are displayed in the following table.

GROUNDWATER – RAOs
Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards
Restore groundwater aquifer to pre-release conditions, to the extent practicable
Prevent contact with contaminated groundwater

3.3 OTHER POTENTIALLY APPLICABLE REQUIREMENTS

The NYSDEC Environmental Remediation Programs guidance (6 New York Code of Rules and Regulations [NYCRR] Part 375) requires that site remedies "*conform to standards and criteria that are generally applicable, consistently applied, and officially promulgated, that are either directly applicable, or that are not directly applicable but are relevant and appropriate, unless good cause exists why conformity should be dispensed with* [6 NYCRR Part 75, 375-1.8(f)(2)]". The primary requirements are presented in the following table.

SCGS FOR THE JACK'S DRYCLEANERS SITE	
Requirement	Rationale
FEDERAL	
Clean Water Act **National Pollution Discharge Elimination System 40 Code of Federal Regulations (CFR) Part 122** The National Pollution Discharge Elimination System establishes permitting requirements, technology-based limitations and standards, control of toxic pollutants, and monitoring of effluents to assure discharge permit conditions and limits are not exceeded.	Applicable if groundwater will be extracted from ground and discharged.
Safe Drinking Water Act (National Primary and Secondary Drinking Water Regulations) (42 U.S.C. 300f, 40 CFR Part 141, 40 CFR Part 143) The Safe Drinking Water Act provides a national framework to ensure the quality and safety of drinking water. The primary standards establish maximum contaminant levels and maximum contaminant level goals for chemical constituents in drinking water. Secondary standards pertain primarily to the aesthetic qualities of drinking water.	The removal action is being conducted to reduce chemical concentrations in soil and groundwater, with a goal of meeting cleanup levels at the property boundary.
Clean Air Act, as Amended (42 U.S.C. 7401) The Clean Air Act is a comprehensive law which is designed to regulate any activities that affect air quality, and provides the national framework for controlling air pollution. The National Primary and Secondary Ambient Air Quality Standards (40 CFR Part 50) set standards for ambient pollutants which are regulated within a region. The National Emissions Standards for Hazardous Air Pollutants (40 CFR Part 61) establishes numerical standards for hazardous air pollutants.	The Clean Air Act will be required if any remediation alternatives produce air emissions.
Resource Conservation and Recovery Act Provides the governing regulations for owners and operators of hazardous waste treatment, storage, and disposal facilities; and for the generators and transporters of hazardous waste.	All waste generated during the removal action will be characterized and handled per Resource Conservation and Recovery Act regulations, as implemented by WAC 173-303.
Occupational Safety and Health Act (29 CFR 1910) Establishes the worker health and safety requirements for operations at hazardous waste sites.	Site activities will be conducted under appropriate Occupational Safety and Health Act standards.

SCGS FOR THE JACK'S DRYCLEANERS SITE	
Requirement	Rationale
FEDERAL	
Rules for Transport of Hazardous Waste (49 CFR 107, 171) The U.S. Department of Transportation establishes requirements for packaging, handling, and manifesting hazardous waste.	Any hazardous waste generated during site activities will be characterized as needed to determine packaging, handling, and transport requirements.
SCGS FOR THE JACK'S DRYCLEANERS SITE	
Requirement	Rationale
STATE	
NYSDEC Environmental Remediation Programs. 6 NYCRR Part 375 This program applies to the development and implementation of remedial programs for environmental restoration sites.	Site cleanup will be conducted in accordance with 6 NYCRR Part 375.
Solid Waste Management Facilities. 6 NYCRR Part 360 Provides standards and regulations for permitting and operating solid waste management facilities.	
Waste Transporter Permits. NYCRR Part 364 Provides standards and regulations for waste transporters.	
Land Disposal Restrictions. 6 NYCRR Part 376	
Hazardous Waste Management System. 6 NYCRR Part 370, 371, 372, 373, 375 Provides standards and regulations for the state hazardous waste management system, identification and listing of hazardous wastes, and provides standards, regulations, and guidelines for the manifest system, as well as additional standards for generators, transporters, and facilities.	These regulations will be followed for off site treatment and disposal of hazardous waste.
New York State Department of Transportation Rules for Hazardous Materials Transport. 49 CFR, Parts 107, 171.1-500. Addresses requirements for marking, manifesting, handling, and transport of hazardous materials; applicable if offsite treatment or disposal of wastes is required.	
Water Quality Regulations for Surface Waters and Groundwater. 6 NYCRR Part 700-706 Provides standards, regulations, and guidelines for the protection of waters within the state.	Water discharged from the site will comply with this guidance.
Implementation of NPDES Program in NYS. 6 NYCRR Part 750-757 Provides regulations regarding the SPDES program.	A SPDES permit may be required depending on selected remedial action.
Permits and Registration (Air). 6 NYCRR Part 201 Describes permits and registration requirements	Permit or registration may be required depending on selected remedial action.
Air Quality Standards. 6 NYCRR Part 257 Air quality standards are designed to provide protection from the adverse health effects of air contamination; and they are intended further to protect and conserve the natural resources and environment.	All substantive requirements of the State air pollution control regulations will be followed during implementation of the remedial action.
LOCAL	
Land development standards, storm water and surface water regulations, and clearing and grading requirements.	Local permits are required depending on the selected remedial action.
Building permits and building codes.	Local permits are required depending on the selected remedial action.

4. GENERAL RESPONSE ACTIONS

In general, remedial technologies fit into one or more category of general response actions (GRA). GRAs are generic, medium-specific, remedial actions that will satisfy the RAOs discussed earlier. GRAs may include no action, institutional controls, containment, removal, treatment, disposal, monitoring, or a combination thereof (USEPA 1988). The development of remedial alternatives for this FS begins with the identification of GRAs that can meet RAOs. These GRAs are then screened based on their effectiveness, implementability, and cost; and developed into remedial alternatives to address all contaminated media at the site.

4.1 GROUNDWATER

Technologies for the remediation of groundwater will fall into GRAs no further action, monitored natural attenuation, containment, removal, and treatment.

No Further Action

The no further action alternative is included to be used as the baseline alternative against which the effectiveness of all other remedial alternatives are judged.

Monitored Natural Attenuation

For groundwater contaminated with VOCs, monitored natural attenuation consists of sampling groundwater for contaminant concentrations and natural attenuation parameters. Natural attenuation with monitoring allows natural processes to achieve site-specific remedial objectives without enhancement or aggressive treatment. The "natural attenuation processes" that are at work in such a remediation approach include physical, chemical, or biological processes, that under favorable conditions, reduce the mass, toxicity, mobility, volume, or concentration of contaminants in the groundwater. Natural attenuation processes that could occur include biodegradation (aerobic or anaerobic), abiotic transformation (e.g., hydrolosis), adsorption, dispersion, or dilution.

Containment

Containment can be accomplished via containment walls or via physical extraction of groundwater for *ex-situ* treatment. Once groundwater is extracted, treatment technologies for groundwater could include air stripping, granular activated carbon, etc.

In-Situ Treatment

In-well ozone sparging is considered a potential *in-situ* treatment technology for groundwater. In-well ozone sparging consists of injecting ozone into the VOC-contaminated groundwater, which dissolves in the water and oxidizes the contaminants. Because the contaminants are treated and not volatilized, vapor does not need to be managed.

Another *in-situ* technology for groundwater contaminated with VOCs is enhanced reductive dechlorination, which is achieved by the injection of an electron donor emulsified product into the aquifer. Contaminants fully degrade to ethene and ethane.

5. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

5.1 PRELIMINARY SCREENING

Two preliminary screening criteria (effectiveness and implementability) were used to screen the remedial technologies listed in Section 4. Definitions for these criteria are presented below and the technology screening is presented in Table 1.

5.1.1 Effectiveness

This criterion is a measure of the ability of an option to: (1) reduce toxicity, mobility, or volume of contamination; (2) minimize residual risks; (3) afford long-term protection; (4) comply with applicable or relevant and appropriate requirements; (5) minimize short-term impacts; and (6) achieve protectiveness in a limited duration. Technologies that offer significantly less effectiveness than other proposed technologies may be eliminated from the alternative development process. Options that do not provide adequate protection of human health and the environment likewise may be eliminated from further consideration.

5.1.2 Implementability

Implementability is a measure of the technical feasibility and availability of the option and the administrative feasibility of implementing it (e.g., obtaining permits for off-site activities, rights-of-way, or construction). Options that are technically or administratively infeasible or that would require equipment, specialists, or facilities that are not available within a reasonable period may be eliminated from further consideration.

5.2 SCREENING SUMMARY

The results of the technology screening are summarized in the following two sections. The first section discusses technologies that were not retained for further analysis, and the reasons for exclusion. The second section lists technologies that were retained for further analysis as individual components in remedial alternatives. The screening is presented in greater detail in Table 1.

5.2.1 Technology Not Retained for Further Analysis

From the list of technologies potentially applicable for remediation of the chemicals and media of concern at this site, numerous technologies were excluded from further consideration because they were considered ineffective, not implementable at this site, or too costly relative to the other alternatives under consideration. The reasons for exclusion are explained in the following paragraph.

Technologies Not Retained for Groundwater Remediation

Containment walls will not treat contaminated groundwater and when implemented alone, do not prevent the further contamination of groundwater. Containment walls can only alter the groundwater flow direction and, thus, are considered ineffective for remediation of groundwater.

5.2.2 Technologies Retained for Further Analysis

Technologies that passed through screening and will be retained and combined to create remedial alternatives for the site are listed below for each media of concern.

The focused list of remedial technologies considered in this FS for groundwater is:

- No further action
- Monitored natural attenuation
- *In-situ* treatment
- *Ex-situ* treatment

6. SCOPING AND DEVELOPMENT OF REMEDIAL ALTERNATIVES

EA has completed the alternative comparison in accordance with DER-10 and the 1988 USEPA publication *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA 1540lG-891004). The screening of alternatives was designed to provide a basis for an overall assessment of applicable technologies based on impacted media identified at the site during the RI. The list of alternatives was limited to three to focus the FS on known and frequently implemented alternatives used for remediation of the COCs in the environment.

The five remedial alternatives evaluated are:

- No further action
- Long-term monitoring with monitored natural attenuation
- *In-situ* enhanced reductive dechlorination
- *In-situ* ozone-enhanced aquifer air sparging
- Groundwater extraction and treatment.

6.1 ALTERNATIVE 1: NO FURTHER ACTION

The no further action alternative is evaluated as a procedural requirement and as a basis for comparison. This alternative would leave the site in its present condition.

6.2 ALTERNATIVE 2: LONG TERM MONITORING WITH MONITORED NATURAL ATTENUATION

Natural attenuation with monitoring consists of monitoring groundwater COCs to ensure the contamination footprint and contaminant concentrations are stable or decreasing. This alternative includes long-term groundwater monitoring for VOCs and natural attenuation parameters. Existing monitoring wells would be used.

Monitoring will be implemented as follows:

- Groundwater samples would be collected semiannually for the first 5 years and annually thereafter to measure the concentration of VOCs and natural attenuation parameters (monitoring is estimated to be conducted for 30 years). Monitored Natural Attenuation (MNA) parameters have not been collected at the site yet. Samples would be collected from 20 existing monitoring wells.

6.3 ALTERNATIVE 3: *IN-SITU* ENHANCED REDUCTIVE DECHLORINATION

Direct-push methods would be used to inject an electron donor emulsion into the contaminated aquifer. This emulsion would optimize anaerobic biodegradation, speeding up natural degradation processes. While only one injection event was included in this alternative, it is possible that additional events may be required to attain SCGs. The need for supplementary injections would depend on field conditions.

In-situ enhanced reductive dechlorination would be implemented as follows and as shown on Figure 5:

- A utility locator would be brought onsite to locate any underground utilities or other obstructions that may prove problematic to drilling.
- Pre-design sampling would be conducted to determine whether or not MNA is occurring at the site.
- Electron donor emulsion would be injected into the aquifer using direct-push equipment and a diaphragm pump with a rating of 800 psi. Emulsion would be diluted 10:1 prior to application.
- Emulsion would be injected into 42 points within the source area in a 15-ft × 20-ft grid.
- Emulsion would be injected into 105 points within the plume area in 7 rows of 15 points, spaced 10 ft apart. Each row would run in a northeast-southwest direction, and the rows would be parallel, in an east-west direction, 60 ft apart.
- Following injection, injection points would be filled with sand to the top of the treatment zone, then sealed with bentonite and a concrete or asphalt cap, as needed to prevent surfacing of the emulsion.
- Groundwater samples would be collected quarterly for the first 2 years and annually thereafter to measure the concentration of VOCs (monitoring is estimated to be conducted for 10 years or until soil cleanup objectives [SCOs] are achieved). Samples would be collected from 20 existing monitoring wells.

6.4 ALTERNATIVE 4: *IN-SITU* OZONE SPARGING

Air combined with ozone would be forced into the aquifer via a network of wells installed as a grid designed to cover the extent of the plume; thereby, promoting contaminant degradation vertically and horizontally within the dissolved phase plume. This remedy would involve the installation of treatment infrastructure at the site. Ozone sparging would operate continuously until pre-disposal conditions are achieved.

In-situ ozone sparging would be implemented as follows and as shown on Figure 6:

- A utility locator would be brought onsite to locate any underground utilities or other obstructions that may prove problematic to well installation.
- A pump test would be performed to determine radius of influence for the design.

- A network of 116 wells would be installed at a 30-ft grid throughout the plume footprint.

- An ozone generator would introduce ozone to an air sparger, which would force the air/ozone into the wells by a network of hoses and pipes.

- Ozone/air sparging would be conducted within network wells on an alternating basis, so as to avoid creating treatment pathways and maximize the radius of influence.

- Groundwater samples would be collected quarterly for the first 2 years and annually thereafter to measure the concentration of VOCs (monitoring is estimated to be conducted for 10 years or until SCOs are achieved). Samples would be collected from 20 existing monitoring wells.

6.5 ALTERNATIVE 5: GROUNDWATER EXTRACTION AND TREATMENT

Extraction wells within and along the plume boundary would be used to continuously pump water into a granular activated carbon treatment system, and then discharged. Groundwater extraction and treatment would be implemented as follows and as shown on Figure 7:

- A utility locator would be brought onsite to locate any underground utilities or other obstructions that may prove problematic to well installation.

- A pump test would be performed to determine radius of influence for the design.

- 10 new extraction wells would be installed to approximately 35 ft bgs, 30 ft apart within the southeastern part of the plume.

- Water will be pumped at a rate of 375 ft^3 per day (2 gal per minute). Extracted groundwater will be treated on-site via three granular activated carbon vessels in series. Effluent will be discharged to the municipal storm sewer system pending permit application and acceptance.

- Groundwater samples would be collected from 20 existing monitoring wells.

- For this cost estimate, it is assumed the remedial goals would be achieved within 30 years and groundwater monitoring would occur semi-annually for the first 2 years of remediation and annually thereafter, for a total of 30 years.

7. DETAILED ANALYSIS OF ALTERNATIVES

This section describes the process for the detailed analysis of remedial alternatives for the Jack's Drycleaners site and also presents the cost estimates used as part of the analysis.

The detailed analysis of the remedial alternatives including comparison using the criteria listed below is presented in Table 3.

7.1 CRITERIA USED FOR ANALYSIS OF ALTERNATIVES

The criteria to which potential remedial alternatives are compared (and used during this detailed analysis) are defined in 6 NYCRR Part 375, which governs the remediation of inactive hazardous waste disposal sites in New York, and are listed below:

- Overall protectiveness of the public health and the environment
- SCGs
- Long-term effectiveness and permanence
- Reduction in toxicity, mobility, or volume of contamination through treatment
- Short-term impacts and effectiveness
- Implementability
- Cost-effectiveness
- Land use
- Community acceptance.

A description of the criteria and how alternatives are evaluated against them follows.

Overall Protectiveness of the Public Health and the Environment. This criterion is an overall evaluation of each alternative's ability to protect public health and the environment.

Standards, Criteria, and Guidance. Compliance with SCGs addresses whether a remedy would meet environmental laws, regulations, and other standards and criteria. The SCGs are presented in Section 3.

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

Reduction of Toxicity, Mobility, or Volume of Contamination Through Treatment. The degree to which the alternative permanently reduces the toxicity, mobility, or volume of hazardous substances including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated. Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility, or volume of the wastes at the site.

Short-term Impacts and Effectiveness. Evaluation of the short-term effectiveness for an alternative includes consideration of the risk to human health and the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks. Impacts from remedial action implementation include vehicle traffic; temporary relocation of residences/buildings; temporary closure of public facilities; odor; open excavations; and noise, dust, and safety concerns associated with extensive heavy equipment activity. The greatest short-term risk to human health is related to safety and general construction activity.

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

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

Land Use. The current and anticipated future use of the site will be considered. Land use must comply with applicable zoning laws and maps.

Community Acceptance. Public comments will be considered after the close of the public comment period.

7.2 COST ASSUMPTIONS

An unrestricted use cost was developed for each remedial alternative as part of the FS process. Cost assumptions were prepared for each alternative using USEPA's *Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (1996). Net present value of the project costs were estimated using an interest rate of 5 percent. The cost assumptions were calculated using the most common products and application methods available for a remedial alternative. The USEPA guidance was used in conjunction with *DER-10 Technical Guidance for Site Investigation and Remediation* (NYSDEC 2010).

7.2.1 Costs

Based on the results of the remedial technology screening in Table 1, the following cost estimates were prepared for Alternatives 1 through 5. Appendix A shows the detailed cost estimates.

Alternative 1: No Further Action

Present Worth............*$0*
Capital Cost............*$0*
Annual Costs............*$0*

Alternative 2: Long-Term Monitoring with Monitored Natural Attenuation

Present Worth............*$438,000*
Capital Cost............*$0*
Annual Costs (Years 1-5)............*$45,000*
Annual Costs (Years 6-30)............*$22,000*

Alternative 3: *In-Situ* Enhanced Reductive Dechlorination

Present Worth............*$602,000*
Capital Cost............*$389,000*
Annual Costs (Years 1-2)............*$64,000*
Annual Costs (Years 3-10)............*$16,000*

Alternative 4: *In-Situ* Ozone-Enhanced Aquifer Air Sparging

Present Worth............*$2,041,000*
Capital Cost............*$1,087,000*
Annual Costs (Years 1-2)............*$64,000*
Annual Costs (Years 3-10)............*$16,000*

Alternative 5: Groundwater Extraction and Treatment

Present Worth............*$1,400,000*
Capital Cost............*$479,000*
Annual Costs (Years 1-5)............*$70,000*
Annual Costs (Years 6-30)............*$56,000*

8. RECOMMENDATIONS

The purpose of this FS was to develop, screen, and evaluate potential remedial alternatives for the Jack's Drycleaners site. Remedies were identified and screened in accordance with USEPA and NYSDEC guidance.

Five remedial alternatives were developed in this FS, as identified below.

- **Alternative 1**—No Further Action
- **Alternative 2**—Long-Term Monitoring with Monitored Natural Attenuation
- **Alternative 3**—*In-Situ* Enhanced Reductive Dechlorination
- **Alternative 4**—*In-Situ* Ozone-Enhanced Aquifer Air Sparging
- **Alternative 5**—Groundwater Extraction and Treatment.

Alternative 1 does not meet any of the RAOs. Alternative 2 may meet RAOs over time through naturally occurring degradation, but needs to be proven through long-term monitoring. Alternatives 3, 4 and 5 will meet RAOs and in less time than Alternative 2, but at a greater cost. Alternative 5 will take a significantly longer time (30 years) than Alternatives 3 and 4 to meet RAOs, as well as cost more than Alternative 3. Alternatives 3 and 4 should take a similar amount of time if one treatment event is sufficient to reach SCGs in Alternative 3. However, Alternative 4 is more expensive and involves the installation of site remedial facilities and infrastructure. Alternative 3 is recommended because it is an effective treatment solution with minimal site construction requirements and will meet RAOs in a short amount of time at a significantly lower cost.

9. REFERENCES

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Legend

★ Jack's Drycleaners

Miles
0 0.5 1 2

Source: ESRI Base Layer

EA®	JACK'S DRYCLEANERS (7-34-112) FEASIBILITY STUDY BREWERTON, NEW YORK	FIGURE 1 Site Location

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JAG	CJS	DCC	JAG	AS SHOWN	MAY 2012	14368.38	GIS/PROJECTS/ FIGURE1.MXD

Legend

- Jack's Drycleaners
- Surrounding Parcels
- Historic Location of Septic System

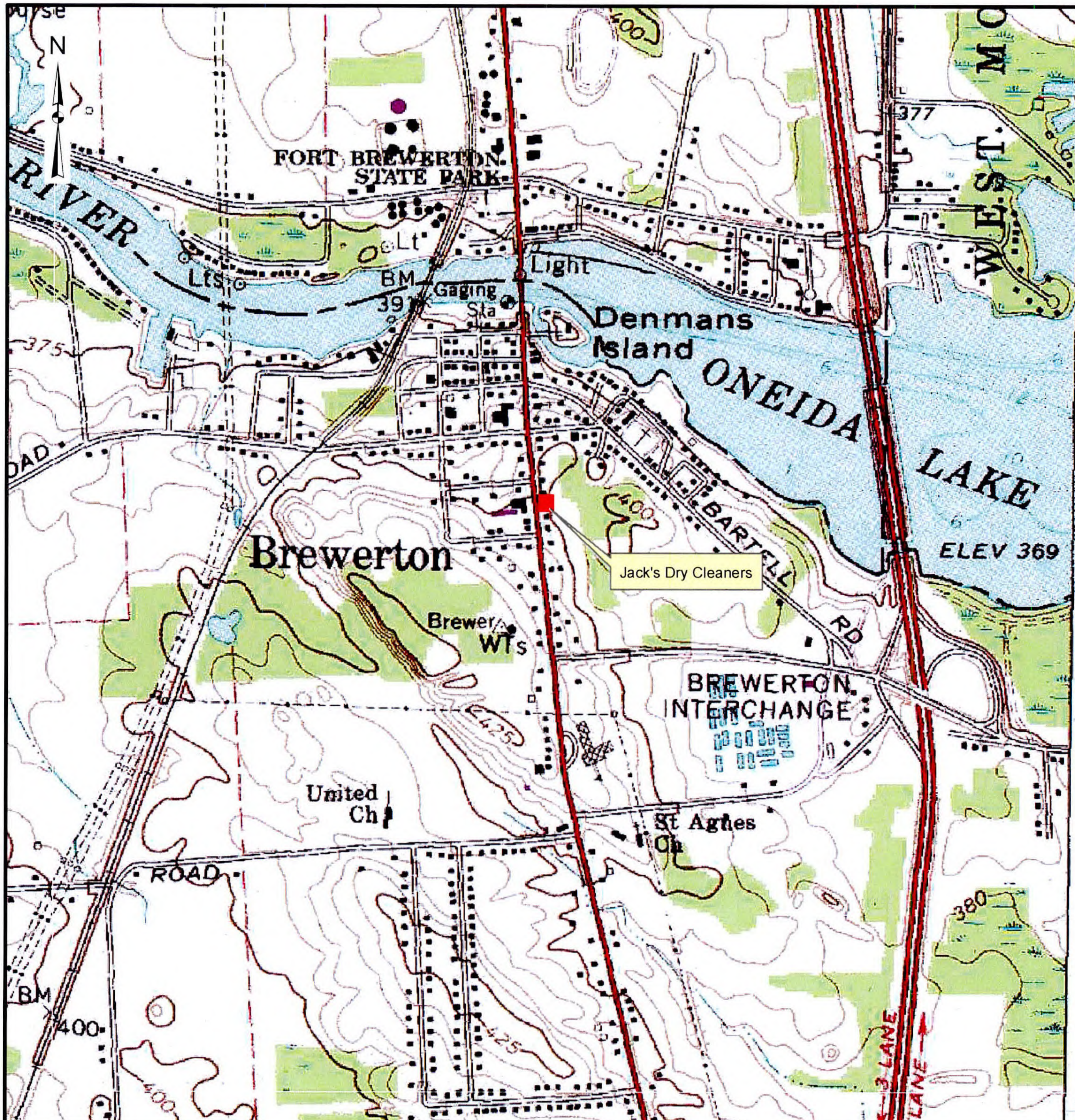
Feet
0 25 50 100

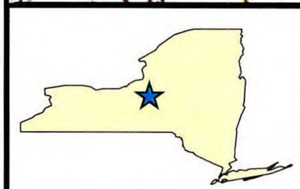
Source: USGS EROS 2005

JACK'S DRYCLEANERS (7-34-112)
FEASIBILITY STUDY
BREWERTON, NEW YORK

FIGURE 2
Site Map

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JAG	MEM	MEM	JAG	AS SHOWN	MAY 2012	14368.38	GIS/PROJECTS/ FIGURE2.MXD



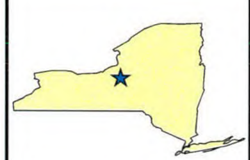


Jack's Drycleaners

0 25 50 100 150 200 Feet

	JACKS DRYCLEANERS (7-34-112) FEASIBILITY STUDY BREWERTON, NEW YORK	FIGURE 3 USGS Topographic Map

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JAG	CJS	DCC	JAG	AS SHOWN	MAY 2012	14368.38	...GIS/PROJECTS/ FIGURE3.MXD



Legend

- Bedrock Monitoring Well
- Overburden Monitoring Well

(5,207) Total VOC Concentration in ppb

(ND) Non Detect

Isopleth Concentration (lines dashed where inferred)

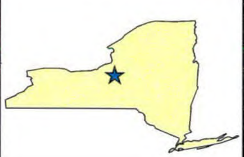
Source: NYS GIS Clearing House

JACKS DRYCLEANERS (734112)
FEASIBILITY STUDY
BREWERTON, NEW YORK

FIGURE 4A
Total VOC Concentrations
in Shallow Groundwater
July 2011

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JAG	CJS	DCC	JAG	AS SHOWN	MAY 2012	14368.38	GIS/PROJECTS/ FIGURE6.MXD

0 60 120 240 Feet



Legend

- Bedrock Monitoring Well
- Overburden Monitoring Well
- (1,250 ppb) Total VOC Concentration

Source: NYS GIS Clearing House

JACKS DRY CLEANERS SITE (734112)
FEASIBILITY STUDY
BREWERTON, NEW YORK

FIGURE 4B
Total VOC Concentrations
in Bedrock Groundwater
July 2011

Feet: 0 60 120 240

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JAG	CJS	DCC	JAG	AS SHOWN	MAY 2012	14368.38	GIS/PROJECTS/ FIGURE4-X.MXD

Legend

- Bedrock Monitoring Well
- Overburden Monitoring Well
- Direct-push injection point
- Approximate Isopleth Concentration

Source: NYS GIS Clearing House

JACKS DRYCLEANERS SITE (734112)
FEASIBILITY STUDY
BREWERTON, NEW YORK

FIGURE 5
In-Situ Enhanced Reductive Dechlorination System Layout

Feet
0 15 30 60 90 120

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JAG	MEM	MEM	JAG	AS SHOWN	OCTOBER 2011	14368.38	GIS/PROJECTS/ FIGURE5.MXD

Legend

- Bedrock Monitoring Well
- Overburden Monitoring Well
- Radius of Influence (sparge well inferred at center)
- Air sparge/Ozone Pipe Lines
- Approximate Isopleth Concentration

Source: NYS GIS Clearing House

JACKS DRYCLEANERS SITE (734112)
FEASIBILITY STUDY
BREWERTON, NEW YORK

FIGURE 6
In-Situ Ozone Sparging System Layout

*Monitoring Well gauged and sampled on 4 October 2010

Feet
0 15 30 60 90 120

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JAG	MEM	DCC	MEM	AS SHOWN	MAY 2012	14368.38	GIS/PROJECTS/ FIGURE6.MXD

Legend
- Bedrock Monitoring Well
- Overburden Monitoring Well
- Extraction Well
- Approximate Isopleth Concentration
- Pipe and direction of flow

Source: NYS GIS Clearing House

JACKS DRYCLEANERS SITE (734112)
FEASIBILITY STUDY
BREWERTON, NEW YORK

FIGURE 7
Groundwater Extraction and Treatment System Layout

*Monitoring Well gauged and sampled on 4 October 2010

Feet: 0 20 40 80 120 160

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JAG	MEM	DCC	MEM	AS SHOWN	MAY 2012	14368.38	GIS/PROJECTS/ FIGURE6.MXD

TABLE 1 REMEDIAL TECHNOLOGY SCREENING

General Response Action	Technology	Effectiveness	Implementability	Status
Media: Groundwater				
Target Contaminant of Concern: Volatile Organic Compounds				
No Further Action	No Further Action	Not effective	Easy to implement	Retained
Monitoring	Long-Term Monitoring with Monitored Natural Attenuation	Effectiveness depends on conditions, including groundwater flow, oxidation reduction potential, and dissolved oxygen levels within the plume	Implementable	Retained
In-Situ Biological Treatment	Reductive Dechlorination	Effective at promoting degradation of contaminants within aquifer.	Easy to implement, with no infrastructure required. Requires long-term treatment and monitoring.	Retained
	Ozone Sparging	Effective at promoting degradation of contaminants within aquifer.	Implementable, but requires infrastructure. Requires long-term operation and maintenance.	Retained
Removal and Treatment	Groundwater Extraction and Treatment	Effective at removing contamination from extracted groundwater.	Implementable. Requires long-term operation and maintenance	Retained

TABLE 2 GROUNDWATER ALTERNATIVES SCREENING

Media: Groundwater					
	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Further Action	**Long-Term Monitoring with Monitored Natural Attenuation**	***In-Situ* Enhanced Reductive Dechlorination**	***In-Situ* Ozone Sparging**	**Groundwater Extraction and Treatment**
Size and Configuration of Process Options	None.	Groundwater samples would be collected semiannually for the first five years, and annually for the next twenty five, or until cleanup goals are achieved.	An injectable substrate would be applied via 147 direct push locations. Groundwater samples would be collected following injection to evaluate the need for further treatment, and for up to 10 years, or until cleanup goals are achieved.	116 air sparge wells would be installed on the Jack's Drycleaners site. Air with ozone would be forced into the aquifer within the sand-gravel layer. Groundwater samples would be collected semiannually for the first five years and annually for the next five, or until cleanup goals are achieved.	Ten extraction wells would be installed along the downgradient edge of the contaminated groundwater plume. Contaminated groundwater would be pumped to a treatment trailer on the site property, then discharged. Groundwater samples would be collected semiannually for the first five years and annually for the next five, or until cleanup goals are achieved.
Time for Remediation	NA	Approximately 30 years.	Approximately 1-2 years.	Approximately 10 years.	Approximately 30 years.
Spatial Requirements	None	None	None	Area for equipment and treatment (~50,000 sq ft)	Area for equipment and treatment (~20,000 sq ft).
Options for Disposal	NA	NA	NA	NA	Water would be treated and sampled prior to discharge.
Substantive Technical Permit Requirements	None	None	None	None	SPDES equivalency permit would be required for discharging treated water to storm sewers, or approval by sewer authorities for disposal to sanitary sewer.
Limitations or Other Factors Necessary to Evaluate Alternatives	Will not remove contaminants from groundwater.	Will not remove contaminants from groundwater, as it relies on natural degradation processes.	Groundwater sampling will be necessary to track progress.	Groundwater sampling will be necessary to track progress	Pump test will be required to finalize design. Groundwater sampling will be necessary to track progress.
Public Impacts	None	None	None	Equipment may be loud in the treatment area.	Extraction wells will need to be installed on private property to achieve hydraulic control of the plume.
Beneficial and/or Adverse Impacts on Fish and Wildlife Resources	No known impacts on fish and wildlife resources.	No known impacts on fish and wildlife resources.	No known impacts on fish and wildlife resources.	No known impacts on fish and wildlife resources.	No known impacts on fish and wildlife resources.
Net Present Worth	$0.00	$438,000	$597,000	$2,051,000	$1,400,000

NOTE: NA = Not Applicable
SPDES = State Pollutant Discharge Elimination System

TABLE 3 GROUNDWATER ALTERNATIVE EVALUATION SUMMARY

Media: Groundwater					
	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Further Action	**Long-Term Monitoring with Monitored Natural Attenuation**	**In-Situ Enhanced Reductive Dechlorination**	**In-Situ Ozone Sparging**	**Groundwater Extraction and Treatment**
(1) Overall Protection of the Public Health and the Environment					
	There is no reduction of risk with this alternative. The groundwater pathways would continue to pose unacceptable risk to all receptors.	There is no reduction of risk with this alternative. The groundwater pathways would continue to pose risk to all receptors.	No risk remains because entire plume will be treated.	No risk remains because entire plume will be treated.	No risk remains because entire plume will be treated.
(2) Standards, Criteria and Guidance (SCGs)					
	Does not meet SCG criterion.	Does not meet SCG criterion.	Will meet SCG criterion for groundwater in the treated area.	Will meet SCG criterion for groundwater in the treated area.	Will meet SCG criterion for groundwater in the treated area.
(3) Long-Term Effectiveness and Permanence					
	This alternative will not provide long-term effectiveness or permanence. This alternative offers no controls. The plume may expand and contaminate previously uncontaminated portions of the aquifer.	This alternative will only track long-term migration and natural degradation of the plume. It will not prevent the plume from expanding and contaminating previously uncontaminated portions of the aquifer.	In-situ treatment will provide long-term effectiveness and permanence for groundwater within plume. Monitoring will provide a means to recognize remedy failure and implement a more aggressive remedy, if necessary.	In-situ treatment will provide long-term effectiveness and permanence for groundwater within plume. Monitoring will provide a means to recognize remedy failure and implement a more aggressive remedy, if necessary.	Ex-situ treatment will provide long-term effectiveness and permanence for groundwater within plume. Monitoring will provide a means to recognize remedy failure and implement a more aggressive remedy, if necessary.
(4) Reduction of Toxicity, Mobility, or Volume of Contamination Through Treatment					
Amount of Hazardous Materials Destroyed, Treated, or Removed	None	None	In-situ treatment will break down COCs in groundwater within plume.	In-situ treatment will break down COCs in groundwater within plume.	Ex-situ filtration treatment will remove COCs from groundwater within plume.
Degree of Expected Reductions in Toxicity, Mobility, or Volume	None	None	Contaminant toxicity and volume will be reduced.	Contaminant toxicity and volume will be reduced.	Contaminant toxicity and volume will be reduced.
Irreversible Treatment?	No	No	Yes	Yes	Yes
Residuals Remaining After Treatment	Yes	Yes	No	No	No
(5) Short-Term Impact and Effectiveness					
Community Protection	There is no action and therefore, no additional risk to the community.	No additional risk to the community.	Increased short-term risks to the public during installation activities and transport of equipment and materials to and from site. These can be mitigated through standard construction practices and permitting.	Increased short-term risks to the public during installation activities and transport of equipment and materials to and from site. These can be mitigated through standard construction practices and permitting.	Increased short-term risks to the public during installation activities and transport of equipment and materials to and from site. These can be mitigated through standard construction practices and permitting.
Worker Protection	Workers can potentially be exposed to contaminated groundwater by trenching activities south of the site.	Workers can potentially be exposed to contaminated water during groundwater sampling activities. Risks can be minimized by implementing health and safety controls.	Workers can potentially be exposed to contaminated vapors or water during activities. Work around heavy equipment and electrical power carries potential risk to workers. Risks can be minimized by implementing health and safety controls.	Workers can potentially be exposed to contaminated vapors or water during activities. Work around heavy equipment and electrical power carries potential risk to workers. Risks can be minimized by implementing health and safety controls.	Workers can potentially be exposed to contaminated vapors or water during activities. Work around heavy equipment and electrical power carries potential risk to workers. Risks can be minimized by implementing health and safety controls.
Environmental Impacts	None	None	Wastes produced will include contaminated PPE. Wastes will be managed in compliance with ARARs.	Wastes produced will include contaminated PPE. Wastes will be managed in compliance with ARARs.	Wastes produced will include contaminated PPE. Wastes will be managed in compliance with ARARs.
Time Until Action Complete (Field Construction Time)	No action taken	30 years	1-2 years- dependent upon groundwater sampling	10 years (Approximately 6 months construction time) - dependent upon groundwater sampling	30 years (Approximately 2 months construction time) - dependent upon groundwater sampling

TABLE 3 GROUNDWATER ALTERNATIVE EVALUATION SUMMARY

Media: Groundwater					
	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**
	No Further Action	**Long-Term Monitoring with Monitored Natural Attenuation**	**In-Situ Enhanced Reductive Dechlorination**	**In-Situ Ozone Sparging**	**Groundwater Extraction and Treatment**
(6) Implementability					
Ability to Construct and Operate	Not Applicable.	Not Applicable.	In-situ bioremediation is easy to implement.	In-situ aquifer air sparging with ozone is implementable.	Ex-situ treatment of groundwater is implementable.
Monitoring Requirements	Not Applicable.	Monitoring would take place semiannually for the first five years, and annually thereafter.	Groundwater requires monitoring until cleanup confirmed. Monitoring would take place semiannually for the first five years, and annually thereafter.	Groundwater requires monitoring until cleanup confirmed. Monitoring would take place semiannually for the first five years, and annually thereafter.	Groundwater requires monitoring until cleanup confirmed. Monitoring would take place semiannually for the first five years, and annually thereafter.
Availability of Equipment and Specialists	Not Applicable.	Equipment and specialists are available for the implementation of this alternative.	Equipment and specialists are available for the implementation of this alternative.	Equipment and specialists are available for the implementation of this alternative.	Equipment and specialists are available for the implementation of this technology.
Ability to Obtain Approvals and Coordinate with Other Agencies	Not Applicable.	Ability to obtain approvals and coordinate with other agencies assumed to be possible.	Ability to obtain approvals and coordinate with property owners assumed to be possible.	Ability to obtain approvals and coordinate with property owners assumed to be possible.	Ability to obtain approvals and coordinate with other agencies assumed to be possible.
(7) Cost Effectiveness					
Cost	**$0**	**$438,000**	**$597,000**	**$2,051,000**	**$1,400,000**
(8) Land Use					
	Unrestricted	Unrestricted	Unrestricted	Unrestricted	Unrestricted
(9) Community Acceptance					
	TBD	TBD	TBD	TBD	TBD

NOTE: COC = Contaminant of Concern
PPE = Personal protective equipment
ARAR = Applicable Relevant and Appropriate Response
TBD = To be determined

Appendix A

Cost Estimates

TECHNOLOGY	LOCATION	MEDIA	Estimated Cost to Implement	$438,000	
Groundwater Alternative 2 Long Term Monitoring of GW with Monitored Natural Attenuation	Jack's Drycleaners Site Brewerton, NY	Groundwater	Construction Time:	NA	days
			Operation Time:	NA	years
			Post Remediation Monitoring	30	years

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantity Unit	Cost Breakdown (if available): Material Unit Cost	Material Total Cost	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
LONG TERM MONITORING										**ANNUAL LTM COST (YRS 1-5)**	**$45,000**
										ANNUAL LTM COST (YRS 6-30)	**$22,000**
										LIFETIME LTM (NPV)	**$437,800**
Monitoring, Sampling, Testing and Analysis (Per Event)											$22,313
Site Monitoring											
Sampling for 1 event - Includes collection of field parameters		24	well	$ -	$ 50	$ 340	$ 8,160	$ 92	$ 2,199	$ -	$10,409
Mobilization/Demobilization of Field Sampling Crew		1	event	$ -	$ -	$ -	$ -	$ -	$ -	$ 510.00	$510
Reporting		50	hour			$ 85	$ 4,250.00	$ -	$ -	$ -	$4,250
Laboratory analysis											
Volatile Organic Compounds (8260B)	*Chemtech*	24	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 90.05	$2,161
Monitored Natural Attenuation Parameters	*Chemtech*	24	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 207.62	$4,983
Lifetime Long Term Monitoring (Net Present Value)											
5 Years of Semi-Annual Monitoring											
25 Years of Annual Monitoring											
5% Discount Factor (per NYSDEC)											
TOTAL ESTIMATED NPV TECHNOLOGY COST (Capital + Lifetime O&M + Long Term Monitoring)											**$438,000**

Assumptions:

Working condition is Safety Level: **D** **(Labor productivity: 82%; Equipment productivity: 100%)**

Weighted Average of city cost index (Syracuse, NY) **96.5%** **(not applicable for costs derived from vendor quotes).**

Costs are loaded with a profit factor **10%**

Inflation **3%** per year

Sampling

20 wells | **2** Events per year | **2** hrs/sample | **$85** Cost per hr

3 hrs for travel per event | **2** workers per event

Long Term Monitoring

20% added for QA/QC

First 5 years will be on a semiannual sampling schedule.

After 5 years, monitoring will occur on an annual basis.

Analytical cost

Chemtech VOC's- 8260 **$81.86** per sample

Chemtech MNA (2008, inflated 3 yrs) **$207.62**

For each sampling event, assumed: **$50** for materials (gloves, notebooks, etc.)

Work day consists of: **10** hrs

Typical Rental Rates - Includes G&A and 10% Profit

Truck/SUV (1/2 ton or smaller)	**$70.74**	per day
Water Quality Analyzer	**$159.00**	per day
Water Level Meter	**$31.80**	per day
Submersible Pump	**$113.91**	per day
Generators: 220 Volt	**$82.68**	per day

Notes

ea	each
O&M	Operation and maintenance

TECHNOLOGY	LOCATION	MEDIA	Estimated Cost to Implement	$602,000	
Groundwater Alternative 3 In-Situ Enhanced Reductive Dechlorination	Jack's Drycleaners Site Brewerton, NY	Groundwater	Construction Time:	3	months
			Operation Time:	3	months
			Post Remediation Monitoring	10	years

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantity Unit	Cost Breakdown (if available): Material Unit Cost	Material Total Cost	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
REMEDIAL ACTION		**TOTAL CAPITAL COST (totals rounded to nearest thousand)**									**$389,000**
		1			**$30,257**		**$33,995**		**$2,199**	**$12,210**	**$262,530**
Site Preparation											
Utility Locator (based on recent bids)	*recent quote*	1	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,475.00	$2,475
Pre-Implementation Samling											
Sampling for 1 event- includes collection of field parameters)		24	wells	$ 170	$ 4,080	$ 170	$ 4,080	$ 92	$ 2,199	$ -	$10,359
Mobilization/Demobilization of Field Sampling Crew		1	event	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,040.00	$2,040
Analysis for MNA Parameters and VOCs	*Chemtech*	24	ea	$ -	$ -	$ -	$ -	$ -	$ -	$289.48	$6,947
Drill Rig and Crew for Direct Push Application											
Mobilization/Demobilization	*PEC*	2	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 500.00	$1,000
Decontamination Pad	*PEC*	1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 220.00	$220
Steam Generator	*PEC*	25	day	$ -	-	$ -	$ -	$ -	$ -	$ 82.50	$2,021
Standby Time (Decontamination)	*PEC*	147	hr	$ -	$ -	$ 204	$ 29,915	$ -	$ -	$ -	$29,915
Drill Rig and Crew	*PEC*	25	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,600.00	$39,200
Sand -.5 CY per bag	*PEC*	2,078	bag	$ 8	$ 16,625	$ -	$ -	$ -	$ -	$ -	$16,625
Bentonite- 3 bags per point	*PEC*	441	bag	$ 20	$ 8,820	$ -	$ -	$ -	$ -	$ -	$8,820
Quick Set Concretee- 1 bag per point	*Home Depot*	147	bag	$ 5	$ 732	$ -	$ -	$ -	$ -	$ -	$732
Treatment											
3D Microemulsion 75 Product	*Regenesis*	33,600	lb	$ -	$ -	$ -	$ -	$ -	$ -	$ 3.20	$107,520
Shipment of product	*Engineer's Estimate*	1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000.00	$5,000
Mixing Tank	*ECHOS 33 32 0133*	3	mo	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,104.13	$3,312
Chemical feed pump, 0.86 GPH, 700 PSI	*ECHOS 33 32 0123*	2	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,758.94	$5,518
Labor		245	hr	$ -	$ -	$ 85	$ 20,825	$ -	$ -	$ -	$20,825
Contingency											**$39,379**
15%	of Total Construction Activitie									$262,530	$39,379
Professional/Technical Services											**$86,635**
8%	Project Management									$262,530	$21,002
15%	Remedial Design										$39,379
10%	Construction Management										$26,253
LONG TERM MONITORING								**ANNUAL LTM COST (YRS 1-2)**			**$64,000**
								ANNUAL LTM COST (YRS 3-10)			**$16,000**
								LIFETIME LTM (NPV)			**$212,800**
Monitoring, Sampling, Testing and Analysis (Per Event)											$15,970
Site Monitoring											
Sampling for 1 event - includes collection of field parameters		24	wells	$ -	$ 50	$ 340	$ 8,160	$ 92	$ 2,199	$ -	$10,409
Mobilization/Demobilization of Field Sampling Crew		1	event	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,040.00	$2,040
Reporting		16	hour	$85	$ 1,360.00	$ -	$ -	$ -	$ -	$ -	$1,360
Laboratory analysis											
VOCs (8260)	*Chemtech*	24	ea	$ -	$ -	$ -	$ -	$ -	$ -	$90.05	$2,161
Lifetime Long Term Monitoring (Net Present Value)											
5	Years of Semiannual Monitoring										
4	Years of Annual Monitoring										
1	Year of Quarterly Monitoring (final year)										
5%	Discount Factor (per NYSDEC)										
TOTAL ESTIMATED NPV TECHNOLOGY COST (Capital + Post Remediation Monitoring)											**$602,000**

Assumptions:

Working condition is Safety Level: D **(Labor productivity:** 82% **; Equipment productivity:** 100% **)**

Weighted Average of city cost index (Roch 96.5% **(not applicable for costs derived from vendor quotes).**

Costs are loaded with a profit factor 10%

Inflation 3% per year 16% for 5 years of inflation

Consultant Bill Rates (as of 12/15/2010) - Includes G&A and 10% Profit

Truck/SUV (1/2 ton or smaller)	$70.74	per day
Water Quality Analyzer	$159.00	per day
Water Level Meter	$31.80	per day
Submersible Pump	$113.91	per day
Generators: 220 Volt	$82.68	per day

Injection Point Installation Assumed 147 Direct push injection point 0.5 diameter (ft) 35 ft in length (direct push borings) Labor

6 Injections per day 3 pi 1 hour for well development per well

Sampling 20 wells 2 Events per year (yrs 1-5) 2 hrs/sample $85 Cost per hr

20% QA/QC 1 Event per year (yrs 6-30)

12 hrs for travel per event 2 workers per event

Analytical cost

VOCs $81.86 per sample

MNA $207.62

For each sampling event, assumed: $50 for materials (gloves, notebooks, etc.)

Work day consists of: 10 hrs

Notes

Discharge to storm sewer, no cost for water discharge

kW-hr	kilowatt-hour	O&M	Operation and maintenance
bcy	bank cubic yard		
lcy	loose cubic yard		
sf	square feet		
ls	lump sum		

TECHNOLOGY	LOCATION	MEDIA	Estimated Cost to Implement	$2,041,000	
Groundwater Alternative 4 In-Situ Ozone-Enhanced Aquifer Air Sparging	Jack's Drycleaners Site Brewerton, NY	Groundwater	Construction Time:	6	months
			Operation Time:	10	years
			Monitoring	10	years

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantity Unit	Cost Breakdown (if available): Material Unit Cost	Material Total Cost	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
REMEDIAL ACTION		**TOTAL CAPITAL COST (totals rounded to nearest thousand)**									**$1,087,000**
		1			$800		$48,449		$1,827	$2,887	$734,204
Pump Test											
Equipment Rental- pump, water level meter, generator, filters	*Pine*	8	day	$ 100	$ 800	$ -	$ -	$ 228	$ 1,827	$ -	$2,627
Filter bag housing rental		1	mo	$ -	$ -	$ -	$ -	$ -	$ -	$ 750.00	$750
Oversight/Engineering		400	hour	$ -	$ -	$ 85	$ 34,000	$ -	$ -	$ -	$34,000
Drill Rig and Crew for Air Sparge Well Installation											
Mobilization/Demobilization	*PEC*	4	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 200.00	$800
4 1/4" Hollow Stem Auger	*PEC*	100	lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 13.20	$1,320
Decontamination Pad	*PEC*	2	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 220.00	$440
Steam Generator	*PEC*	36	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 82.50	$2,929
Standby Time (Decontamination)	*PEC*	71	hour	$ -	$ -	$ 204	$ 14,449	$ -	$ -	$ -	$14,449
Well Installation											
Geoprobe Daily Rate - 8 hour day	*PEC*	36	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,210.00	$42,955
Air Sparge Wells, Stainless Steel, 2"	*Parratt Wolf*	2,485	lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 60.00	$149,100
Monitoring Points- 2" PVC	*Parratt Wolf*	355	lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 51.00	$18,105
Well covers	*Engineer's Estimate*	71	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 300.00	$21,300
Well head setup- stainless steel	*Engineer's Estimate*	71	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 500.00	$35,500
Site Preparation											
Utility Locator (based on recent bids)	*recent quote*	10	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,475.00	$24,750
Electrical Permit and Utility Connection to PCU	*TRS Group*	5	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 44,000.00	$220,000
Treatment System											
Treatment Construction Enclosure	*Engineer's Estimate*	1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 100,000.00	$100,000
Air Compresser, 1-2' diameter, PVC Coating	*ECHOS-33 13 0785*	1	ea	$ 1,232.24	$ 1,232	$ -	$ -	$ -	$ -	$ -	$1,232
Ozone equipment	*Engineer's Estimate*	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 50,000.00	$50,000
HDPE air lines	*recent quote*	25	100 lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 63.00	$1,575
Trenching- 4' deep, 3/8 CY excavator	*31 23 16.13 0050*	1,481	bcy	$ -	$ -	$ 4.44	$ 6,576	$ 2.46	$ 3,644	$ -	$10,221
NYS Certified Clean Back Fill Material	*Paragon*	132	lcy	$ 16.34	$ 2,151	$ -	$ -	$ -	$ -	$ -	$2,151
Contingency											**$110,131**
15% of Total Construction Activities										$734,204	$110,131
Professional/Technical Services											**$242,287**
8% Project Management										$734,204	$58,736
15% Remedial Design											$110,131
10% Construction Management											$73,420
LONG TERM MONITORING								**ANNUAL LTM COST (YRS 1-2)**			**$64,000**
								ANNUAL LTM COST (YRS 3-10)			**$16,000**
								LIFETIME LTM (NPV)			**$212,800**
Monitoring, Sampling, Testing and Analysis (Per Event)											$15,970
Site Monitoring											
Sampling for 1 event - includes collection of field parameters		24	well	$ -	$ 50	$ 340	$ 8,160	$ 92	$ 2,199	$ -	$10,409
Mobilization/Demobilization of Field Sampling Crew		1	event	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,040.00	$2,040
Reporting		16	hr	$85	$ 1,360.00	$ -	$ -	$ -	$ -	$ -	$1,360
Laboratory analysis											
Volatile Organic Compounds (8260B)	*Chemtech*	24	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 90.05	$2,161
Lifetime Long Term Monitoring (Net Present Value)											
5 Years of Semiannual Monitoring											
4 Years of Annual Monitoring											
1 Year of Quarterly Monitoring											
5% Discount Factor (per NYSDEC)											
LONG TERM OPERATIONS AND MAINTENANCE								**ANNUAL LTOM COST (YRS 1-10)**			**$96,000**
								LIFETIME LTOM (NPV)			**$741,300**
System Operations (per month)											$7,850
Electricity	*NYSEG*	28,500	kW-hr	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.10	$2,850
General O&M		1	months	$ -	$ -	$ 5,000.00	$ 5,000.00	$ -	$ -	$ -	$5,000
Lifetime Operations and Maintenance (Net Present Value)											
10 Years of Operations and Maintenance											
5% Discount Factor (per NYSDEC)											
TOTAL ESTIMATED NPV TECHNOLOGY COST (Capital + Lifetime O&M + Post Remediation Monitoring)											**$2,041,000**

Assumptions:

Working condition is Safety Level: D (Labor productivity: 82% ; Equipment productivity: 100%)
Weighted Average of city cost index (Rochester, NY) 96.5% **(not applicable for costs derived from vendor quotes).**
Costs are loaded with a profit factor 10%
Inflation 3% per year 16% for 5 years of inflation

Pump Test:

10 Hours worked to set up pump test
10 15-60 minutes, every 10 minutes for 60-120 minutes, and every 30 minutes for 120 minutes-10 hours
10 Hours worked (total) second and third day of pump test (measurements taken every 4 hours to 48 hours, then one more time before the end of the test
2 People working during pump test
per day

Consultant Bill Rates (as of 12/15/2010) - Includes G&A and 10% Profit

Truck/SUV (1/2 ton or smaller) $70.74 per day
Water Quality Analyzer $159.00 per day
Water Level Meter $31.80 per day
Submersible Pump $113.91 per day
Generators: 220 Volt $82.68 per day

Sparge Wells

Assumed 71 wells will be installed 30 ft apart
2 wells per day
2,500 ft pipe for air lines to wells
35 ft in length (new wells)
1 hour for well development per well
Labor

Sampling

20 wells
20% added for Q
12 hrs for travel per event
2 Events per year (yrs 1-5)
1 Event per year (yrs 6-30)
2 hrs/sample
2 workers per event
$85 Cost per hr

Well Development

1 hrs per well

Analytical cost

VOCs $81.86 per sample
For each sampling event, assumed: $50 for materials (gloves, notebooks, etc.)

Work day consists of: 10 hrs

Notes

sy	square yard	mo	month
cy	cubic yard	ls	lump sum
lcy	loose cubic yard	O&M	Operation and maintenance
bcy	bank cubic yard	H&S	Health and Safety
lf	linear feet		
sf	square feet		
msf	1,000 square feet		

TECHNOLOGY	LOCATION	MEDIA	Estimated Cost to Implement	$1,400,000
Groundwater Alternative 5 **Groundwater Extraction and Treatment**	**Jack's Drycleaners Site** **Brewerton, NY**	**Groundwater**	**Construction Time:** **Operation Time:** **Post Remediation Monitoring**	**2** months **10** years **30** years

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantities: Quantity Unit	Cost Breakdown (if available): Material Unit Cost	Material Total Cost	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
REMEDIAL ACTION		**TOTAL CAPITAL COST (totals rounded to nearest thousand)**									**$479,000**
		1			**$2,026**		**$20,738**		**$6,137**	**$4,256**	**$323,521**
Pump Test											
Equipment Rental- pump, water level meter, generator, filters		4	day	$ 100	$ 400	$ -	$ -	$ 228	$ 914	$ -	$1,314
Filter bag housing rental		1	week	$ -	$ -	$ -	$ -	$ -	$ -	$ 750.00	$750
Oversight/Engineering		200	hours	$ -	$ -	$ 85	$ 17,000	$ -	$ -	$ -	$17,000
Drill Rig and Crew for Extraction Well Installation											
Mobilization/Demobilization	*PEC*	2	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,650.00	$3,300
4 1/4" Hollow Stem Auger	*PEC*	50	lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 13.20	$660
Decontamination Pad	*PEC*	1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 220.00	$220
Steam Generator	*PEC*	3	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 82.50	$275
Standby Time (Decontamination)	*PEC*	10	hr	$ -	$ -	$ 204	$ 2,035	$ -	$ -	$ -	$2,035
Well Installation											
Geoprobe Daily Rate - 8 hour day	*PEC*	3	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,210.00	$4,033
4" PVC Piping Monitoring Wells Installed	*33 21 13.10 8340*	350	lf	$ 4.65	$ 1,626	$ 4.87	$ 1,703	$ 14.92	$ 5,223	$ -	$8,553
Flush Mount Well Covers	*PEC*	10	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 165.00	$1,650
Well Development	*PEC*	10	hr	$ -	$ -	$ -	$ -	$ -	$ -	$ 165.00	$1,650
Site Preparation											
Utility Locator (based on recent bids)	*recent quote*	1	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,475.00	$2,475
Discharge Line		1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 15,000.00	$15,000
Electrical Permit and Utility Connection to PCU	*TRS Group*	1	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 44,000.00	$44,000
Treatment System											
Treatment Construction Enclosure	*Engineer's Estimate*	1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 150,000.00	$150,000
6" PVC pipe	*33 11 13.25 4530*	500	ft	$ 5.06	$ 2,531	$ 4.48	$ 2,241	$ -	$ -	$ -	$4,772
NYS Certified Clean Back Fill Material	*Paragon*	44	lcy	$ 16.34	$ 726	$ -	$ -	$ -	$ -	$ -	$726
Borrow, 8 CY truck, 30 mph, cycle 6 miles	*31 23 23.20 0052*					$ 1.65	$ -	$ 2.49	$ -		
Trenching- 4' deep, 3/8 CY excavator	*31 23 16.13 0050*	296	bcy	$ -	$ -	$ 4.44	$ 1,315	$ 2.46	$ 729	$ -	$2,044
Carbon System (see below for details)	*Carbon Service*	1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,678.94	$2,679
Influent and effluent hoses- 2" diameter	*Ace Hose & Rubber Company*	2	300 lf	$ 2,167.30	$ 4,335	$ -	$ -	$ -	$ -	$ -	$4,335
Hose couplings	*Ace Hose & Rubber Company*	4	ea	$ 12.64	$ 51	$ -	$ -	$ -	$ -	$ -	$51
Submersible Pumps	*Pine Environmental*	10	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,400.00	$44,000
Lift station before treatment	*Engineer's Estimate*	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 12,000.00	$12,000
Contingency											**$48,528**
15% of Total Construction Activities										$323,521	$48,528
Professional/Technical Services											**$106,762**
8% Project Management										$323,521	$25,882
15% Remedial Design											$48,528
10% Construction Management											$32,352
LONG TERM MONITORING								**ANNUAL LTM COST (YRS 1-5)** **ANNUAL LTM COST (YRS 6-30)** **LIFETIME LTM (NPV)**			**$28,000** **$14,000** **$275,800**
Monitoring, Sampling, Testing and Analysis (Per Event)											$13,954
Site Monitoring											
Sampling for 1 event - Includes collection of field parameters		24	well	$ 340	$ 8,160	$ 92	$ 2,199	$ -	$ 100	$ -	$10,459
Mobilization/Demobilization of Field Sampling Crew		1	event	$ -	$ -	$ -	$ -	$ -	$ -	$ 170.00	$170
Reporting		16	hr	$85	$ 1,360.00	$ -	$ -	$ -	$ -	$ -	$1,360
Laboratory analysis											
Volatile Organic Compounds (8260B)	*Chemtech*	24	ea	$ -	$ -	$ -	$ -	$ -	$ -	$81.86	$1,965
Lifetime Long Term Monitoring (Net Present Value)											
5 Years of Semiannual Monitoring											
25 Years of Annual Monitoring											
5% Discount Factor (per NYSDEC)											
LONG TERM OPERATIONS AND MAINTENANCE								**ANNUAL LTOM COST (YRS 1-30)** **LIFETIME LTOM (NPV)**			**$42,000** **$645,600**
System Operations (per 6 months)											$21,470
Electricity	*NYSEG*	36,000	kW-hr	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.10	$3,600
General O&M		6	months	$ -	$ -	$ 2,500.00	$ 15,000.00	$ -	$ -	$ -	$15,000
Carbon changeout, service run, incl. labor, every 6 mo	*Carbon Service*	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,870.00	$2,870
Lifetime Operations and Maintenance (Net Present Value)											
10 Years of Operations and Maintenance											
5% Discount Factor (per NYSDEC)											
TOTAL ESTIMATED NPV TECHNOLOGY COST (Capital + Lifetime O&M + Post Remediation Monitoring)											**$1,400,000**

Assumptions:

Working condition is Safety Level: **D** **(Labor productivity: 82%; Equipment productivity: 100%)**

Weighted Average of city cost index (Rochester, NY) **96.5%** **(not applicable for costs derived from vendor quotes).**

Costs are loaded with a profit factor **10%**

Inflation **3%** per year **23%** for 7 years of inflation

Sales Tax **8%**

Pump Test:

10 Hours worked to set up pump test

10 15-60 minutes, every 10 minutes for 60-120 minutes, and every 30 minutes for 120 minutes-10 hours

10 test

2 People working during pump test

Consultant Bill Rates (as of 12/15/2010) - Includes G&A and 10% Profit

Truck/SUV (1/2 ton or smaller)	**$70.74**	per day
Water Quality Analyzer	**$159.00**	per day
Water Level Meter	**$31.80**	per day
Submersible Pump	**$113.91**	per day
Generators: 220 Volt	**$82.68**	per day

Extraction Well Installation Assumed **10** wells will be installed 30 ft apart; **35** ft in length (new wells) Labor

3 wells per day; **1** hour for well development per well

Sampling **20** wells; **2** Events per year (yrs 1-5); **2** hrs/sample; **$85** Cost per hr

20% QA/QC; **1** Event per year (yrs 6-30)

1 hrs for travel per event; **2** workers per event

Well Development **2** hrs per well

Carbon Vessel **2,255** Cost of 3 AQ 100 HP adsorbers each filled with virgin liquid phase carbon, one pre-filter, one flow totalizer, interconnecting hoses, freight of equipment on a pallet to Brewerton, NY via common carrier truck with a lift gate, not including sales tax

Analytical cost

VOCs **$81.86** per sample

For each sampling event, assumed: **$50** for materials (gloves, notebooks, etc.)

Work day consists of: **10** hrs

Notes

Assume NPDES or equivalent permit is used, no cost for water discharge

bcy	bank cubic yard	O&M	Operation and maintenance
ECY	Embankment Cubic Yards	sf	square feet
H&S	Health and Safety	VOC	Volatile Organic Compound
lcy	loose cubic yard		
ls	lump sum		