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Focused Feasibility Study

Greener Cleaners Site

809 State Street

Schenectady, New York

Site # 447041

Work Assignment # D-007618-18

June 2016

ARCADIS

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I, Daniel J. Loewenstein, certify that I am currently a NYS registered professional engineer and that this Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and that all activities were performed in full accordance with the DER approved work plan and any DER approved modifications.

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1 Introduction

This Focused Feasibility Study (FFS) has been prepared to evaluate remedial alternatives for chlorinated volatile organic compounds (CVOCs) in soil, groundwater, and soil vapor at the former Greener Cleaners Site, in the City of Schenectady, Schenectady County, New York (site) (Figures 1 and 2). The FFS was conducted under New York State Department of Environmental Conservation (NYSDEC) State Superfund Standby Contract Work Assignment No. D-007618-18. The purpose of this report is to evaluate potential remedial alternatives based on the seven evaluation criteria listed in the NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10).

After approval of this FFS, the NYSDEC will issue a Proposed Remedial Action Plan (PRAP) which is open to public comment. Following the public comment period, the NYSDEC will issue a Record of Decision (ROD) for the site.

This FFS was completed in accordance with DER-10, NYSDEC guidance on presumptive remedies as defined in 6 NYCRR Part 375, NYSDEC DER program policy for Green Remediation (DER-31), and other appropriate NYSDEC and United States Environmental Protection Agency (USEPA) guidance.

1.1 Site Location and Background

The Greener Cleaners Site located at 809 State Street, in the eastern portion of the City of Schenectady (City) (Figure 1), consists of an active retail dry cleaning facility currently owned by Best Cleaners, who purchased the property from Greener Cleaners (formerly KEM Cleaners) on July 7, 2010. While Best Cleaners does not currently utilize chlorinated solvents for their operations, tetrachloroethene (PCE) was reportedly used at the site until 2008. Greener Cleaners reportedly occupied, and conducted dry cleaning operation on the site for up to 12 years. King Cadillac reportedly owned the site before Greener Cleaners and utilized the site for automobile retail sales and service. The site is generally flat and the ground surface over the majority of the site is covered with asphalt. The site is located within a mixed residential-commercial neighborhood. Existing structures on the site include a large concrete block and brick building used for retail dry cleaning operations and a vacant garage that has recently been converted to a storage area and was historically used for automobile service. The automobile service infrastructure (hydraulic lifts and floor drains) in the garage are still in place.

1.2 Previous Investigations

A release of unknown quantity, reportedly due to poor housekeeping practices, was reported at the site on October 23, 2007 and was subsequently reported to the NYSDEC. The NYSDEC assigned Spill number 0751597 to the site and performed an inspection of the site on October 26, 2007. The NYSDEC inspection documented poor housekeeping practices, measured elevated concentrations of volatile organic compounds (VOCs) with a photoionization detector (PID), noted significant olfactory evidence of vapors within the building, and observed liquid flowing into an open floor drain.

On behalf of the NYSDEC, Precision Environmental Services, Inc. (PES) conducted a subsurface investigation in the Spring and Summer of 2009. PCE was detected at elevated concentrations in soil, groundwater, and soil vapor (PES, 2009), particularly in the area immediately west of the building near stormwater and/or sanitary drain pipes.

PES conducted a supplemental subsurface investigation in the Fall of 2010 (PES, 2011a) to further delineate PCE impacts. Soil containing PCE at concentrations up to 25 milligrams per kilogram (mg/kg) was identified in the area west of the site building near stormwater/sanitary lines. Groundwater containing PCE at concentrations up to 520 micrograms per liter (µg/L) was identified in a plume area that extends from the western side of the site building at MW-4 approximately 100 feet westward toward Mynderse Street. Soil vapor containing PCE at concentrations up to 144,439 micro grams per cubic meter (µg/m^3) was identified immediately west of the on-site building. PES noted that the spatial extent of PCE-impacted soil vapor is larger than that of PCE-impacted groundwater, suggesting the potential for off-site soil vapor migration.

Additional investigative work was conducted by PES in the summer of 2011 and reported as an addendum to the supplemental subsurface investigation report issued earlier that year (PES, 2011b). Additional soil vapor sampling identified PCE concentrations up to 2,400,000 µg/m^3 immediately west of the on-site building at sampling point SV-1. Additional groundwater sampling indicated elevated PCE concentrations within the plume area, up to 2,500 µg/L in the sample from MW-7. Collectively, the findings from these investigations suggested that source material is likely present within the area immediately west of the northern portion of the building where utility lines exit the building.

1.3 Geology/Hydrogeology

Natural overburden materials in the area are characterized as lacustrine delta deposits (Caldwell et al., 1987). Overburden materials observed during the subsurface

investigations and the RI generally consisted of well sorted sand overlying poorly sorted sand, silty sand, and/or silt with clay. Urban fill materials overlie the sand. The Ordovician Schenectady Formation, consisting largely of greywacke and shale, is present beneath the overburden in the area (Fisher et al., 1970). Bedrock was not encountered during the subsurface investigations performed prior to and during the RI, which reached a maximum depth of approximately 60 feet below ground surface (bgs), likely at glacial till, although this has not been visually verified. Groundwater is typically encountered in the overburden between approximately 12 and 20 feet bgs. Groundwater flow at the site is generally to the northwest toward the Mohawk River, which is the regional groundwater discharge.

2 Remedial Investigation Summary

2.1 Remedial Investigation

A Remedial Investigation (RI) was conducted between 2013 and 2015 on behalf of the NSYDEC (ARCADIS, 2015). Unsaturated subsurface soil at, and in the vicinity of, the site does not appear to be negatively impacted by site-related contaminants of concern (COCs); however, as discussed in the RI Report, soil samples could not be collected beneath the building and the condition of that soil is unknown. As shown on Figure 3, only one shallow soil sample from the 2010 subsurface investigation contained PCE at a concentration greater than the applicable 6 NYCRR Part 375 Unrestricted Use Soil Cleanup Objective (SCO). As shown on Figure 4, PCE was present at concentrations greater than the NYSDEC Class GA Standard in groundwater samples from up to seven of the 16 wells in the site monitoring well network, generally in the vicinity of the on-site sewer/drain lines. None of the deep zone wells contained CVOCs at concentrations greater than the corresponding NYSDEC Class GA Standards. As shown on Figure 5, PCE was present in all of the soil vapor monitoring points. Daughter products trichloroethene (TCE), cis-1,2-dichloroethene, and vinyl chloride are generally not present or present at very low concentrations in both groundwater and soil vapor. As shown on Figure 6, PCE and TCE were detected in all sub-slab and indoor air samples collected during the 2014-2015 heating season, with the exception of one sample which only contained PCE. All samples with the exception of one contained either PCE or TCE at concentrations exceeding NYSDOH potential mitigation guidance values, while eight of the samples contained PCE or TCE at concentrations exceeding NYSDOH mitigation guidance values. As shown on Figure 6, PCE, 1,1,1-TCA, and/or carbon tetrachloride were detected in the 2013-2014 heating season samples from adjacent properties; however, the concentrations of these compounds did not exceed the NYSDOH mitigation guidance values.

The extent of CVOC groundwater impacts extends from the suspected source area near the on-site building northwestward toward Mynderse Street and is generally bounded to the southwest with a maximum width of approximately 100 feet and maximum known length of approximately 150 feet. Based on soil vapor, sub-slab, indoor air sampling, and a soil vapor extraction (SVE) pilot study, off-site properties do not appear to be impacted by site-related contaminants, while the dry cleaning building requires vapor intrusion mitigation due to the presence of CVOCs, primarily PCE, in the sub-slab soil vapor and indoor air. Implementation of an Interim Remedial Measure (IRM) in the form of a SVE/sub-slab depressurization system (SSDS) was approved by the NYSDEC in November 2015.

2.2 Conceptual Site Model

With the conclusion of RI sampling, the current Conceptual Site Model is as follows:

Previous investigations indicated that the source of the groundwater and soil vapor contamination at, and in the vicinity of, the site, was located in the eastern portion of the parking lot near the cleaning room and former cooling tower. Multiple rounds of groundwater sampling showed a CVOC plume emanating from a source coincident with the drain lines exiting the building toward MW-7. The spatial distribution of groundwater impacts coupled with documented poor housekeeping practices and observed liquid flowing to an open floor drains, suggested a conceptual model of CVOC introduction to the environment via the sewer/drain lines. Video inspection of the drain lines during the RI showed 6 inch vitreous clay pipe with a probable joint near the most up-gradient area of the groundwater plume, which strengthens this conceptual model. Further, CVOCs were not detected at concentrations greater than applicable SCOs during extensive soil sampling in the presumed source area during the RI. The general lack of CVOC daughter products in groundwater and soil vapor samples suggests that natural degradation via reductive dechlorination is not likely occurring at the site.

The thickness of overburden and/or fill materials in the vicinity of the site is at least 60 feet, likely overlying glacial till, although this has not been visually verified. Groundwater flow in the vicinity of the site is generally to the northwest. The area is served by municipal water and sewer service. Those residential properties that were accessible for sampling did not have soil vapor intrusion impacts.

3 Exposure/Risk Assessment

A qualitative exposure assessment was performed using the data collected during the RI. The qualitative exposure assessment consists of characterizing the exposure setting, identifying potential exposure pathways, and evaluating contaminant fate and transport. An exposure pathway describes the means by which an individual may be exposed to contaminants originating from the site. An exposure pathway has five elements: (1) a contaminant source; (2) contaminant release and transport mechanism; (3) a point of exposure; (4) a route of exposure; and (5) a receptor population.

3.1 Exposure Pathways

3.1.1 Soil

Subsurface soil, in the vicinity of one shallow soil sample, contains PCE at concentrations greater than the corresponding 6 NYCRR Part 375 Unrestricted Use SCO; however, these soils are present below asphalt and the concentrations of PCE do not exceed the corresponding 6 NYCRR Part 375 Commercial SCO, which are applicable to the past and current site use. These subsurface soils do not presently have a direct exposure point or route, as they are capped by asphalt. However, contact with the impacted soils by construction and/or utility workers represents a possible future exposure pathway.

3.1.2 Groundwater

Overburden groundwater at the site contains CVOCs at concentrations greater than the NYSDEC Class GA Standards. These compounds appear to originate from the area of sewer/drain lines immediately west of the building and have migrated, via generally northwestward groundwater flow, impacting an area with a maximum width of approximately 100 feet and maximum known length of approximately 150 feet. The City of Schenectady has an ordinance requiring connection to the City drinking water system, thus the homes in the area do not utilize groundwater as a drinking water source and ingestion of groundwater in not a potential exposure pathway.

3.1.3 Soil Vapor

Overburden CVOC-impacted soil and/or groundwater at the site has caused sub-slab soil vapor and indoor air impacts to the dry cleaning building, therefore inhalation of CVOCs via the vapor intrusion pathway is a potential exposure pathway. Based on the limited sampling of indoor air in available neighboring residences, the potential for soil vapor

intrusion into neighboring buildings appears to be limited to the Greener Cleaners building.

4 Interim Remedial Measures (IRMs)

Based on the concentrations of CVOCs detected in the soil vapor and indoor air beneath/in the dry cleaning building identified during the RI, an Interim Remedial Measure (IRM) will be implemented to mitigate the potential vapor intrusion pathway prior to the selection of the final remedial alternative for the site. The IRM will consist of a combined soil vapor extraction (SVE) / sub-slab depressurization system (SSDS) using four extraction points to extract soil vapors from the source area and to mitigate indoor air exposure via a piping network and vacuum blower. The IRM system will treat soil vapors with granular activated carbon (GAC), if needed, prior to discharge to the atmosphere.

5 Remedial Action Objectives and Evaluation Criteria

The remedial goal for the Former Greener Cleaners Site will be the restoration of the site to pre-release conditions, to the extent feasible, given the existing and anticipated land use. At this time, the property is an active dry cleaning facility. Accordingly, the remedial action objectives (RAOs) discussed in this section were developed based upon a similar end-use (e.g. commercial use) of the site.

5.1 Remedial Action Objectives

The RAOs for the affected media are listed below. Generally, these RAOs may be achieved by minimizing the:

- Magnitude and extent of contamination in the affected media;
- Migratory potential of the contaminants; and
- Potential for human exposure to in-situ contaminated media.

5.1.1 Soil

The RAOs for soil are listed below.

- Restoration to pre-release conditions, to the extent practical.
- Prevent direct contact with contaminated soil.
- Prevent inhalation of, or exposure to, contaminants volatilizing from soil.
- Prevent migration of contaminants which would result in further groundwater contamination.

5.1.2 Groundwater

The RAOs for groundwater are listed below.

- Prevent ingestion of contaminated groundwater.

- Prevent contact with, or inhalation of, contaminants volatilizing from contaminated groundwater.
- Restore the groundwater aquifer to pre-release conditions, to the extent practical.
- Remove the source of groundwater contamination.

5.1.3 Soil Vapor

The RAOs for soil vapor are listed below.

- Prevent contact with, or inhalation of, contaminants volatilizing from contaminated soil and/or groundwater.
- Remove the source of soil vapor contamination.

5.2 Evaluation Criteria

In accordance with DER-10 Technical Guidance for Site Investigation and Remediation (DER-10) (NYSDEC, 2010), the remedial measure alternatives developed in this Feasibility Study will be screened based on an evaluation of the following criteria:

- Overall Protection of Human Health and the Environment;
- Compliance with Standards, Criteria, and Guidance (SCGs);
- Long-term Effectiveness and Permanence;
- Reduction of Toxicity, Mobility, and Volume;
- Short-term Effectiveness;
- Implementability;
- Cost;
- Community Acceptance.

5.2.1 Overall Protection of Human Health and the Environment

This criterion serves as a final check to assess whether each alternative meets the requirements that are protective of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under the other evaluation criteria. The evaluation focuses on how a specific alternative achieves protection over time and how site risks are reduced. The analysis includes how each source of contamination is to be eliminated, reduced, or controlled for each alternative.

5.2.2 Compliance with SCGs

This evaluation criterion assesses how each alternative complies with 6 NYCRR Part 375 Unrestricted Use Soil Cleanup Objectives, 6 NYCRR Part 375 Commercial Soil Cleanup Objectives, NYSDEC Class GA Standards, and the guidelines set forth in the NYSDOH October 2006 Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York.

5.2.3 Long-Term Effectiveness and Permanence

This evaluation criterion addresses the results of a remedial action in terms of its permanence and quantity/nature of waste or residual remaining at the site after response objectives have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the waste or residual remaining at the site and operating system necessary for the remedy to remain effective. The factors being evaluated include the permanence of the remedial alternative, magnitude of the remaining risk, adequacy of controls used to manage residual waste, and reliability of controls used to manage residual waste.

5.2.4 Reduction of Toxicity, Mobility, and Volume

This evaluation criterion assesses the remedial alternative's use of the technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous wastes as their principal element. The NYSDEC's policy is to give preference to alternatives that eliminate any significant threats at the site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in the contaminants mobility, or reduction of the total volume of contaminated media. This evaluation includes: the amount of the hazardous materials that would be destroyed or treated, the degree of expected reduction in toxicity, mobility, or volume measured as a percentage, the degree in which the treatment would be irreversible, and the type and quantity of treatment residuals that would remain following treatment.

5.2.5 Short-Term Effectiveness

This evaluation criterion assesses the effects of the alternative during the construction and implementation phase. Alternatives are evaluated with respect to the effects on human health and the environment during implementation of the remedial action. The aspects evaluated include: protection of the community during remedial actions, environmental impacts as a result of remedial actions, time until the remedial response objectives are achieved, and protection of workers during the remedial action.

5.2.6 Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The evaluation includes: feasibility of construction and operation; the reliability of the technology; the ease of undertaking additional remedial action; monitoring considerations; activities needed to coordinate with other offices or agencies; availability of adequate off-site treatment, storage, and disposal services; availability of equipment; and the availability of services and materials.

5.2.7 Cost

Cost estimates are prepared and evaluated for each alternative. The cost estimates include capital costs, operation and maintenance (O&M) costs, and future capital costs. A cost sensitivity analysis is performed which includes the following factors: the effective life of the remedial action, the O&M costs, the duration of the cleanup, the volume of contaminated material, other design parameters, and the discount rate. Cost estimates developed at the detailed analysis of alternatives phase of a feasibility study generally have an expected accuracy range of -30 to +50 percent (USEPA, 2000).

5.2.8 Community Acceptance

Following submission of this report and the generation of the PRAP by the NYSDEC, a summary of the proposed remedial action will be sent to the project's contact list. The summary will include the date, time, and location of the public meeting, and announcement of the 30-day period for submission of written comments from the public. A Responsiveness Summary will be prepared to address public comments on the PRAP. After the submission of Responsiveness Summary, a final remedy will be selected and publicized. If the final remedy differs significantly from the proposed remedy, public notices will include descriptions of the differences and the reason for the changes.

6 Remedial Alternatives Analysis

Based upon the site characteristics and in consultation with the NYSDEC, the following remedial alternatives were considered to be potentially applicable to the soil, groundwater, and soil vapor contamination at the site:

Alternative 1: No Further Action

Alternative 2: Institutional Controls + Continued SVE/SSDS IRM Operation + Long-Term Monitoring

Alternative 3: Groundwater Source Treatment via In-Situ Reductive Dechlorination + Continued SVE/SSDS IRM Operation + Long Term Monitoring

Alternative 4: Groundwater Source Treatment via In-Situ Chemical Oxidation + Continued SVE/SSDS IRM Operation + Long Term Monitoring

Alternative 5: Excavation to Unrestricted Use SCOs + Groundwater Treatment via In-Situ Chemical Oxidation + Continued SVE/SSDS Operation

This section presents an analysis of the potential remedial alternatives for remediation of the Former Greener Cleaners Site in accordance with the criteria described in Section 4.2.

6.1 Remedial Alternatives Evaluation

6.1.1 Alternative 1: No Further Action

6.1.1.1 Description

The no further action alternative, by definition, involves no further institutional controls, environmental monitoring, or remedial action, and therefore, includes no technological barriers. In accordance with DER-10, this alternative serves as a baseline, defining the minimum steps that would be taken at the site in the absence of any type of action directed at the existing contamination.

Alternative 1 would include removal of the SVE/SSDS IRM system and abandoning of all monitoring wells, extraction wells, and soil vapor/vacuum monitoring points.

6.1.1.2 Overall Protection of Human Health and the Environment

The No Further Action alternative would not be protective of public health and the environment as the SVE/SSDS IRM would no longer be operated – thereby completing the soil vapor intrusion exposure pathway. Soil and groundwater containing CVOCs at concentrations greater the Unrestricted Use SCOs and NYSDEC Class GA standards, respectively, would remain at the site. Although the nearest receptors are supplied with public drinking water; the potential for future exposure to contaminated soil and groundwater via construction/excavation activities at the site would also remain.

6.1.1.3 Compliance with SCGs

The No Further Action alternative would not meet the SCGs as contamination would persist at concentrations greater than standards/guidelines in soil, groundwater, and soil vapor.

6.1.1.4 Long-Term Effectiveness and Permanence

The No Further Action alternative would not meet the SCGs over the long term as contamination would persist at concentrations greater than standards/guidelines in soil, groundwater, and soil vapor.

6.1.1.5 Reduction of Toxicity, Mobility, and Volume with Treatment

The No Further Action alternative would not reduce the toxicity or mobility of the contaminants. The volume of the contamination may be reduced through natural attenuation.

6.1.1.6 Short-Term Impact and Effectiveness

Community Protection

Standard protection measures for mitigation of environmental impacts and nuisance conditions would be implemented during system dismantling and well abandoning.

Worker Protection

Implementation of this alternative would be undertaken using standard procedures for worker protection including the establishment of a health and safety plan which would

outline the appropriate protective measures which should be undertaken during any subsurface activities in the affected area.

Environmental Impacts

Implementation of this alternative would not be expected to create adverse environmental impacts; however, the source of the vapor intrusion impacts would remain.

Time Required to Implement

This alternative would likely require less than one year to implement.

6.1.1.7 Implementability

The No Further Action alternative can be easily implemented.

6.1.1.8 Cost

The capital and present worth costs for Alternative 1 are presented in Table 1. There are no O&M costs.

- **Capital Costs**: The probable capital cost to construct and implement Alternative 1 is approximately $70,000.
- **Present Worth Cost**: The probable net present worth for this alternative is approximately $70,000. This was calculated using a 5% annual discount rate.

6.1.2 Alternative 2: Institutional Controls + Continued SVE/SSDS IRM Operation + Long-Term Monitoring

6.1.2.1 Description

Institutional controls are not technologies, but rather, are legal actions that reduce or prevent exposure of the human population to the contaminated soil and/or groundwater (e.g., deed restrictions, fencing/signs, health advisories). Institutional controls can be used as a stand-alone alternative or can be used in conjunction with other technologies to achieve RAOs.

Alternative 2 would include the following elements:

- The implementation of restrictions on the access to on-site soil and the use of groundwater at the site and in the immediate vicinity;
- The requirement for the continued operation of the SVE/SSDS IRM until indoor air impacts are successfully mitigated;
- Groundwater use restrictions which would include deed restrictions to prevent future use of the groundwater and control activities at the site, including notification procedures for future owners and/or developers/workers of the restricted use of the property. Because the City already has an ordinance requiring connection of all users to the City potable water supply system, a moratorium on groundwater use within the impacted area would not be required.

This alternative would not actively reduce groundwater contaminant concentrations; however; this alternative would be effective at eliminating exposure to contaminated groundwater. Additionally, continued operation of the SVE/SSDS IRM would mitigate exposure to CVOC-impacted soil vapor and indoor air. Because contamination would remain, a Site Management Plan (SMP) would be required that would provide specific requirements for site development and use including annual site inspections. A long-term monitoring program will be implemented at the site to evaluate the extent of contaminant migration and attenuation. Annual groundwater monitoring of the existing groundwater monitoring well network for the first two years and sampling every five years thereafter would be part of the long-term monitoring program.

6.1.2.2 Overall Protection of Human Health and the Environment

Alternative 2 would be protective of public health and the environment. Although groundwater impacted by CVOCs is known to exist beneath the site, natural attenuation of groundwater contaminants over time is expected. Restrictions on the access to on-site soil and prohibition of the use of groundwater through the City ordinance would prevent the future exposure to soil and groundwater via ingestion, therefore, potential future exposure to contaminated soil and groundwater would be to construction/excavation activities at the site or utility rights-of-way. This exposure pathway could be mitigated through the use of appropriate health and safety protocols during any such work. Continuing operation of the SVE/SSDS IRM would prevent the future exposure to soil vapor via inhalation. Continued monitoring would provide a means to evaluate contaminant concentrations over time and ensure that mitigation remains effective.

6.1.2.3 Compliance with SCGs

Alternative 2 may meet the SCGs over the long term as only low-level isolated soil impacts remain and natural attenuation of groundwater contaminants over time is expected.

6.1.2.4 Long-Term Effectiveness and Permanence

Alternative 2 should be effective in the long-term as natural attenuation of groundwater contaminants over time is expected. Continued operation of the SVE/SSDS IRM would effectively prevent human exposure to soil vapor via inhalation.

6.1.2.5 Reduction of Toxicity, Mobility, and Volume with Treatment

Alternative 2 would not reduce the toxicity or mobility of the contaminants. Continued operation of the SVE/SSDS IRM and ongoing natural attenuation in groundwater would reduce contaminant volume over time, which would be documented by long-term monitoring.

6.1.2.6 Short-Term Impact and Effectiveness

Community Protection

Standard protection measures for mitigation of environmental impacts and nuisance conditions would be implemented during routine system O&M and groundwater sampling.

Worker Protection

Implementation of this alternative would be undertaken using standard procedures for worker protection including the establishment of a health and safety plan which would outline the appropriate protective measures which should be undertaken during any subsurface activities in the affected area.

Environmental Impacts

Implementation of this alternative would not be expected to create adverse environmental impacts as there are no ground-intrusive elements to this alternative.

Time Required to Implement

This alternative would likely require less than one year to implement and 30 years to monitor.

6.1.2.7 Implementability

Alternative 2 could be easily implemented using readily available technologies.

6.1.2.8 Cost

The capital, O&M and present worth costs for Alternative 2 are presented in Table 2. A 30 year monitoring period was chosen for this alternative.

- **Capital Costs**: The probable capital cost to construct and implement Alternative 2 is approximately $92,500.

- **O&M Costs**: The probable annual operations, monitoring, and maintenance cost for this alternative for the first two years is $27,500. The probable annual operations, monitoring, and maintenance cost for this alternative for years three through 30 is $15,000. The operations, monitoring, and maintenance cost every five years for this alternative is $12,500. The final year's operations, monitoring, and maintenance cost for this alternative is $42,800.

- **Present Worth Cost**: Over a 30 year monitoring period, the probable net present worth for this alternative is approximately $355,000. This was calculated using a 5% annual discount rate.

6.1.3 Alternative 3: Groundwater Source Treatment via In-Situ Reductive Dechlorination + Continued SVE/SSDS IRM Operation + Long-Term Monitoring

6.1.3.1 Description

Alternative 3 would include all of the elements of Alternative 2, plus the following items, which are depicted on Figure 7:

- Installation of new injection wells;

- Off-site disposal of drill cuttings as F-listed hazardous waste in accordance with applicable federal, state, and local regulations;

- Injection of a controlled-release organic carbon substrate mixed with zero valent iron (EHC-L 5% or equivalent) to achieve reducing conditions across the treatment area and stimulate chemical and biological reductive dechlorination of CVOCs within the source area;
- Pre- and Post-remediation groundwater and soil vapor sampling;
- Monthly O&M visits and semi-annual effluent sampling of the SVE/SSDS; and
- Annual groundwater monitoring of the existing well network.

6.1.3.2 Overall Protection of Human Health and the Environment

Alternative 3 would be protective of public health and the environment in that this alternative treats the source of the groundwater contamination and mitigates human exposure via vapor intrusion based on continued operation of the SVE/SSDS IRM.

6.1.3.3 Compliance with SCGs

Alternative 3 would meet soil and groundwater SCGs over the long-term, and should meet indoor air SCGs over the long-term, by removing most remaining sources of contamination and mitigating indoor air exposure.

6.1.3.4 Long-Term Effectiveness and Permanence

Alternative 3 would be effective in the long-term through removal of the remaining sources of contamination and mitigating indoor air exposure.

6.1.3.5 Reduction of Toxicity, Mobility, and Volume with Treatment

Alternative 3 would reduce the toxicity and volume of the contaminants, but would not reduce their mobility.

6.1.3.6 Short-Term Impact and Effectiveness

Community Protection

Standard protection measures for mitigation of environmental impacts and nuisance conditions would be implemented during remedial well installation, injection events, and during routine system O&M and groundwater sampling.

Worker Protection

Implementation of this alternative would be undertaken using standard procedures for worker protection including the establishment of a health and safety plan which would outline the appropriate protective measures which should be undertaken during any subsurface activities in the affected area.

Environmental Impacts

Implementation of this alternative would not be expected to create adverse environmental impacts.

Time Required to Implement

This alternative would likely require approximately three years to implement and 10 years to monitor.

6.1.3.7 Implementability

Alternative 3 could be implemented using readily available technologies.

6.1.3.8 Cost

The capital, O&M, and Present worth costs for Alternative 3 are presented in Table 3. A 10 year monitoring period was chosen for the analysis.

- **Capital Costs**: The probable capital cost to construct and implement Alternative 3 is approximately $339,800.

- **O&M Costs**: The probable annual operations, monitoring, and maintenance cost for this alternative is $27,500. The final year's operations, monitoring, and maintenance cost for this alternative is $42,800.

- **Present Worth Cost**: Over a 10 year monitoring period, the probable net present worth for this alternative is approximately $561,000. This was calculated using a 5% annual discount rate.

6.1.4 Alternative 4: Groundwater Source Treatment via In-Situ Chemical Oxidation + Continued SVE/SSDS IRM Operation + Long-Term Monitoring

6.1.4.1 Description

Alternative 4 would include all of the elements of Alternative 2, plus the following items, which are depicted on Figure 8:

- Installation of new injection wells;
- Off-site disposal of drill cuttings as F-listed hazardous waste in accordance with applicable federal, state, and local regulations;
- Up to two injections of sodium permanganate within the source area;
- Pre- and Post-remediation groundwater and soil vapor sampling;
- Monthly O&M visits and semi-annual effluent sampling of the SVE/SSDS; and
- Annual groundwater monitoring of the existing well network.

6.1.4.2 Overall Protection of Human Health and the Environment

Alternative 4 would be protective of public health and the environment in that this alternative treats the source of the groundwater contamination and mitigates human exposure via vapor intrusion through continued operation of the SVE/SSDS IRM.

6.1.4.3 Compliance with SCGs

Alternative 4 would meet soil and groundwater SCGs and should meet indoor air SCGs over the long term by removing most remaining sources of contamination and mitigating indoor air exposure.

6.1.4.4 Long-Term Effectiveness and Permanence

Alternative 4 would be effective in the long-term through removal of the remaining sources of contamination and mitigating indoor air exposure.

6.1.4.5 Reduction of Toxicity, Mobility, and Volume with Treatment

Alternative 4 would reduce the toxicity and volume of the contaminants, but would not reduce their mobility.

6.1.4.6 Short-Term Impact and Effectiveness

Community Protection

Standard protection measures for mitigation of environmental impacts and nuisance conditions would be implemented during remedial well installation, injection events, and during routine system O&M and groundwater sampling.

Worker Protection

Implementation of this alternative would be undertaken using standard procedures for worker protection including the establishment of a health and safety plan which would outline the appropriate protective measures which should be undertaken during any subsurface activities in the affected area. Injection of a chemical oxidant (sodium permanganate) would result in minimal risk to site workers, the community and environment; risks would be controlled with engineering controls.

Environmental Impacts

Implementation of this alternative would not be expected to create adverse environmental impacts.

Time Required to Implement

This alternative would likely require approximately two years to implement and five years to monitor.

6.1.4.7 Implementability

Alternative 4 could be implemented using readily available technologies.

6.1.4.8 Cost

The capital, O&M, and Present worth costs for Alternative 4 are presented in Table 4. A five year monitoring period was chosen for the analysis.

- **Capital Costs**: The probable capital cost to construct and implement Alternative 4 is approximately $788,500.

- **O&M Costs**: The probable annual operations, monitoring, and maintenance cost for this alternative is $27,500. The final year's operations, monitoring, and maintenance cost for this alternative is $42,800.

- **Present Worth Cost**: Over a five year monitoring period, the probable net present worth for this alternative is approximately $920,000. This was calculated using a 5% annual discount rate.

6.1.5 Alternative 5: Excavation to Unrestricted Use SCOs + Groundwater Treatment via In-Situ Chemical Oxidation + Continued SVE/SSDS IRM Operation

6.1.5.1 Description

Alternative 5 would include the following elements, which are depicted on Figure 9:

- Excavation of on-site soil within the remediation area to a depth of 12 feet bgs (based on prior investigation samples with contaminants greater than SCGs) or the water table, whichever is shallower. The remediation area is generally based on the following samples

    - SS-M (0-2') from the 2010 supplemental subsurface investigation which contained PCE at a concentration greater than the Unrestricted Use and Residential Use SCOs;

    - SB-24 (10-12') from the RI which contained mercury at a concentration greater than the Unrestricted Use and Residential Use SCOs; and

    - SB-19 (10-12') from the RI which contained 4,4'-DDT at a concentration greater than the Unrestricted Use and Residential Use SCOs.

    The excavation horizontal limits are based on points approximately half the distance from the nearest soil sample location with contaminants less than SCGs;

- Off-site disposal of excavated soil as non-hazardous waste, with the exception of the upper two feet of excavated soil from the CVOC-impacted area around SS-M which would be disposed of as F-listed hazardous waste, in accordance with applicable federal, state, and local regulations;

- Backfilling of excavation with clean off-site fill and staged clean on-site soil following confirmation sampling that indicates that impacted soil has been removed;
- Installation of new injection wells;
- Off-site disposal of drill cuttings as F-listed hazardous waste in accordance with applicable federal, state, and local regulations;
- Up to two injections of sodium permanganate within the groundwater plume area;
- Pre- and Post-remediation groundwater and soil vapor sampling;
- Monthly O&M visits and semi-annual effluent sampling of the SVE/SSDS; and
- Annual groundwater monitoring.

This alternative assumes that there is no soil or groundwater contamination beneath the dry cleaning building. This alternative assumes that sheeting would be utilized around the perimeter of the excavation area to protect the adjacent building. Additionally, this alternative assumes that the on-site sewer lines in the vicinity of the excavation area would be relocated.

6.1.5.2 Overall Protection of Human Health and the Environment

Alternative 5 would be protective of public health and the environment in that this alternative treats all groundwater contamination and removes all soil contamination remaining at concentrations greater than SCGs and mitigates human exposure via vapor intrusion based on continued operation of the SVE/SSDS IRM.

6.1.5.3 Compliance with SCGs

Alternative 5 would meet soil and groundwater SCGs and should meet indoor air SCGs over the long term by removing all remaining sources of contamination and mitigating indoor air exposure.

6.1.5.4 Long-Term Effectiveness and Permanence

Alternative 5 would be effective in the long-term through removal of remaining sources of contamination and mitigating indoor air exposure.

6.1.5.5 Reduction of Toxicity, Mobility, and Volume with Treatment

Alternative 5 would reduce the toxicity and volume of the contaminants, but would not reduce their mobility.

6.1.5.6 Short-Term Impact and Effectiveness

Community Protection

Standard protection measures for mitigation of environmental impacts and nuisance conditions would be implemented during excavation activities, well installation, injection events, and during routine system O&M and groundwater sampling.

Worker Protection

Implementation of this alternative would be undertaken using standard procedures for worker protection including the establishment of a health and safety plan which would outline the appropriate protective measures which should be undertaken during any subsurface activities in the affected area.

Environmental Impacts

Implementation of this alternative would not be expected to create adverse environmental impacts.

Time Required to Implement

This alternative would likely require approximately two years to implement and five years to monitor.

6.1.5.7 Implementability

Alternative 5 could be implemented using readily available technologies.

6.1.5.8 Cost

The capital, O&M, and Present worth costs for Alternative 5 are presented in Table 5. A five year monitoring period was chosen for the analysis.

- **Capital Costs**: The probable capital cost to construct and implement Alternative 5 is approximately $1,458,000.

- **O&M Costs**: The probable annual operations, monitoring, and maintenance cost for this alternative is $27,500. The final year's operations, monitoring, and maintenance cost for this alternative is $42,800.

- **Present Worth Cost**: Over a five year monitoring period, the probable net present worth for this alternative is approximately $1,589,000. This was calculated using a 5% annual discount rate.

6.2 Comparative Analysis

6.2.1 Overview

The RAOs for the site are concerned with the prevention of contact with contaminated soil, groundwater, and soil vapor and the remediation of the affected media to pre-release conditions, Commercial SCOs or the Unrestricted Use SCOs, and NYSDEC Class GA Standards for soil and groundwater, to the extent practicable. The alternatives presented for the site provide varying levels of remedial actions.

Alternative 1, the No Further Action alternative, defines the minimum steps to be taken for remediation of the site. This alternative alone, will not meet the RAOs over the long-term. Alternative 2, the Institutional Controls plus Continued SVE/SSDS Operation and Long-Term Monitoring alternative would include deed restrictions, activity/use limitations for groundwater, groundwater monitoring to document plume distribution over time, and indoor air sampling and SSDS monitoring to ensure effective mitigation of vapor intrusion. Alternative 2 may meet the RAOs over the long term through natural attenuation and volatilization from continued SVE. Alternative 3, Groundwater Source Treatment via In-Situ Reductive Dechlorination plus Continued SVE/SSDS IRM Operation and Long-Term Monitoring, includes active groundwater remediation and would likely meet the RAOs over the long-term. Alternative 4, Groundwater Source Treatment via In-Situ Chemical Oxidation plus Continued SVE/SSDS IRM Operation and Long-Term Monitoring, includes active groundwater remediation, like Alternative 3 and would likely meet the RAOs over the long-term. Alternative 5, Excavation to Unrestricted Use SCOs plus Plume-wide Groundwater Treatment via In-Situ Chemical Oxidation and Continued SVE/SSDS IRM Operation, is considered to be the alternative most effective for returning the site to pre-release conditions.

6.2.2 Overall Protection of Public Health

Alternative 1 would not be protective of human health and the environment. CVOCs would remain in soil, groundwater, soil vapor, and indoor air, while active mitigation of indoor air, the only completed exposure pathway, would be discontinued.

Alternative 2 provides more protection than Alternative 1 in that property and groundwater use would be restricted, indoor air exposure would continue to be mitigated, and the exposure pathways would be monitored over time. Residual groundwater contamination would be addressed over time by monitored natural attenuation.

Alternatives 3, 4, and 5 provide more protection than Alternative 2 in that direct contact with residual soil and groundwater contamination would be eliminated through active groundwater treatment and/or excavation.

6.2.3 Compliance with SCGs

Alternatives 1 will likely not meet the SCGs over time. Alternative 2 will meet the SCGs with time. Alternatives 3, 4, and 5 are capable of meeting SCGs in less time.

6.2.4 Long-Term Effectiveness and Permanence

Alternative 1 will likely not be effective in the long term. Alternatives 2 may be effective in the long-term. Alternatives 3, 4, and 5 would be effective in the long-term.

6.2.5 Reduction of Toxicity, Mobility, and Volume with Treatment

Alternatives 1 and 2 would not reduce the toxicity or mobility of the contaminants. Alternative 1 may reduce the contaminant volume over time. Alternative 2 would reduce the contaminant volume over time. Alternatives 3, 4, and 5 would reduce the toxicity and volume of the contaminants, but would not reduce their mobility.

6.2.6 Short-Term Impact and Effectiveness

The ranking of each of the alternatives, in order of short-term impact and effectiveness (from least to greatest) is shown below.

1. Alternative 2 – Institutional Controls + Continued SVE/SSDS IRM Operation + Long-Term Monitoring.

2. Alternative 1 – No Further Action.

3. Alternative 4 – Groundwater Source Treatment via In-Situ Chemical Oxidation + Continued SVE/SSDS IRM Operation + Long-Term Monitoring.

4. Alternative 3 - Groundwater Source Treatment via In-Situ Reductive Dechlorination + Continued SVE/SSDS IRM Operation + Long-Term Monitoring.

5. Alternative 5 – Excavation to Unrestricted Use SCOs + Plume-wide Groundwater Treatment via In-Situ Chemical Oxidation + Continued SVE/SSDS IRM Operation.

6.2.7 Implementability

Each of the alternatives could be readily implemented using regionally available resources.

6.2.8 Cost

A comparison of the costs for each alternative is provided in Table 6. The ranking of each of the alternatives, in order of the cost (from lowest to highest) required to meet the RAOs is shown below.

1. Alternative 1 – No Further Action
2. Alternative 2 – Institutional Controls + Continued SVE/SSDS IRM Operation + Long-Term Monitoring
3. Alternative 3 – Groundwater Source Treatment via In-Situ Reductive Dechlorination + Continued SVE/SSDS IRM Operation + Long-Term Monitoring
4. Alternative 4 – Groundwater Source Treatment via In-Situ Chemical Oxidation + Continued SVE/SSDS IRM Operation + Long-Term Monitoring
5. Alternative 5 – Excavation to Unrestricted Use SCOs + Plume-wide Groundwater Treatment via In-Situ Chemical Oxidation + Continued SVE/SSDS IRM Operation

7 References

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ARCADIS

Figures

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
GREENER CLEANERS, 809 STATE STREET
SCHENECTADY, NEW YORK (SITE # 447041)

FOCUSED FEASIBILITY STUDY

SITE LOCATION

ARCADIS
Infrastructure · Water · Environment · Buildings

FIGURE 1

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: TR:
Project (Project #)
C:\Users\bagnato\Desktop\Greener Cleaners\Greener Cleaners Site Location.mxd - 12/17/2012 @ 9:07:39 AM

Source: Schenectady County 2011 Orthoimagery, NYS GIS Clearinghouse.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

GREENER CLEANERS 809 STATE STREET
SCHENECTADY, NEW YORK (SITE # 447041)

FOCUSED FEASIBILITY STUDY

AERIAL PHOTOGRAPH

ARCADIS
Infrastructure · Water · Environment · Buildings

FIGURE 2

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: TR:
Project (Project #)
G:\GIS\MXD\00266413.0000\Greener Cleaners.mxd - 6/25/2013 @ 8:52:10 AM

NOTE: Soil CVOC concentrations given in µg/kg.
E = Analyte concentration exceeded calibration range.

- Concentration exceeds corresponding 6 NYCRR Part 375 Commercial Soil Cleanup Objective.
- Concentration exceeds corresponding 6 NYCRR Part 375 Residential Soil Cleanup Objective.
- Concentration exceeds corresponding 6 NYCRR Part 375 Unrestricted Use Soil Cleanup Objective.

SB-12 (MW-8) (2-4')	8/13/2009
Compound	
PCE	69

SB-21 (10-11')	10/10/2013
Compound	
PCE	15

SB-25 (10-11')	10/10/2013
Compound	
PCE	12

SS-M (0-2')	9/15/2010
Compound	
PCE	25,000

SB-24 (10-12')	10/10/2013
Compound	
PCE	5.2

SB-19 (10-12')	10/10/2013
Compound	
PCE	2.2

SB-20 (9-11')	10/10/2013
Compound	
PCE	11

SB-11 (MW-6) (2-4')	8/13/2009
Compound	
PCE	17

SS-N (0-2')	9/15/2010
Compound	
PCE	18

SB-14 (18-20')	10/10/2013
Compound	
PCE	2.5

SB-9 (MW-4) (10-12')	8/13/2009
Compound	
PCE	23

SB-15 (16-18')	10/10/2013
Compound	
PCE	11

SB-4 (17-19')	4/20/2009
Compound	
PCE	11

SB-23 (11-12')	10/10/2013
Compound	
PCE	20

SB-17 (10-12')	10/10/2013
Compound	
PCE	3.3

SB-18 (10-12')	10/10/2013
Compound	
PCE	17

SS-1109 (0-2')	8/15/2011
Compound	
PCE	15

SB-22 (11-12')	10/10/2013
Compound	
PCE	5

SB-10 (MW-5) (4-6')	8/13/2009
Compound	
PCE	210 E

MW-2 (SB-3)
SS-H
MW-8
SS-K
SB-25
SS-1107
SS-1106
SB-21
MW-14
MW-7
SB-16
SB-24
MW-6
SS-M
MW-13
SB-20
SS-N
MW-4
SB-19
SS-1108
SS-1109
SB-14
SB-15
SB-4
SB-2
SB-23
SB-18
SB-17
MW-5
SB-22

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

0 5 10 20 30 40 Feet

Legend

- Groundwater Monitoring Wells
- Buried Sewer (Approx.)
- Catch Basins/Manholes
- Cleanouts

N

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GREENER CLEANERS
SCHENECTADY, NEW YORK
FOCUSED FEASIBILITY STUDY

SUMMARY OF CVOCs IN SOIL

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FIGURE 3

G:\GIS\MXD\D0026413.0000\Greener Cleaners Air Sampling.mxd

NOTE: Groundwater CVOC concentrations for detected compounds given in µg/L.
ND = Not detected.

= Concentration exceeds corresponding NYSDEC Class GA Standard.

MW-11 (SB-A) Compound	10/21/2010	7/14/2011	9/26/2013	5/6/2014	7/16/2015
PCE	ND	ND	DRY	8.7	DRY

MW-10 (SB-C) Compound	10/21/2010	7/14/2011	9/26/2013	5/7/2014	7/16/2015
CVOCs	ND	ND	ND	ND	ND

MW-15 Compound	2/12/2014	5/7/2014	7/16/2015
CVOCs	ND	ND	ND

MW-2 (SB-3) Compound	8/20/2009	10/21/2010	7/14/2011	9/25/2013	5/7/2014	7/16/2015
PCE	ND	ND	ND	ND	0.16	0.19

MW-6 Compound	8/20/2009	10/21/2010	9/26/2013	5/8/2014	7/17/2015
PCE	120	100	32	47	50
TCE	ND	ND	ND	0.26	0.87

MW-12 Compound	2/12/2014	5/6/2014	7/16/2015
CVOCs	ND	ND	ND

MW-8 Compound	8/20/2009	10/21/2010	7/14/2011	9/26/2013	5/8/2014	7/16/2015
PCE	16	19	24	DRY	DRY	DRY

MW-4 Compound	8/20/2009	10/21/2010	7/14/2011	9/26/2013	5/7/2014	7/17/2015
PCE	47	520	290	35	52	15

MW-1105 Compound	7/14/2011	9/26/2013	5/6/2014	7/16/2015
CVOCs	ND	ND	ND	ND

MW-14 Compound	2/12/2014	5/8/2014	7/16/2015
PCE	ND	0.18	ND

MW-13 Compound	2/12/2014	5/7/2014	7/17/2015
PCE	ND	ND	0.89

MW-7 Compound	8/20/2009	10/21/2010	7/14/2011	9/26/2013	5/8/2014	7/16/2015
PCE	350	250	2,500	480	120	210
TCE	ND	ND	ND	ND	ND	0.74

MW-5 Compound	8/20/2009	10/21/2010	7/14/2011	9/26/2013	5/8/2014	7/17/2015
PCE	17	250	170	150	230	57
TCE	ND	ND	ND	ND	ND	0.67

MW-9 (SB-E) Compound	10/21/2010	7/14/2011	9/26/2013	5/6/2014	7/16/2015
CVOCs	ND	ND	ND	ND	ND

MW-1 (SB-1) Compound	8/20/2009	10/21/2010	7/14/2011	9/26/2013	5/7/2014	7/16/2015
PCE	ND	ND	ND	ND	0.3	ND

MW-3 (SB-5) Compound	8/20/2009	10/21/2010	7/14/2011	9/26/2013	5/7/2014	7/16/2015
PCE	ND	ND	12	DRY	3	DRY

0 25 50 100 150 200 Feet

Legend

- Groundwater Monitoring Wells
- Buried Sewer (Approx.)
- Catch Basins/Manholes
- Cleanouts

N

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SCHENECTADY, NEW YORK
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SUMMARY OF CVOCs IN GROUNDWATER

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FIGURE 4

G:\GIS\MOD\00286413.0000\Greener Cleaners Air Sampling.mxd

NOTE: Soil vapor CVOC concentrations given in µg/m^3.
ND = Not detected.
E = Analyte concentration exceeded calibration range.

SV-B		
Compound	7/14/11	11/14/13
PCE	3.4	58

SV-1103		
Compound	7/14/11	11/14/13
PCE	7.4	2.9

SV-G			
Compound	10/21/10	7/14/11	11/14/13
PCE	1,146	900	430

SV-D		
Compound	7/14/11	11/14/13
PCE	3.5	2.1

SV-H			
Compound	10/21/10	7/14/11	11/14/13
PCE	4,096	5,600	2,700
TCE	ND	ND	5.5

SV-J			
Compound	10/21/10		11/14/13
		Dup	
PCE	7.66	12,410	14,000
TCE	ND	ND	5.5

Ambient Air	
Compound	11/14/13
PCE	ND

SV-1102	
Compound	7/14/2011
PCE	5.7

SV-1104	
Compound	7/14/2011
PCE	720

SV-1				
Compound	5/6/09	10/21/10	7/14/11	11/14/13
PCE	840,867 E	144,439	2,400,000	72,000
TCE	ND	ND	ND	490
cis-1,2-DCE	ND	ND	ND	11

SV-F			
Compound	10/21/10	7/14/11	11/14/13
PCE	120	84	73

SV-L			
Compound	7/14/11		11/14/13
		Dup	
PCE	500,000	500,000	110,000
TCE	ND	ND	4,300
cis-1,2-DCE	ND	ND	570
trans-1,2-DCE	ND	ND	7.2

SV-P		
Compound	7/14/11	11/14/13
PCE	2,100	900
TCE	ND	1.6

SV-2				
Compound	5/6/09	10/21/10	7/14/11	11/14/13
PCE	82.73	228	170	120

SV-1101		
Compound	7/14/11	11/14/13
PCE	32	36

Ambient Air			
Compound	5/6/2009	10/21/2010	7/14/2011
PCE	34.24	1.97	ND

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Legend

- Soil Vapor Point
- Groundwater Monitoring Wells
- Buried Sewer (Approx.)
- Catch Basins/Manholes
- Cleanouts

0 30 60 120 180 240 Feet

N

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SUMMARY OF CVOCs IN SOIL VAPOR

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FIGURE
5

G:\GIS\MOD\00266413.0000\Greener Cleaners Air Sampling.mxd

NOTE: Soil vapor CVOC concentrations given in µg/m³.
ND = Not detected.
J = Estimated
Yellow highlighting denotes locations requiring mitigation based on NYSDOH requirements.
Orange highlighting denotes potential mitigation based on NYSDOH requirements.

Ambient Air	11/21/14
Compound	
No Detections	

IA-07	11/21/14
Compound	
PCE	4

SS-07	11/21/14	Dup
Compound		
PCE	300 J-	550 J
TCE	17 J-	35 J
trans-1,2-DCE	0.4 J-	ND

310 Victory	Basement Air	Ambient Air
Compound	12/20/13	12/20/13
Carbon Tetrachloride	0.44	0.44
PCE	0.24	0.27
1,1,1-TCA	0.26	ND

IA-06	11/21/14
Compound	
PCE	13
TCE	9.2

SS-03	11/21/14
Compound	
PCE	2,900
TCE	4.2

13 Chestnut	Basement Air	Ambient Air
Compound	12/19/13	12/19/13
Carbon Tetrachloride	0.40	0.45

SS-06	11/21/14
Compound	
PCE	6,200
TCE	140

SS-02	11/21/14
Compound	
PCE	59,000
TCE	56

IA-04	11/21/14
Compound	
PCE	9.9
TCE	1.9

SS-04	11/21/14
Compound	
PCE	80,000
TCE	55

IA-01-02-03	11/21/14
Compound	
PCE	15
TCE	4.4

SS-01	11/21/14
Compound	
PCE	14,000
TCE	15

IA-08	11/21/14
Compound	
PCE	4
TCE	0.78

IA-05	11/21/14
Compound	
PCE	8
TCE	1.7

SS-05	11/21/14
Compound	
PCE	350
TCE	3

GC-AMBIENT AIR
GC-IA-07
GC-SS-07
GC-DUP-01
GC-SS-03
GC-IA-06
GC-SS-06
GC-IA-01-02-03
GC-SS-02
GC-SS-01
GC-IA-04
GC-SS-04
GC-IA-08
GC-IA-05
GC-SS-05
310 Victory Ave.
13 Chestnut St.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

0 25 50 100 150 200 Feet

Legend

- Ambient Air Sample
- Indoor Air Sample Location
- Sub-Slab Sample Location
- Residential Air Sampling

N

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GREENER CLEANERS
SCHENECTADY, NEW YORK
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SUMMARY OF CVOCs IN AIR

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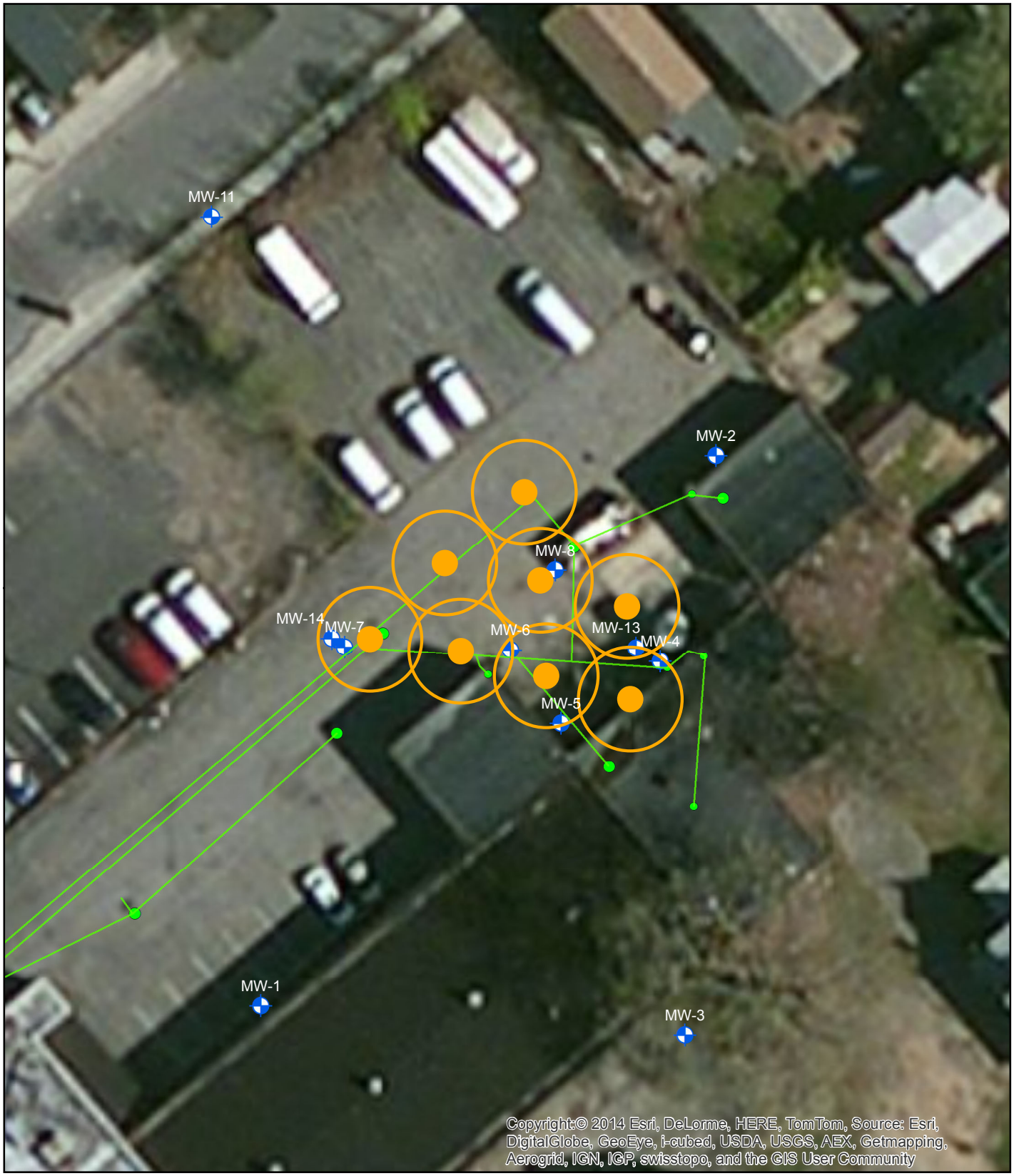
FIGURE 6

G:\GIS\MXD\00026413.0000\Greener Cleaners Air Sampling.mxd



0 10 20 40 60 80 Feet

N

Legend

- Groundwater Monitoring Wells
- In Situ Reductive Dechlorination Injection Point
- Buried Sewer (Approx.)
- Catch Basins/Manholes
- Cleanouts

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FORMER GREENER CLEANERS SITE, SCHENECTADY, NEW YORK

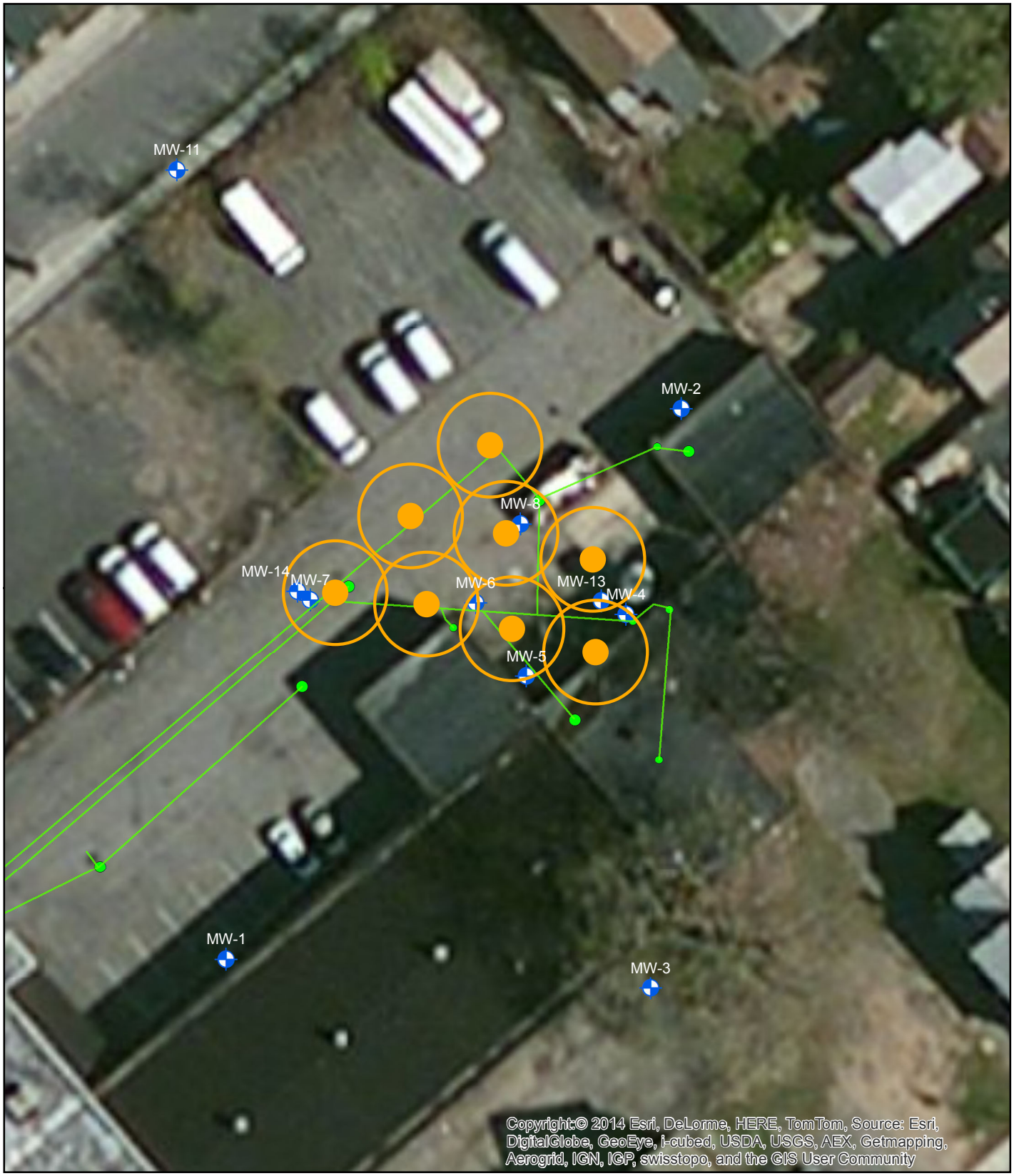
FOCUSED FEASIBILITY STUDY

ALTERNATIVE 3
Groundwater Source Treatment via In-Situ Reductive Dechlorination

ARCADIS

FIGURE
7

Path: G:\GISMOD\00266413.0000\FFS Alternative 3.mxd Date Saved: 3/16/2016 1:56:25 PM



0 10 20 40 60 80 Feet

N

Legend

- Groundwater Monitoring Wells
- ISCO Injection Point
- Buried Sewer (Approx.)
- Catch Basins/Manholes
- Cleanouts

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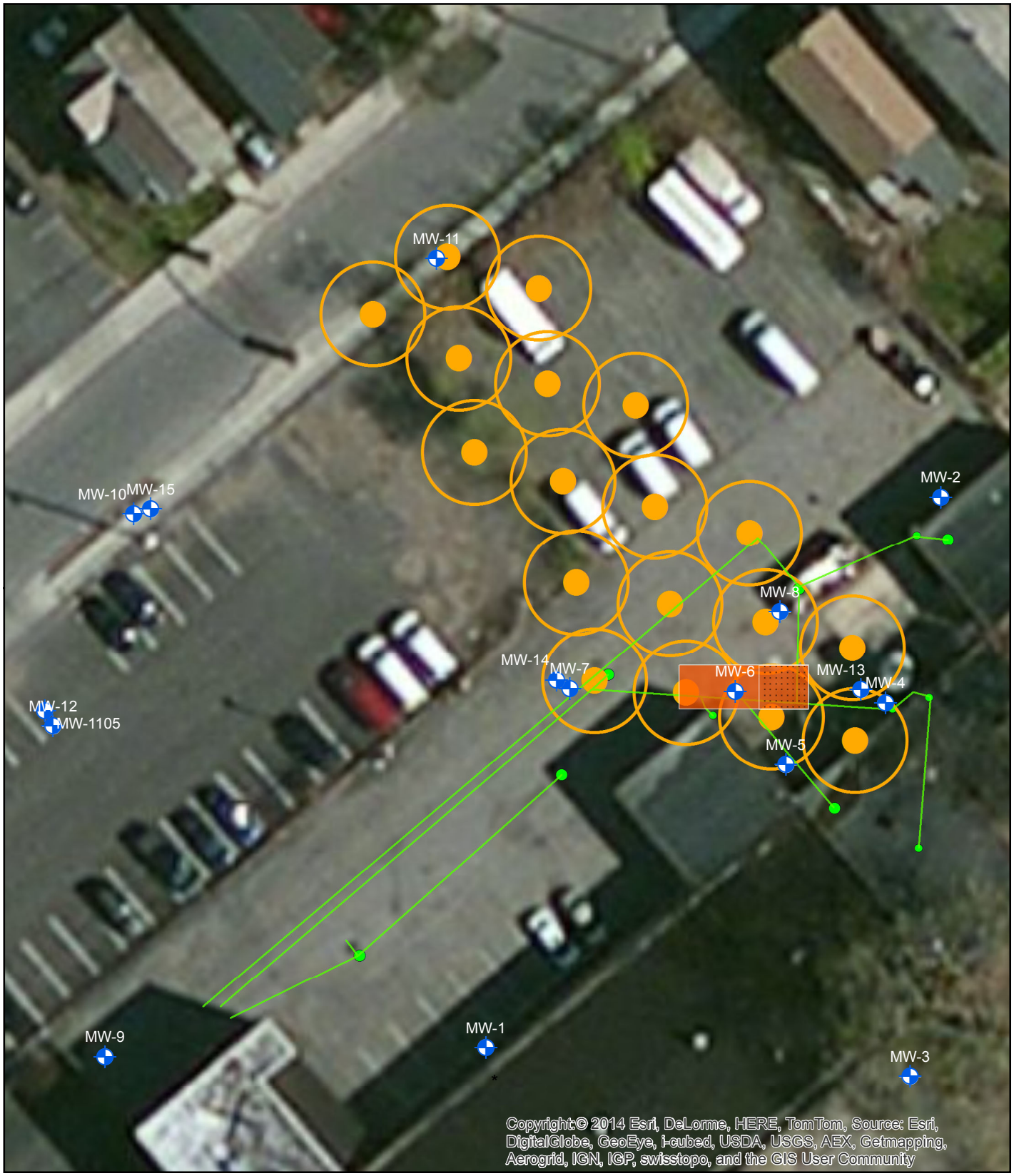
ALTERNATIVE 4
Groundwater Source Treatment via In-Situ Chemical Oxidation

ARCADIS

FIGURE
8

Path: G:\GIS\MOD\00266413.0000\FFS Alternative 4.mxd Date Saved: 3/16/2016 1:57:44 PM



0 10 20 40 60 80 Feet

N

Legend

- Excavation Area*
- Groundwater Monitoring Wells
- ISCO Injection Point
- Buried Sewer (Approx.)
- Catch Basins/Manholes
- Cleanouts

* Top 2 feet of dotted area will be disposed of as F-listed waste. Remaining excavation will be disposed of as non-hazardous waste.

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FOCUSED FEASIBILITY STUDY

ALTERNATIVE 5
Excavation to Unrestricted Use SCOs and Groundwater Treatment via In-Situ Chemical Oxidation

ARCADIS

FIGURE
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Tables

TABLE 1
Remedial Alternative Cost Summary

Alternative 1

NO FURTHER ACTION

OPINION OF PROBABLE COST

Site:	Former Greener Cleaners Site
Location:	Schenectady, New York
Phase:	Alternatives Analysis (-30% to +50%)
Base Year:	2016
Date:	June 2016

Description: Alternative 1 consists of removal of the SVE/SSDS IRM system and abandoning of all site wells and vapor points. Capital costs are incurred in Year 1. There are no O&M costs.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Removal of SVE/SSDS IRM System	1	lump sum	$25,000	$25,000	
Well and Vapor Point Abandoning					
Abandonment of Monitoring and Extraction Wells	20	EA	$700	$14,000	
Abandonment of Soil Vapor/Vacuum Monitoring Points	19	EA	$200	$3,800	
SUBTOTAL				$42,800	
Contingency	30%			$12,840	
SUBTOTAL				$55,640	
Project Management	10%			$5,564	
Remedial Oversight/Reporting	15%			$8,346	
TOTAL CAPITAL COST				**$69,600**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$69,600	$69,600	1.00	$69,600	
		$69,600			$69,600	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$70,000**	

TABLE 2
Remedial Alternative Cost Summary

Alternative 2
INSTITUTIONAL CONTROLS + CONTINUED SVE/SSDS IRM OPERATION + LONG TERM MONITORING

OPINION OF PROBABLE COST

Site: Former Greener Cleaners Site
Location: Schenectady, New York
Phase: Alternatives Analysis (-30% to +50%)
Base Year: 2016
Date: June 2016

Description: Alternative 2 consists of institutional controls, continued SVE/SSDS operation, and long-term monitoring of the existing well network. Capital costs are incurred in Year 1. O&M costs are incurred in Years 1-30.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	lump sum	$25,000	$25,000	
Site Management Plan	1	lump sum	$15,000	$15,000	
SUBTOTAL				$40,000	
Contingency	30%			$12,000	
SUBTOTAL				$52,000	
Project Management	10%			$5,200	
Remedial Oversight/Reporting	15%			$7,800	
TOTAL CAPITAL COST				**$65,000**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COST:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
SVE/SSDS O&M					
Monthly SVE/SSDS Checks	1	YR	$6,500	$6,500	
Utilities, Replacement Equip., GAC Change Outs	1	YR	$7,500	$7,500	
Performance Monitoring Sampling & Analysis	1	YR	$1,000	$1,000	Semi-annual effluent sampling
SUBTOTAL				$15,000	
TOTAL ANNUAL O&M COST				**$15,000**	
Site Monitoring - First 2 Years					
Groundwater Sampling & Analysis	1	YR	$7,500	$7,500	Annual sampling - 16 wells
Data Evaluation and Reporting	1	YR	$5,000	$5,000	
SUBTOTAL				$12,500	
TOTAL ANNUAL O&M COST - FIRST 2 YEARS				**$12,500**	
Site Monitoring - Years 7 - 27					
Groundwater Sampling & Analysis	1	YR	$7,500	$7,500	Pent-annual sampling - 16 wells
Data Evaluation and Reporting	1	YR	$5,000	$5,000	
SUBTOTAL				$12,500	
TOTAL EVERY 5 YR. O&M COST - YEARS 7 - 27				**$12,500**	
Removal of SVE/SSDS IRM System	1	lump sum	$25,000	$25,000	
Well and Vapor Point Abandoning					
Abandonment of Monitoring and Extraction Wells	20	EA	$700	$14,000	16 MW, 4 EW
Abandonment of Soil Vapor/Vacuum Monitoring Points	19	EA	$200	$3,800	14 SV, 5 VMP
TOTAL CLOSEOUT COST - YEAR 30				**$42,800**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$92,500	$92,500	1.00	$92,500	Capital + 1st Year O&M Costs
Annual OM&M	2	$27,500	$27,500	0.95	$26,190	SVE/SSDS + GW sampling
Annual OM&M	3-30	$420,000	$15,000	14.90	$223,472	SVE/SSDS
Annual OM&M	7-27	$62,500	$12,500	0.27	$3,348	GW sampling every 5 yrs
Annual OM&M	30	$42,800	$42,800	0.23	$9,903	Close out
		$602,500			$355,413	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$355,000**	

TABLE 3
Remedial Alternative Cost Summary

Alternative 3
GROUNDWATER SOURCE TREATMENT VIA IN SITU REDUCTIVE DECHLORINATION + CONTINUED SVE/SSDS IRM OPERATION + LONG-TERM MONITORING

OPINION OF PROBABLE COST

Site: Former Greener Cleaners Site
Location: Schenectady, New York
Phase: Alternatives Analysis (-30% to +50%)
Base Year: 2016
Date: June 2016

Description: Alternative 3 consists of source area in-situ reductive dechlorination using sodium lactate, bioaugmentation culture, and emulsified vegetable oil, continued SVE/SSDS IRM operation, and long-term monitoring of the existing well network. Capital costs are incurred in Year 1. O&M costs occur in Years 1-10.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	lump sum	$25,000	$25,000	
Site Management Plan	1	lump sum	$15,000	$15,000	
SUBTOTAL				$40,000	
ISRD System					
Pilot Testing	1	LS	$15,000	$15,000	
Injection Wells	8	EA	$1,500	$12,000	2" PVC v-wire to 30', 12.5' ROI
Transportation & Disposal of Drill Cuttings	1	ROLL-OFF	$5,000	$5,000	Assumes disposal as F-listed waste
Wellhead Assembly	8	EA	$450	$3,600	
Misc valves and fittings	1	LS	$5,000	$5,000	
Distribution Hose (1-inch), with cam-lock fittings	800	Linear Feet	$5	$4,000	
Plume Area ISRD Injection (incl. substrate, site personnel, performance monitoring)	1	EA	$96,000	$96,000	
SUBTOTAL				$140,600	
SUBTOTAL				$180,600	
Contingency	30%			$54,180	
SUBTOTAL				$234,780	
Design	15%			$35,217	
Project Management	8%			$18,782	
Remedial Oversight/Reporting	10%			$23,478	
TOTAL CAPITAL COST				**$312,257**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
SVE/SSDS O&M					
Monthly SVE/SSDS Checks	1	YR	$6,500	$6,500	
Utilities, Replacement Equip., GAC Change Outs	1	YR	$7,500	$7,500	
Performance Monitoring Sampling & Analysis	1	YR	$1,000	$1,000	Semi-annual effluent sampling
SUBTOTAL				$15,000	
Site Monitoring					
Groundwater Sampling & Analysis	1	YR	$7,500	$7,500	Annual sampling - 16 wells
Data Evaluation and Reporting	1	YR	$5,000	$5,000	
SUBTOTAL				$12,500	
TOTAL ANNUAL O&M COST				**$27,500**	
Removal of SVE/SSDS IRM System	1	lump sum	$25,000	$25,000	
Well and Vapor Point Abandoning					
Abandonment of Monitoring and Extraction Wells	20	EA	$700	$14,000	16 MW, 4 EW
Abandonment of Soil Vapor/Vacuum Monitoring Points	19	EA	$200	$3,800	14 SV, 5 VMP
TOTAL CLOSEOUT COST - YEAR 10				**$42,800**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$339,757	$339,757	1.00	$339,757	Capital + 1st Year O&M Costs
Annual OM&M	2-10	$247,500	$27,500	7.11	$195,465	
Annual OM&M	10	$42,800	$42,800	0.61	$26,275	Close out
		$630,057			$561,498	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$561,000**	

TABLE 4
Remedial Alternative Cost Summary

Alternative 4
GROUNDWATER SOURCE TREATMENT VIA IN-SITU CHEM OX + CONTINUED SVE/SSDS IRM OPERATION + LONG-TERM MONITORING

OPINION OF PROBABLE COST

Site: Former Greener Cleaners Site
Location: Schenectady, New York
Phase: Alternatives Analysis (-30% to +50%)
Base Year: 2016
Date: June 2016

Description: Alternative 4 consists of source area in-situ chemical oxidation using sodium permanganate, continued SVE/SSDS IRM operation, and long-term monitoring of the existing well network. Capital costs are incurred in Year 1. O&M costs occur in Years 1-5.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	lump sum	$25,000	$25,000	
Site Management Plan	1	lump sum	$15,000	$15,000	
SUBTOTAL				$40,000	
ISCO System					
Pilot Testing	1	LS	$15,000	$15,000	
Injection Wells	8	EA	$1,500	$12,000	2" PVC v-wire to 30', 12.5' ROI
Transportation & Disposal of Drill Cuttings	1	ROLL-OFF	$5,000	$5,000	Assumes disposal as F-listed waste
Wellhead Assembly	8	EA	$450	$3,600	
Misc valves and fittings	1	LS	$5,000	$5,000	
Distribution Hose (1-inch), with cam-lock fittings	800	Linear Feet	$5	$4,000	
Plume Area ChemOx Injection (incl. chemicals, site personnel, performance monitoring)	2	EA	$190,000	$380,000	
SUBTOTAL				$424,600	
SUBTOTAL				$464,600	
Contingency	30%			$139,380	
SUBTOTAL				$603,980	
Design	12%			$72,477.60	
Project Management	6%			$36,238.80	
Remedial Oversight/Reporting	8%			$48,318.40	
TOTAL CAPITAL COST				**$761,015**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
SVE/SSDS O&M					
Monthly SVE/SSDS Checks	1	YR	$6,500	$6,500	
Utilities, Replacement Equip., GAC Change Outs	1	YR	$7,500	$7,500	
Performance Monitoring Sampling & Analysis	1	YR	$1,000	$1,000	Semi-annual effluent sampling
SUBTOTAL				$15,000	
Site Monitoring					
Groundwater Sampling & Analysis	1	YR	$7,500	$7,500	Annual sampling - 16 wells
Data Evaluation and Reporting	1	YR	$5,000	$5,000	
SUBTOTAL				$12,500	
TOTAL ANNUAL O&M COST				**$27,500**	
Removal of SVE/SSDS IRM System	1	lump sum	$25,000	$25,000	
Well and Vapor Point Abandoning					
Abandonment of Monitoring and Extraction Wells	20	EA	$700	$14,000	16 MW, 4 EW
Abandonment of Soil Vapor/Vacuum Monitoring Points	19	EA	$200	$3,800	14 SV, 5 VMP
TOTAL CLOSEOUT COST - YEAR 5				**$42,800**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$788,515	$788,515	1.00	$788,515	Capital + 1st Year O&M Costs
Annual OM&M	2-5	$110,000	$27,500	3.55	$97,514	
Annual OM&M	5	$42,800	$42,800	0.78	$33,535	Close out
		$941,315			$919,563	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$920,000**	

TABLE 5
Remedial Alternative Cost Summary

Alternative 5
EXCAVATION TO UNRESTRICTED USE SCOs + PLUME-WIDE GROUNDWATER TREATMENT VIA IN-SITU CHEM OX + CONTINUED SVE/SSDS IRM OPERATION

OPINION OF PROBABLE COST

Site: Former Greener Cleaners Site
Location: Schenectady, New York
Phase: Alternatives Analysis (-30% to +50%)
Base Year: 2016
Date: June 2016

Description: Alternative 5 consists of soil excavation to Unrestricted SCOs, plume-wide groundwater treatment via in-situ chemical oxidation using sodium permanganate, and continued SVE/SSDS IRM operation. Capital costs are incurred in Year 1. O&M costs occur in Years 1-5.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Excavation of F-Listed Hazardous Soil					
Mobilization, Site Prep, & Staging	1	lump sum	$20,000	$20,000	
Furnish & Install Sheeting to Protect Building	2,000	SF	$40	$80,000	
Sewer Relocation	1	lump sum	$25,000	$25,000	
Excavation, Stockpiling, and/or Loading of Soil and/or Debris	185	CY	$30	$5,550	Approx. 35'x12'x12' excav
Confirmation Sampling	5	EA	$150	$750	
Transportation & Disposal (non-haz)	300	Tons	$35	$10,500	
Transportation & Disposal (haz)	15	Tons	$440	$6,600	Assumes disposal of PCE-impacted zone as F-Listed waste
SUBTOTAL				$148,400	
Backfill & Site Restoration					
Backfill Placement (incl. Load and Haul)	185	CY	$30	$5,550	
Backfill & Compaction	185	CY	$10	$1,850	
Well Replacement	1	EA	$2,000	$2,000	MW-6
SUBTOTAL				$9,400	
ISCO System					
Pilot Testing	1	LS	$15,000	$15,000	
Injection Wells	18	EA	$1,500	$27,000	2" PVC v-wire to 30', 12.5' ROI
Transportation & Disposal of Drill Cuttings	2	ROLL-OFF	$5,000	$10,000	Assumes disposal as F-listed waste
Wellhead Assembly	18	EA	$450	$8,100	
Misc valves and fittings	1	LS	$7,500	$7,500	
Distribution Hose (1-inch), with cam-lock fittings	1,600	Linear Feet	$5	$8,000	
Plume Area ChemOx Injection (incl. chemicals, site personnel, performance monitoring)	2	EA	$320,000	$640,000	
SUBTOTAL				$715,600	
SUBTOTAL				$873,400	
Contingency	30%			$262,020	
SUBTOTAL				$1,135,420	
Design	12%			$136,250.40	
Project Management	6%			$68,125.20	
Remedial Oversight/Reporting	8%			$90,833.60	
TOTAL CAPITAL COST				**$1,430,629**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Site Monitoring					
Monthly SVE/SSDS Checks	1	YR	$6,500	$6,500	
Utilities, Replacement Equip., GAC Change Outs	1	YR	$7,500	$7,500	
Performance Monitoring Sampling & Analysis	1	YR	$1,000	$1,000	Semi-annual effluent sampling
SUBTOTAL				$15,000	
Site Monitoring					
Groundwater Sampling & Analysis	1	YR	$7,500	$7,500	Annual sampling - 16 wells
Data Evaluation and Reporting	1	YR	$5,000	$5,000	
SUBTOTAL				$12,500	
TOTAL ANNUAL O&M COST				**$27,500**	
Removal of SVE/SSDS IRM System	1	lump sum	$25,000	$25,000	
Well and Vapor Point Abandoning					
Abandonment of Monitoring and Extraction Wells	20	EA	$700	$14,000	16 MW, 4 EW
Abandonment of Soil Vapor/Vacuum Monitoring Points	19	EA	$200	$3,800	14 SV, 5 VMP
TOTAL CLOSEOUT COST - YEAR 5				**$42,800**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$1,458,129	$1,458,129	1.00	$1,458,129	Capital + 1st Year O&M Costs
Annual OM&M	2-5	$110,000	$27,500	3.55	$97,514	
Annual OM&M	5	$42,800	$42,800	0.78	$33,535	Close out
		$1,610,929			$1,589,178	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$1,589,000**	

Table 6

Remedial Alternative Cost Summary

OPINION OF PROBABLE COST SUMMARY

Site: Former Greener Cleaners Site
Location: Schenectady, New York
Phase: Alternatives Analysis (-30% to +50%)
Base Year: 2016
Date: June 2016

Alternative	Description	Capital Costs and 1st Year O&M	2nd Year O&M Costs	Annual O&M Costs	Every 5 Yr O&M Costs	Close Out O&M Costs	Assumed Remediation Time (years)	Total Present Value
Alternative 1	NO FURTHER ACTION	$69,600	NA	NA	NA	NA	NA	$70,000
Alternative 2	INSTITUTIONAL CONTROLS + CONTINUED SVE/SSDS IRM OPERATION + LONG TERM MONITORING	$92,500	$27,500	$15,000	$12,500	$42,800	30	$355,000
Alternative 3	GROUNDWATER SOURCE TREATMENT VIA IN SITU REDUCTIVE DECHLORINATION + CONTINUED SVE/SSDS IRM OPERATION + LONG-TERM MONITORING	$339,757	NA	$27,500	NA	$42,800	10	$561,000
Alternative 4	GROUNDWATER SOURCE TREATMENT VIA IN-SITU CHEM OX + CONTINUED SVE/SSDS IRM OPERATION + LONG-TERM MONITORING	$788,515	NA	$27,500	NA	$42,800	5	$920,000
Alternative 5	EXCAVATION TO UNRESTRICTED USE SCOs + PLUME-WIDE GROUNDWATER TREATMENT VIA IN-SITU CHEM OX + CONTINUED SVE/SSDS IRM OPERATION	$1,458,129	NA	$27,500	NA	$42,800	5	$1,589,000