Environmental
Resources
Management

520 Broadhollow Road
Suite 210
Melville, NY 11747
(212) 447-1900
(212) 447-1904 (fax)

http://www.erm.com

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VIA FEDERAL EXPRESS

Mr. Jeffrey McCullough
Project Manager
New York State Department of Environmental Conservation
625 Broadway, 12th Floor
Albany, NY 12233-7013

Subject: Remedial Investigation / Feasibility Study Report
Volume 2 of 2: Feasibility Study Report
Former Sciore's Dry Cleaners Site No. 8-49-003
Work Assignment No. D003970-15

Dear Mr. McCullough:

Enclosed is one (1) copy of the Environmental Resources Management (ERM) document entitled *Remedial Investigation / Feasibility Report – Volume 2 of 2: Feasibility Study Report* for the Former Sciore's Dry Cleaners (Site No. 8-49-003). It has been prepared as part of New York State Department of Environmental Conservation (NYSDEC) Work Assignment (No. D003970-15).

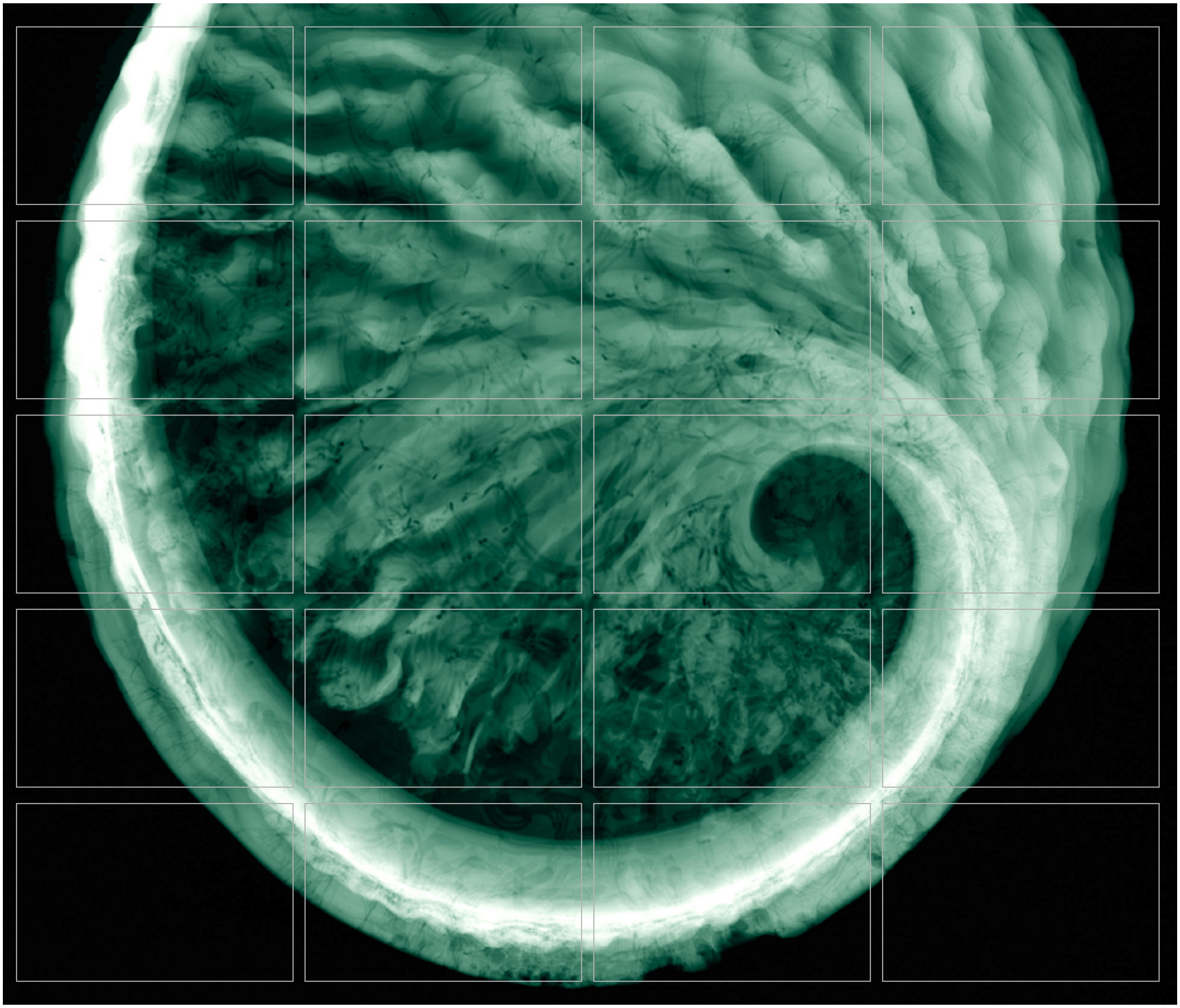
Please note that this document is the second volume of a comprehensive report for this Site. *Volume 1 of 2: Remedial Investigation Report* will be sent to you under separate cover.

If you have any questions or comments, or require additional copies of the document, please call me at 631-756-8900.

Very truly yours,

John Mohlin, P.E.
Project Manager

Cc: Harriet Eisman, Watkins Glen Public Library
Lisa Silvestri, NYSDEC Region 8 office



New York State Department of Environmental Conservation

Remedial Investigation/ Feasibility Study Report

Volume 2 of 2: Feasibility Study Report

Former Sciore's Dry Cleaners
Watkins Glen, New York

March 2006

Environmental Resources Management
520 Broad Hollow Road, Suite 210
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REMEDIAL INVESTIGATION / FEASIBILITY STUDY REPORT

Volume 2 of 2: Feasibility Study Report

Former Sciore's Dry Cleaners
Watkins Glen, New York
Site No. 8-49-003
Work Assignment No. D003970-15

March 2006

Prepared for:

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

Prepared by:

Environmental Resources Management
520 Broad Hollow Road, Suite 210
Melville, New York 11747

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6.0 *REMEDIAL GOALS AND REMEDIAL ACTION OBJECTIVES*

This section presents the remedial goals and remedial action objectives (RAOs) established for the Site media of interest (i.e., soil, groundwater, and surface water). As discussed below, consistent with Division of Environmental Remediation (DER) "*Draft Technical Guidance for Site Investigation and Remediation*, (DER-10)", dated December 2002 (New York State Department of Environmental Conservation [NYSDEC], 2002), the remedial goals for soil gas will be evaluated in the context of the RAOs for Site soil and groundwater.

Remedial goals are derived from 6 New York Code of Rules and Regulations (6NYCRR) Part 375 and NYSDEC guidance, and express the intention that, within certain limitations, remedial actions restore the Site to conditions prior to disposal. Examples of relevant remedial goals are set forth in the DER-10.

The remedial goals for this Site are therefore to:

- Restore to pre-disposal/pre-release conditions, to the extent feasible and authorized by law; and,

- Eliminate or mitigate all significant threats to the public health and the environment caused by Site-related operations through the proper application of scientific and engineering principles.

The remedial goals provide the broad framework in which RAOs can be defined for media impacted by the Site operations.

Guidance on developing RAOs is provided in NYSDEC Technical and Administrative Guidance Memorandum (TAGM) No. 4030 (NYSDEC, 1990) and examples of RAOs are also set forth in DER-10 (NYSDEC, 2002). The RAOs are media-specific targets aimed at protecting public health and the environment. In the case of protection of human health, RAOs usually reflect the concentration of a chemical of potential concern (COPC) and the potential exposure route. Protection may be achieved by reducing potential exposure (e.g., use restrictions, limiting access) as well as by reducing concentrations. RAOs, established for protection of environmental receptors, usually focus on preservation or restoration of the resource. As such, environmental RAOs are set for a media of interest and a target concentration level.

Remedial evaluation of contaminated media is based on the nature and extent of contamination and applicable or relevant and appropriate Standards, Criteria and Guidelines (SCGs). As discussed in Section 2.0 of the Remedial Investigation (RI) report, potential media of interest, identified during the RI, are soil, groundwater, and surface water. As indicated in 6 NYCRR 375-1.10(c)(1)(ii), the NYSDEC will identify SCGs. The most recent NYSDEC specified SCG list is found in draft *DER-10* (NYSDEC, 2002).

In addition to SCGs, certain Site-specific factors are considered when developing the RAOs for media of interest. These Site-specific factors relate to the impacted media, types of constituents and potential routes of exposure. The factors considered in developing RAOs for Site media are discussed in the following subsections.

6.1 IDENTIFICATION OF SCGS

SCGs include promulgated standards and non-promulgated guidance, which govern activities that may affect the environment. The standards and criteria (SCs) are those cleanup standards, standards of control and other substantive requirements, criteria or limitations that are officially promulgated under federal, state, or local law. Though guidance does not represent a legal requirement, it should be considered based on professional judgment when applicable to site conditions (NYSDEC, 2002).

Table 6-1 presents potential SCGs, which may govern remedial actions at the Site. This table lists: the citation; a description of the SCG; SCG type (i.e., chemical, action or location specific); and, reason for listing (e.g., remedy selection and/or remedial action) and how the SCG applies to the remedy evaluation.

SCGs considered in the development of RAOs for impacted Site media are discussed in remedial requirements for the media of interest in the following sections. The relevance of the SCGs to the remedial alternatives is discussed in the evaluation of each alternative presented in Section 8.0 (i.e., in the evaluation of each remedial action alternative to comply with the SCGs).

6.2 MEDIA OF INTEREST

The following impacted Site media were identified during the RI and evaluated as potentially requiring RAOs: soil; groundwater; and surface water, consistent with DER-10. Soil gas and indoor air will be discussed in the context of the soil and groundwater. This is consistent with draft DER-10. The RI sampling results for these media were discussed in Section 3.0 and the Human Health Exposure Assessment (HHEA) in Section 3.3. The RI sampling results showed that there are no dry-cleaning soil contaminants above the SCGs. Therefore, there are no remedial action requirements for soil, and soil is not carried forward as a media of interest. Similarly, there are no dry-cleaning contaminants above the SCGs in surface water. Therefore, there are no remedial actions for surface water, and surface water is not carried forward as a media of interest.

6.2.1 *Groundwater*

Groundwater at the Site is encountered at approximately 10 to 15 feet below ground surface (bgs) and generally flows to the north towards Seneca Lake (Figure 2-4). The water table is flat with a hydraulic gradient of approximately 0.0010 to 0.0014. Groundwater velocity is estimated at 12 to 68 feet per year.

During the RI, four deep vertical profile (VP) borings were installed at or near the Site to evaluate the vertical distribution of contaminants in the aquifer. Groundwater samples were collected at 10-foot intervals from 15 feet bgs to 103 feet bgs, for a total of 35 discrete sampling intervals. Four samples collected from VP-02 and VP-03 contained tetrachloroethene (PCE) above the New York State Class GA Groundwater Quality Standard (GWQS) of 5 ug/l. The samples that contained PCE were collected from the 15 feet to 18 feet and the 35 feet to 38 feet ranges. No other volatile organic compound (VOC) concentrations in the deep vertical profile borings were detected above the GWQS.

An initial round of shallow groundwater samples was also collected from the six original monitoring wells at the Site (MW-01 through MW-06). During a second groundwater sampling event, samples were collected from MW-01 through MW-06, and three new wells (MW-07 to MW-09). Four of the monitoring wells, MW-02, MW-03, MW-06, and MW-09 contained PCE above the GWQS. No other VOCs were detected in the groundwater above the Class GA GWQS in either sampling event.

6.2.1.1 *Remedial Requirements*

The remedial requirements for Site groundwater are based on the SCGs and the results of the HHEA.

6.2.1.1.1 *Standards, Criteria, and Guidelines (SCGs)*

A comparison of Site groundwater data to the Class GA standards is shown in Tables 2-3 and 2-9 and summarized in Table 3-4. Comparison to the Class GA standards indicates that the shallow and the deeper Site groundwater exceed the Class GA standards for the following chemicals at the following frequencies:

Shallow Groundwater (0-25 feet bgs)	Deeper Groundwater (25-103 feet bgs)
Tetrachloroethene (PCE) (6/13 sample locations)	PCE (2/31 sample locations)

6.2.1.1.2 Results of HHEA and Fish and Wildlife Resources Impact Analysis

Under current and future conditions, the HHEA presented in Section 3.3 concluded that the presence of VOCs in Site groundwater, which occurs at a depth of approximately 10 to 15 ft bgs, could potentially result in inhalation exposures to Site workers and residents either in indoor air (in buildings in the Site vicinity) or outdoor air. The only COPC identified in the RI for the volatilization pathway is PCE.

The average concentration of PCE in groundwater is above the NYSDEC Class GA standards, which are based on usage as drinking water. In addition, the average concentration of PCE in groundwater is also above the Class B surface water quality guidance value for fish ingestion. However, the average groundwater concentration of PCE is greater than either the Class GA standard or Class B guidance value by less than a factor of 10. Significant dilution is expected following discharge of groundwater to Seneca Lake. Therefore, this chemical is not expected to represent a significant exposure pathway via direct contact or ingestion of fish. Finally, a Fish and Wildlife Resources Impact Analysis (FWRIA) conducted during the RI concluded that there were no VOCs exceeding groundwater screening levels for ecological impacts to surface water. Thus, no adverse impacts to fish and wildlife resources have occurred or are to expected to occur on, adjacent to, or within a 0.5-mile radius of the Site.

Based on information obtained from the Watkins Glen Department of Public Works, groundwater is not currently used for drinking water or for any purposes at the Site or in the Site area. Discharge to Seneca Lake was not found to be a significant exposure pathway. Therefore, there are no receptors for impacted groundwater. The potential for exposure via volatilization from shallow groundwater to overlying indoor or outdoor air was identified as a potential complete exposure pathway.

6.2.1.2 Remedial Action Objectives for Groundwater

The following RAOs have been established for Site groundwater:

- Prevent inhalation of VOCs volatizing from contaminated groundwater.

6.2.1.3 *Extent of Impacted Groundwater*

PCE was detected in groundwater above the GWQS in one of two on-Site wells (MW-03), three off-Site wells (MW-02, MW-06, and MW-09), and in two off-site VPs (VP-02 and VP-03). The PCE plume extends to the north of the Site and its furthest extent was detected at MW-09, 580 feet downgradient of the Site at a concentration of 7.1 ug/l, which is slightly above the GWQS of 5 ug/l. The exact downgradient extent of the PCE plume has not been fully characterized.

6.3 *SUMMARY OF RAOS*

There is one RAO for Site groundwater:

- Prevent inhalation of VOCs volatizing from contaminated groundwater.

7.0 IDENTIFICATION AND EVALUATION OF REMEDIAL ACTION TECHNOLOGIES AND PRELIMINARY REMEDIAL ACTION ALTERNATIVES

This section screens a variety of remedial technologies that may be employed individually or in combination to achieve the RAOs for Site media of interest. Remedial technologies that pass the evaluation process (Section 7.1) are organized into remedial alternatives. The remedial action alternatives are then, together with a number of common actions, presented and evaluated in detail in Section 8.0.

Common actions involve technologies that would be included in all the remedial action alternatives that are evaluated in Section 8.0 with the exception of No Action. These common actions are generally presumptive remedies, and as a result, the technologies included in these common actions are excluded from the evaluation process discussed in Section 7.1. There is one common action relevant to all remedial action alternatives:

1) Sub-slab depressurization (SSD).

This technology has been proven effective and is not screened in this section. In addition, SSD is being conducted as an interim remedial measure (IRM).

The purpose of a SSD system is to maintain a depressurized zone (i.e., minimum vacuum of 0.004 inches water column) underneath a building slab. This system provides a preferential airflow pathway to areas outside the building footprint. Thus, an alternate means for soil vapor to migrate to areas of lower pressure will be created by the SSD system. As part of the SSD system installation, floor drains, basement cracks, etc., are sealed. These measures aid in generating the necessary vacuum underneath the basement slab. Two SSD systems would be installed in the Site Vicinity.

7.1 TECHNOLOGY EVALUATION

The remedial technologies considered are general engineering approaches that would rely on ex-situ, in-situ or institutional/containment types of response actions that could meet one or more of the RAOs. The considered technologies were identified through a review of NYSDEC information, USEPA guidelines, relevant literature, Site conditions, and experience in developing feasibility studies and remedial action plans for similar types of environmental conditions.

Selected technologies underwent a screening against the following criteria: the ability to protect human health and the environment, effectiveness, and implementability. Table 7-1 provides an evaluation of the potential remedial technologies screened for the Site. The technologies screened are:

Type	Technology/Control
Institutional Controls	Access and Use Restrictions Groundwater Monitoring
Containment	Cover
In-Situ Treatment	In-Situ Chemical Oxidation (ISCO) of Soil/Groundwater Reductive Dechlorination of Groundwater using a Zero Valent Iron (ZVI) Permeable Reactive Barrier (PRB) Enhanced Biodegradation
Ex-Situ Treatment	Groundwater Treatment (Physical/Chemical) Soil Vapor Extraction (SVE) Soil Excavation
Natural Recovery	Monitored Natural Attenuation (MNA) for Groundwater
Others	Groundwater Extraction/Treatment/Discharge

*This table does not include vapor controls since this is being installed as an Interim Remedial Measure (IRM).

Effectiveness considers how a technology will impact the Site in the short-term during its use and its ability to meet the RAOs in the long-term. Protection of human health and environment considers potential positive and adverse impacts that may result from the use of a particular technology. This evaluation incorporates elements of the NYSDEC guidance documents TAGM 4030 and the draft DER-10 (NYSDEC, 1990; NYSDEC, 2002) and the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988).

The evaluation of implementability focuses on institutional aspects associated with use of the remedial technology, along with constructability and operation and maintenance (O&M) requirements. These subcategories are consistent with the approach for remedial alternative evaluation in TAGM 4030. Institutional aspects involve permits or access approvals for on-site use, off-site work, and off-site treatment, storage and disposal services. Constructability, or technical feasibility, refers to the ability to construct, reliably operate and meet technical specifications or criteria, and the availability of specific equipment and technical specialty personnel to operate necessary process units.

The evaluation of effectiveness, implementability and ability to meet the RAO further reduced the list of remedial technologies. Those exhibiting more favorable characteristics in the evaluated areas were carried forward. The results of this evaluation are discussed in the following section.

7.1.1 *Summary of Selected Remedial Technologies*

As presented in Table 7-1, all of the institutional technologies (i.e., access/use restrictions and groundwater monitoring) will be retained. This administrative approach is readily implementable and would address the groundwater RAO by preventing sensitive receptor uses at the site (e.g., child day care) and alerting potential future buyers of the existing SSD (the currently proposed IRM) that would need to remain in place (e.g., deed restriction). Protection of human health and the environment is achieved by implementing controls to prevent exposure, and the long-term effectiveness of this approach is directly related to the compliance with administrative restrictions. Additionally, groundwater monitoring would be conducted to observe fluctuations in concentrations of dissolved constituents in groundwater over time.

Two of the in-situ technologies, ISCO and the installation of a ZVI wall, will be retained for further evaluation. Both of these technologies can be placed in-situ to effect breakdown of PCE.

Based upon groundwater data collected during the RI, enhanced biodegradation and monitored natural attenuation do not seem to be viable options because there is limited evidence of the occurrence of PCE breakdown. That is, the only PCE daughter product detected was TCE at one location at a concentration of 0.11 μg/L. Also, there is little data to support the occurrence of bacterial activity. Thus, even if biostimulants were added to the subsurface, they would not likely be effective.

Ex-situ technologies are not carried forward and developed into remedial action alternatives because there has been no investigation beneath the Site building that has identified a PCE source area. Although groundwater treatment (physical/chemical) along with groundwater extraction and discharge may be effective in removing PCE from the aquifer, unfocused groundwater extraction will have little effect in fulfilling the RAO. Unless the groundwater was collected from beneath every building potentially impacted by vapor intrusion, groundwater extraction would have almost no effect on reaching the RAO. Extracting groundwater from beneath multiple buildings is not practical. Extracting groundwater near the former Sciore's Dry Cleaners, assuming it is the source of groundwater contamination, would also not help in reaching the RAO. Even if groundwater extraction near the Site completely eliminated further PCE migration, it would take more than 90 years before PCE would be flushed from the aquifer and potential vapor intrusion eliminated. Similarly, soil excavation would not address the RAO because it does not address the contaminated groundwater. Although SVE would address the RAO, it would not address soil vapor and groundwater downgradient of the Site and would be highly intrusive to residents residing north of the Site.

Reconsideration of the in-situ and ex-situ technologies would be carried out if data collected during the IRM, or as part of long-term monitoring, identify a source of PCE below the Site building or outside of the Site property. In summary, 4 of the 11 proposed remedial technologies for the site media are carried forward for preliminary remedial alternative development in Section 7.2. These technologies are:

Type	Technology/Control
Institutional Controls	1. Access and Use Restrictions 2. Groundwater monitoring
In-Situ Treatment	3. In-situ Chemical Oxidation 4. Reductive dechlorination of groundwater using ZVI

8.0 DESCRIPTION AND EVALUATION OF REMEDIAL ACTION ALTERNATIVES

Using the seven criteria listed below, the remedial technologies retained from Section 7.0 were developed into full-scale remedial alternatives. These are fully described and evaluated in accordance with the NYSDEC TAGM 4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites (NYSDEC, 1990), Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988) and Draft DER-10. The evaluative criteria used for the evaluation are:

- Overall protection of human health and the environment;
- Compliance with Standards, Criteria and Guidance (SCGs);
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility or volume;
- Short-term effectiveness;
- Implementability; and
- Cost.

The first two criteria, overall protection of human health and the environment and compliance with SCGs, are considered threshold criteria. There is an expectation that each selected remedial action alternative would, at a minimum, achieve these two criteria. The next five evaluation criteria are referred to as balancing criteria. They offer a basis to compare the remedial action alternatives as part of the decision-making process that results in a recommended remedial action alternative. A summary evaluation of the alternatives with respect to the seven criteria is presented in Table 8-1.

The associated costs for the alternatives are conceptual design cost estimates. Changes in the quantities of the media requiring remediation (e.g., volume of impacted groundwater), detailed engineering, as well as other factors not foreseen at the time this report was prepared, could increase costs by as much as 50 percent or decrease costs by as much as 30 percent, as defined in Section 6.2.3.7 of *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988). An interest rate of five percent (5%) was used to compute the present worth of all future costs. The assumed interest rate, which corresponds to the current interest rate for a 30-year treasury bond, was selected to “produce an amount at which the environmental liability theoretically could be settled in an arm's length transaction with a third party, or if such a rate is not readily determinable, the discount should not exceed the interest rate on “risk-free” monetary assets with maturities comparable to the environmental liability” in accordance with the US Securities and Exchange Commission (SEC) Staff Accounting Bulletin (SAB) No. 92 (SEC, 1993). SAB No. 92 provides generally accepted accounting principles for estimating and reporting environmental liability.

The alternatives undergoing detailed evaluation are:

I. No Action
II. Groundwater Monitoring and Vapor Intrusion Abatement
III. Groundwater Treatment via ZVI and ISCO and Vapor Intrusion Abatement

8.1 ALTERNATIVE I: NO ACTION

8.1.1 Description

Section 300.430(e)(6) of the National Contingency Plan (NCP) recommends describing and evaluating a no action alternative as a measure of identifying the potential risks posed by a site if no remedial action were implemented. Pursuant to 6 NYCRR Part 375-1.10(c), a remedial program for a site listed on the Registry must not be inconsistent with the NCP. Accordingly, a No Action Alternative (Alternative 1) has been developed to fulfill the NCP requirement. This alternative is evaluated in this section.

In this Alternative, no remedial actions would be implemented at the Site.

8.1.2 Evaluation

8.1.2.1 Overall Protection of Human Health and the Environment

Alternative 1 would not be protective of human health and the environment. This alternative would not meet the NYSDEC's overall Site remedial goals for the groundwater RAO.

8.1.2.2 Compliance with SCGs

A summary of the applicable SCGs is presented in Table 6-1. Since no remedial actions would be conducted under this alternative, none of the location specific and a limited number of the action specific SCGs are applicable to this alternative. The alternative would not comply with the applicable action or chemical specific SCGs.

8.1.2.3 Long Term Effectiveness and Permanence

Since this alternative does not address vapor intrusion, it would not provide long-term effectiveness or permanence.

8.1.2.4 *Reduction of Toxicity, Mobility or Volume*

There would be no reduction of toxicity, mobility or volume for chemicals at the Site, other than the natural breakdown of PCE over time.

8.1.2.5 *Short-Term Effectiveness*

There are no short-term effects associated with this alternative since there are no actions included with this alternative.

8.1.2.6 *Implementability*

As there are no specific actions related to this alternative, it would be readily implementable.

8.1.2.7 *Cost*

There are no actions taken under this alternative. As such, there are no costs associated with the implementation of Alternative 1.

8.2 *ALTERNATIVE 2: GROUNDWATER MONITORING AND VAPOR INTRUSION ABATEMENT*

8.2.1 *Description*

In this alternative, the RAO for Site groundwater would be addressed through vapor intrusion abatement and groundwater monitoring. Vapor intrusion abatement would require the placement of SSD systems in two buildings as currently proposed in the IRM. The proposed IRM would include SSD, sealing a drain in one building, and placing concrete over the bare soil in the other building.

This alternative would include the following remedial tasks and incorporate the following:

- Access and Use Restrictions
- Groundwater Monitoring
- SSD Beneath Two Buildings

8.2.1.1 *Access/Use Restrictions*

Access and use restrictions would include the provision that a SSD system would be required for any new building construction at the two properties and the currently proposed IRM would need to be maintained. In addition, no potable wells could be installed on-Site.

8.2.1.2 *Groundwater Monitoring*

PCE is present in the upper 20 to 30 feet of the groundwater flow system and appears to be prevented from migrating deeper into the formation by fine-grained material. Under this remedial action, annual groundwater monitoring would be conducted in each of the nine existing groundwater monitoring and additional new upgradient and downgradient wells for a period of 15 years. Samples would be analyzed for VOCs.

8.2.1.3 *SSD Beneath Two Buildings*

Currently, mitigation of soil gas impacts to the two buildings is being carried out as an Interim Remedial Measure (IRM). This common action, i.e. the mitigation of contaminated soil gas from below two buildings, includes installation of vertical suction points through the basement slabs of two buildings The suction points would be piped to an externally mounted fan that would draw soil gas from beneath the building to an exhaust point above the eave of each building. Further, based on the results of the groundwater monitoring component of this alternative, if increases in PCE concentrations above pre-established limits are observed in downgradient wells, SSD systems could be installed in other buildings to meet the RAO.

8.2.2 *Evaluation*

8.2.2.1 *Overall Protection of Human Health and the Environment*

This alternative would provide adequate protection of human health and the environment for the groundwater and subsequent contaminant volatilization. The surface covers over the main bare area and sealing of the drain would prevent indoor air migration to a limited degree. The SSD systems would address the inhalation risks posed by groundwater contaminant volatilization. The SSD will provide an alternate pathway for the vapor to vent to the outside. Because the Site groundwater is not impacting the surface water body, there are no groundwater supply wells at the Site, and inhalation risks posed by groundwater will be addressed through SSD systems, this alternative would provide adequate protection of human health and environment for groundwater. This alternative is expected to provide adequate protection of human health and environment for Site groundwater.

8.2.2.2 *Compliance with SCGs*

A summary of the applicable SCGs that apply to this alternative is presented in Table 8-1. As shown in this table, this alternative would address the chemical specific SCGs through sealing of the drain, concrete cover, SSD systems, and access and use restrictions.

8.2.2.3 *Long Term Effectiveness and Permanence*

This alternative would be effective in the long-term, and its continued effectiveness would be mandated through institutional controls and monitoring. This alternative provides for the installation of a cover over the main bare area in one building, sealing the drain in the other building, and installing SSD systems in both buildings.

8.2.2.4 *Reduction of Toxicity, Mobility or Volume*

This alternative would not result in a significant decrease in the toxicity, mobility and volume of chemicals in shallow groundwater, though groundwater concentrations are expected to decrease over time. This reduction would be confirmed via groundwater monitoring.

8.2.2.5 *Short-Term Effectiveness*

There would be minimal short-term impacts associated with this alternative.

8.2.2.6 *Implementability*

The main components of this alternative will be conducted as an IRM. Groundwater monitoring access and use restrictions would continue beyond this time frame. All activities associated with this alternative are readily implementable.

8.2.2.7 *Cost*

The capital and O&M costs for this alternative are provided in Table 8-2.

8.3 *ALTERNATIVE 3: GROUNDWATER TREATMENT VIA ZVI AND ISCO AND VAPOR INTRUSION ABATEMENT*

8.3.1 *Description*

As discussed in Section 6.0, New York State requires that an alternative that returns the Site to pre-disposal conditions (to the extent feasible and authorized by law) be a remedial goal. This is the overall goal of the Inactive Hazardous Waste Site (IHWS) program as identified in 6NYCRR Part 375. Technologies that were selected to address this goal were: installation of a ZVI wall on the downgradient side of the Site building, and ISCO further downgradient of the Site building to treat and control the further migration of PCE contaminated groundwater. Chemical oxidant injections will be strategically placed to treat the downgradient portion of the contamination plume and the ZVI wall would address the more upgradient portion of the plume. Inherent in the use of any of these technologies is the assumption that the Site is the source of PCE contaminating the groundwater.

The pre-disposal option would therefore include the installation of a ZVI wall and the installation of injection wells for ISCO, and would address the RAO for Site groundwater. This alternative would include the following remedial tasks and incorporate the following:

- Access and Use Restrictions
- Site Preparation and Mobilization
- Installation of a ZVI Wall
- Installation of ISCO Injection Wells
- Site Restoration
- Groundwater Monitoring
- SSD Beneath Two Buildings

8.3.1.1 Access and Use Restrictions

Access and use restrictions would include the provision that a SSD system would be required for any new building construction at the two properties and the currently proposed IRM would need to be maintained. In addition, no potable wells could be installed on-Site.

8.3.1.2 Design of ZVI and ISCO

A remedial design (RD) investigation would be performed to refine the ISCO and ZVI wall approach. Pre-design studies would be conducted for ISCO to refine the fraction of organic content and the associated soil oxidant demand for ISCO injections. This would be accomplished through collection of soil samples for analytical testing. Based on this testing, the most appropriate chemical oxidant would be selected and the oxidant dose would be calculated. Pre-design studies for ZVI would include hydraulic pulse interference testing and a groundwater treatability study. A treatability study on Site-specific groundwater would be conducted to confirm the degradation curves to verify and design appropriate horizontal thickness for the wall. The exact design parameters for the ZVI wall would be based on current round(s) of groundwater samples from the Site.

8.3.1.3 Site Preparation and Mobilization

Site preparation and mobilization would include: relocation of existing utilities; provision of temporary facilities and utilities, as needed;

mobilization of equipment to the Site and set up of the decontamination area; construction activities to install ISCO injection wells and ZVI wall; notification of residents of construction activities; and fencing to prevent unauthorized access during construction. The Site preparation and mobilization task would take approximately one month to complete.

8.3.1.4 *Installation of a ZVI Wall*

To treat groundwater, a ZVI wall will be installed in-situ directly north of the Site along E. Fourth Street at the property line immediately west of N. Decatur Street. ZVI works to abiotically degrade chlorinated compounds into carbon dioxide and water. ZVI technology has been used at many sites to provide a long-term solution to groundwater remediation and can have an effective life of greater than thirty years. The ZVI wall design assumed a hydraulic conductivity of 10 to 40 feet/day. The ZVI wall would be 114 feet in length, 36 feet in vertical height and 3 inches thick.

8.3.1.5 *Installation of ISCO Injection Wells and ISCO Application*

To treat groundwater in the downgradient portion of the plume, oxidants would be injected from the water table to a depth of approximately 27 feet bgs. Potential oxidants that could be used are potassium permanganate, sodium permanganate, persulfate, and hydrogen peroxide. For cost estimation purposes, potassium permanganate was used as the presumed oxidant. If this alternative were selected, pre-design studies would be conducted to make the final oxidant selection.

Oxidation is a destructive chemical process and can quickly and fully mineralize PCE into salt, carbon dioxide, and innocuous chemical precipitates. The reaction is generally rapid and can occur in minutes to hours. The goal of this program in the downgradient area is to create zones of “clean water” that will migrate towards Seneca Lake, resulting in decreased concentrations in a shorter time than if natural dilution alone continued to occur. Although a rebound of concentrations may occur (due to upgradient plume migration), this rebound would be mitigated by the presence of the ZVI wall that would treat upgradient concentrations.

The estimated dose of potassium permanganate is based on current groundwater PCE concentrations. Potassium permanganate was chosen because of its ability to treat long-term and low concentrations of chlorinated compounds in groundwater. When potassium permanganate is injected as part of a solution, it is able to travel faster through the groundwater. The estimated dose of potassium permanganate is highly dependant upon the fraction of organic content (f_{oc}) in the native soils. In the absence of Site-specific information, the f_{oc} was conservatively estimated to be 0.1%. In order to treat the entire estimated plume area of

19,211 cubic yards (455 feet long by 114 feet wide by 10 feet deep), 91 injection points and 467,035 pounds of potassium permanganate would be needed. The installation of 91 injection points is not practicable in this area. Therefore, the installation of approximately 29 wells, based on available locations of injections at a 30-foot spacing, was assumed to be the limiting factor. Thus, it was estimated that 148,565 pounds of potassium permanganate would be injected into 29 injection points.

Twenty-nine injection points will be installed downgradient of the Site. These wells would be located along Fourth, Third, Second, and North Decatur Streets and would be installed at 30- foot spacing. This is based upon a 15-foot radius of influence for each injection point. One-quarter of the dose (37,141 lbs) would be injected annually and the remaining doses would be injected in an iterative manner over the remaining three years, after review of groundwater monitoring data, if determined to be necessary. Using a 2% solution and a delivery rate of 4.5 gallons per minute, it would take approximately 824 hours to inject one-quarter of the estimated full dose. It has been shown that a 2% solution prevents clumping and other delivery problems associated with higher percent solutions. This translates into approximately 137 workdays, or seven months, assuming that six hours of injection can be completed each work day. Thus, each subsequent injection of 37,141 lbs would also take approximately seven months to complete.

A RD Investigation and Treatability study on site-Specific groundwater and soil characteristics would be performed to refine the application strategy based on soil oxidant demands should this alternative be selected for the Site. Additionally, a subsurface injection distribution system could be evaluated to limit disruptions. As part of the design study, an additional monitoring well would be installed downgradient of MW-09 in order to determine any necessary expansion of the proposed ISCO treatment area.

8.3.1.6 Site Restoration

After the ZVI wall and ISCO wells are installed, the Site would be restored to its original condition. This would include removal of equipment, temporary services, and surplus fencing. Repaving of any streets and re-seeding of areas that were disrupted during construction would occur as well.

8.3.1.7 Groundwater Monitoring

Groundwater concentrations in the shallow (i.e. 10 to 25 feet bgs) and deeper (25 to 35 feet bgs) would be monitored to determine the effectiveness of the ZVI treatment wall and the ISCO injections on the groundwater quality in the shallow and deeper groundwater zones. The progress of these activities would be monitored through sampling of the existing groundwater monitoring wells and the newly proposed downgradient, upgradient, and side-gradient wells. Quarterly sampling would be conducted for the first two years, followed by semi-annual sampling for the next two years. Annual sampling would take place the remaining 6 years. All samples would be analyzed for VOCs. A monitoring period of 10 years has been conservatively assumed.

8.3.2 Evaluation

8.3.2.1 Overall Protection of Human Health and the Environment

This alternative would provide adequate protection of human health and the environment for groundwater and indoor air. The SSD systems would address the inhalation risks posed by groundwater contaminant volatization. The ZVI wall would treat contaminants in the groundwater that may originate from a potential source area at the Site. The ISCO injection wells would treat the groundwater downgradient of the Site, thereby reducing groundwater concentrations and subsequent inhalation risks. The Site groundwater is not impacting the surface water body and there are no groundwater supply wells at the Site. Therefore, this alternative would provide adequate protection of human health and the environment for Site-related impacted groundwater.

8.3.2.2 Compliance with SCGs

A summary of the applicable SCGs that apply to this alternative is presented in Table 6-1. As shown in the table, this alternative would address the chemical specific SCGs through SSD systems, ZVI, ISCO, and access and use restrictions. Additionally, this alternative would meet the overall goal of attempting to achieve pre-disposal conditions.

8.3.2.3 Long Term Effectiveness and Permanence

This alternative would be effective in the long- term and its continued effectiveness would be mandated through institutional controls and monitoring. This alternative considers the treatment of both the upgradient and downgradient portion of the contamination. This alternative provides for the installation of the ZVI system, the installation of the ISCO wells, SSD, and groundwater monitoring for effectiveness.

8.3.2.4 Reduction of Toxicity, Mobility, or Volume

Through the ZVI wall and ISCO injections, this alternative would result in a decrease in the toxicity, mobility and volume of chemicals in groundwater.

This reduction would be confirmed via groundwater monitoring.

8.3.2.5 *Short-Term Effectiveness*

Short-term impacts would be associated with constructing the ZVI wall on E. Fourth Street and installing the ISCO injection points. Construction activities for the ZVI wall would include drilling six-inch holes in the street for the ZVI wall and then placing fracture casings through which iron filings can be injected. However, due to the trenchless nature of the operation, E. Fourth Street would be re-opened to allow normal traffic after drilling and iron injection has ceased. Activities would also include drilling deep wells to inject chemicals for ISCO. However, these wells would be closed between routine injection and normal traffic could resume.

8.3.2.6 *Implementability*

The alternative would require additional studies, preparation of a RAWP, and detailed designing of the proposed technologies. Thus, approximately two years would be needed to conduct treatability tests and designs, and preparation of reports. The main installation components of this alternative could be completed within nine months of NYSDEC approval for the RD for this Site. However, additional ISCO injections may be needed at annual intervals until satisfactory groundwater concentrations are observed. This would create further disruption every time equipment is mobilized and work is conducted. Groundwater monitoring, operations, maintenance, and access and use restrictions would continue beyond this time frame until groundwater concentrations are treated to below the SCGs. All activities associated with this alternative are readily implementable. However there may be some issues associated with obtaining permits from the town for street closures. The estimated dosage required at the Site would require approximately seven months of injection activities annually for four years to complete, thereby introducing significant implentability issues. Construction for such a long period of time would cause significant disruptions.

8.3.2.7 *Cost*

The capital and O&M costs for this alternative are provided in Table 8-3.

8.4 COMPARISON EVALUATION OF REMEDIAL ACTION ALTERNATIVES

Using the technologies selected in Section 7.0 to address the RAOs, the following remedial action alternatives were developed in Sections 8.1 through 8.3 for the Site:

Alternative I. No Action,
Alternative II. Groundwater Monitoring and Vapor Intrusion Abatement
Alternative III. Groundwater Treatment via ZVI and ISCO and Vapor Intrusion Abatement

Each alternative was evaluated for the seven items identified in the NCP {40 CFR 300.430(e)(9)} and in the NYSDEC TAGM guidance for the selection of remedial actions (NYSDEC, 1990) as performance criteria to be considered during the preparation of an FS. The NCP and the NYSDEC TAGM guidance (NYSDEC, 1990) also require that alternatives be evaluated for community acceptance. Alternatives are to be evaluated for community acceptance after the NYSDEC has distributed a proposed plan and the proposed plan and FS have been reviewed by the community.

In accordance with the NCP (40 CFR 300.430(f)(1)(i)) and with the NYSDEC TAGM on the selection of remedial actions (NYSDEC, 1990), the first two performance criteria are considered threshold criteria. Remedial action alternatives that do not satisfy both of these criteria cannot be selected for use in remediating a site.

The remaining five criteria are considered primary balancing criteria. These balancing criteria address the following issues:

1. How will the remedial actions perform in the future (long-term effectiveness)?
2. Does the alternative reduce the toxicity, mobility or volume of hazardous substances?
3. Does the implementation of the alternative create adverse impacts (short-term effectiveness)?
4. Can the alternative be implemented (implementability)?
5. What is the total cost of the alternative?

These criteria were discussed in Sections 8.1 through 8.3 for each alternative. A summary comparison of the remedial action alternatives in terms of these criteria is provided in Table 8-1. Detailed cost estimates for Alternatives II, III, and IV are presented in Tables 8-2 and 8-3; there are no costs associated with Alternative I. The total present worth costs for each alternative, as discussed below, are as follows:

Alternative	***Total Present Worth Cost***
Alternative I (No Action)	$0
Alternative II (Groundwater Monitoring and Vapor Intrusion Abatement) [(1)]	$238,037
Alternative III (Groundwater Treatment via ZVI and ISCO and Vapor Intrusion Abatement)	$6,280,715
NOTES: **1.** This does not include the additional expense that may be required to secure the Site Owner's consent to the deed restriction limiting future use of the Site.	

In summary, one media of interest (Site groundwater) was evaluated in Section 6.0 in terms of exposure pathways, cleanup levels, remedial action objectives, and general response actions. In response to the identified media of interest, four of the eleven proposed remedial technologies were evaluated. The selected remedial technologies were formulated into three Remedial Action Alternatives: I No Action, II Groundwater Monitoring and Vapor Intrusion Abatement, and III Groundwater Treatment via ZVI and ISCO and Vapor Intrusion Abatement. Finally, the following sections provide a comparison of these remedial alternatives.

8.4.1 Prevention of Inhalation of VOCs

The media of interest at the Site is groundwater, and the COPC identified for this media is PCE, which is a VOC. Being that groundwater is not a source of drinking water, the potential for exposure solely exists via PCE volatilization from shallow groundwater to overlying indoor or outdoor air. This exposure pathway shall be addressed via the remedial action alternatives. The alternatives outlined above in Section 8.4 address this pathway, with the exception of Alternative I, No Action.

The remedial action alternatives can be categorized by their effectiveness to minimize VOC vapor migration. Alternative II would be a first tier approach in that it provides vapor intrusion abatement for both buildings, and a cover (physical barrier) for bare soil in one building to prevent VOC intrusion. Alternative III provides a two-tier approach whereby a permeable reactive barrier is installed in addition to ISCO injections to treat downgradient contamination. Both alternatives will have varying degrees of VOC minimization/elimination.

8.4.2 *Compliance with SCGs*

The remedial action alternatives also address the compliance of SCGs. All the alternatives, with the exception of Alternative 1 No Action, meet the applicable SCG requirements.

However, Alternative II would prevent vapor intrusion into indoor air and comply with SCGs associated with air. It does not comply with chemical specific SCGs for groundwater or restore the Site to pre-disposal conditions. Nevertheless, groundwater concentrations would be monitored and are expected to decrease over time.

8.4.3 *Long-Term Effectiveness and Permanence*

Because the vapor intrusion pathway is of primary concern at the Site, the long-term effectiveness is assessed based on the ability of the remedial action alternative to minimize or eliminate VOC migration. As a result, Alternative I does not provide an effective or permanent long-term solution, while Alternatives II and III have varying levels of effectiveness.

In essence, the installation of a SSD system would limit toxic chemicals from entering indoor air, but a significant reduction of the toxicity, mobility, and volume is not expected, beyond natural decrease in groundwater concentrations (Alternative II). However, a ZVI wall and ISCO injections (Alternative III) would serve to mitigate chemical toxicity.

8.4.4 *Reduction of Toxicity, Mobility or Volume*

Other than the natural breakdown of PCE, there would be no reduction of toxicity, mobility, or volume by using either no action or monitoring (Alternatives I and II). However, the installation of a ZVI wall and injection of oxidants would result in a reduction of the toxicity, mobility, and volume in groundwater (Alternative III).

8.4.5 *Implementability*

The timeframe for implementation varies depending on the techniques used. The No Action Alternative I and Alternative II are immediate, though Alternative II would also have continued groundwater monitoring. Alternative III would take up to four years for treatment dose applications and an additional six years of monitoring. All the activities associated with these alternatives are readily implementable.

9.0 REFERENCES

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NYSDEC, 1990. Selection of Remedial Actions at Inactive Hazardous Waste Sites, Technical Administrative Guidance Memorandum #4030 (HWR-90-4030), Division of Environmental remediation, May 15, 1990.

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USEPA, 2000. A Guide to Developing and Documenting Cost Estimates during a Feasibility Study, EPA 540-R-00-002, OSWER 9355.0-75, July 2000.

USEPA, 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, EPA/540/6-89/004, October 1988.

TABLES

Table 6-1

Potential New York State Standards, Criteria and Guidelines (SCGs)
Former Sciore's Dry Cleaners, Watkins Glen, New York
Site Number 8-49-003

CITATION	DESCRIPTION	TYPE	POTENTIAL APPLICABILITY TO DEVELOPING REMEDIAL ACTION OBJECTIVES	POTENTIAL APPLICABILITY TO EVALUATING REMEDIAL ACTION ALTERNATIVES
STANDARDS AND CRITERIA (1)				
6 NYCRR Part 364	Waste Transporter Permits	Action	Not applicable	This standard would relate to alternatives that involve waste removal.
6 NYCRR Part 375	Inactive Hazardous Waste Disposal Site Remedial Program	Action	This statute would be used to determine remedial requirements for at the Site.	This standard relates to all Site remedial activities (i.e. remedy selection and remedial action).
6 NYCRR Part 703.5	NYSDEC Water Quality Standards, Surface Water and Ground Water	Action, Chemical	This standard provides promulgated numeric standards that would be applicable to the development of remedial requirements for Site groundwater.	This standard would relate to alternatives that include: discharge of treated groundwater to surface water bodies; and/or groundwater monitoring.
Clean Water Act [Federal Water Pollution Control Act, as amended] Section 304(a)	Federal ambient water quality criteria	Chemical	This standard provides promulgated numeric standards that would be directly applicable to water quality.	This standard could relate to alternatives that include: discharge of treated groundwater to surface water bodies. Remedial activities need to ensure compliance with applicable numeric criteria.
6 NYCRR Part 257	Air Quality Standards	Action	Not applicable.	May relate to remedial action activities

Potential New York State Standards, Criteria and Guidelines (SCGs)
Former Sciore's Dry Cleaners, Watkins Glen, New York
Site Number 8-49-003

CITATION	DESCRIPTION	TYPE	POTENTIAL APPLICABILITY TO DEVELOPING REMEDIAL ACTION OBJECTIVES	POTENTIAL APPLICABILITY TO EVALUATING REMEDIAL ACTION ALTERNATIVES
6 NYCRR Part 750	State Discharge Elimination System (SPDES) Permits	Action	Not applicable.	This standard would relate to alternatives that include: discharge of treated groundwater to surface water bodies.
OSHA; 29 CFR 1910	Guidelines/Requirements for Workers at Hazardous Waste Sites (Subpart 120) and Standards for Air Contaminants (Subpart 1).	Action	Not applicable.	May relate to certain remedial action activities
OSHA; 29 CFR 1926	Safety and Health Regulations for Construction	Action	Not applicable	May relate to certain remedial action activities
Guidelines (2)				
TAGM HWR-90-4030	Selection of Remedial Actions at Inactive Hazardous Waste Sites	Action	Guidance is applicable to developing the remedial action objectives.	May relate to selection of remedial action.
NYSDEC TOGS 1.1.1	Ambient Water Quality Standards and Guidance Values	Action, Chemical	Guidance would be applicable for development of groundwater RAOs.	Guidance would be applicable for remedial action alternatives that involve work associated with Site groundwater.

Potential New York State Standards, Criteria and Guidelines (SCGs)
Former Sciore's Dry Cleaners, Watkins Glen, New York
Site Number 8-49-003

CITATION	*DESCRIPTION*	*TYPE*	*POTENTIAL APPLICABILITY TO DEVELOPING REMEDIAL ACTION OBJECTIVES*	*POTENTIAL APPLICABILITY TO EVALUATING REMEDIAL ACTION ALTERNATIVES*
TO BE CONSIDERED (TBCS) (3)				
NYS DOS, Policy 8 Coastal Management Program	Pollutants – Protection of fish and wildlife resources	Location	Not applicable.	This program is not likely to directly influence the evaluation of remedial action alternatives; however, remedial action outcomes should be consistent with the goals of the program.
NYSDEC *Draft* DER-10	Technical Guidance for Site Investigation and Remediation	Action	Draft guidance relates to development of remedial action objectives.	Relates to all Site remedial action activities.

GLOSSARY OF ACRONYMS

CFR	Code of Federal Regulations
NYSDEC	New York State Department of Environmental Conservation
NYCRR	New York Code of Rules and Regulations
OSHA	Occupational Safety and Health
SCG	Standards, Criteria and Guidelines
TBC	To Be Considered Information
DER	Division of Environmental Remediation

Potential New York State Standards, Criteria and Guidelines (SCGs)
Former Sciore's Dry Cleaners, Watkins Glen, New York
Site Number 8-49-003

Notes:

(1) Standards and Criteria were obtained from NYSDEC Draft DER-10, Technical Guidance for Site Investigation and Remediation, December 2002.

(2) Guidelines were obtained from NYSDEC Draft DER-10, Technical Guidance for Site Investigation and Remediation, December 2002.

(3) TBCs are defined in this report as regulations and guidance documents that are not identified NYSDEC Draft DER-10, Technical Guidance for Site Investigation and Remediation, December 2002.

Table 7-1
Technology Screening and Selection
Former Sciore's Dry Cleaners, Watkins Glen, New York
Site Number 8-49-003

Technology	*Description*	*Ability to Meet the RAO*	*Effectiveness*	*Implementability*	*Technology Carried Forward?*
Access/Use Restrictions	Access/use restrictions prohibit access to areas of the Site and current and future use of the Site. Examples include: deed restrictions, construction work limitations, notification regarding residual contamination through a deed notice, fencing, etc.	This technology would help meet the RAO through preventing Site groundwater use and specific Site uses.	This technology would need to be used in conjunction with other technologies to be effective.	This technology is readily implementable.	Yes.
Cover	A cover can be constructed to limit vapor intrusion into indoor or outdoor air. A cover can include: asphalt, concrete or more impermeable materials, such as those used for a Subtitle C cover. An engineered cover can be constructed of multiple layers and thicknesses in order to prevent diffusion or seepage of harmful vapors through layers.	Soil covers would address the RAO by limiting vapor migration from the subsurface.	The installation of a cover would not result in a reduction of the toxicity, mobility, and volume in shallow groundwater. However, it would prevent vaporization to some degree.	Covers are routinely constructed and readily accepted by the regulators. However, it would not be practicable to cover the site due to multiple uneven cracks existing on both the walls and the floor and the generally degenerate state of the walls in the two buildings.	No.
Groundwater monitoring	Groundwater samples are collected to track contaminant trends and current groundwater conditions. Spikes or decreases in concentrations can be monitored.	This technology would help meet the RAO through continued monitoring of groundwater concentrations.	Continuous groundwater monitoring would reflect any natural attenuation occurring at the Site. The RI report indicated, however, that natural attenuation was not prevalent at the Site.	The installation of several new wells for this alternative can be completed with a six-month time frame. Monitoring of concentrations would continue for a period of years following well installations.	Yes.
Monitored Natural Attenuation for Groundwater	Groundwater samples are collected to track contaminant trends, breakdown byproducts to monitor progress, and nutrients. Spikes or decreases in concentrations can be monitored. Relies on natural processes to breakdown groundwater contaminants. Natural attenuation processes include physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. These processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants.	This technology would help meet the RAO through long-term breakdown of PCE into innocuous compounds. However, there is not significant evidence showing that this is occurring at the Site.	MNA is effective at remediation of groundwater for VOC prevent o be stable or shrinking. However, the RI reported that natural attenuation was not prevalent at the Site. There was little evidence of the breakdown of PCE via degradation to trichloroethylene (TCE), cis-dichloroethene (DCE), trans-DCE, and vinyl chloride (VC). Additionally, other geochemical parameters did not suggest that natural attenuation was taking place.	The installation of several new wells for this alternative can be completed with a six-month time frame. Monitoring of concentrations would continue for a period of years following well installations. Breakdown of PCE is expected to take a significantly long period of time since natural attenuation is currently not prevalent at the Site.	No.

Specific technology descriptions obtained from Federal Remediation Technologies Roundtable, www.frtr.gov.

Technology	*Description*	*Ability to Meet the RAO*	*Effectiveness*	*Implementability*	*Technology Carried Forward?*
Reductive Dechlorination of Groundwater using Zero Valent Iron (ZVI)	ZVI is placed in-situ and promotes abiotic degradation of chlorinated compounds by effecting breakdown.	This technology would meet the RAO in areas of injected chemicals by treating groundwater and reducing PCE concentrations.	This technology would be effective at treating groundwater that flows through it and would also serve to mitigate chemical toxicity.	This technology would be implementable within a nine-month time frame. Additional applications may be necessary based upon treatment effectiveness. Monitoring of effectiveness would continue beyond that time.	Yes.
In-Situ Chemical Oxidation	Oxidants are injected in-situ to mineralize chlorinated compounds to more innocuous chemicals and precipitates.	This technology would meet the RAO in areas downgradient of the ZVI wall by treating groundwater and reducing PCE concentrations.	This technology would be effective at treating groundwater and would also serve to mitigate chemical toxicity.	This technology would be implementable within a nine-month time frame. Monitoring of effectiveness would continue beyond that time. A high dosage requirement, however, would require the dose to be injected in an iterative manner over four years.	Yes.
Groundwater Extraction	This technology employs pumping of groundwater to withdraw water and its dissolved and entrained constituents from the aquifer. This pumping can be used to contain, reduce, remove, divert, or prevent development of chemical plumes. The use of extraction wells is most effective when the targeted chemicals of concern are miscible and move readily with the groundwater and the hydraulic conductivity is high. Groundwater extraction must be used in conjunction with other technologies (i.e., treatment and/or disposal methods) in order to manage the extracted groundwater.	This technology could help meet the RAO by removing groundwater containing PCE above the SCGs from the subsurface, providing a PCE source was identified so that continuing contamination of the aquifer could be controlled.	Groundwater extraction is effective at removing aqueous media from the ground.	The equipment and materials for extraction wells are readily available. No contaminant source has been identified and where to install an extraction system makes implementation of this technology extremely difficult.	No.

Specific technology descriptions obtained from Federal Remediation Technologies Roundtable, www.frtr.gov.

Technology	*Description*	*Ability to Meet the RAO*	*Effectiveness*	*Implementability*	*Technology Carried Forward?*
Ex-Situ Groundwater Treatment (Physical/Chemical)	Physical or chemical treatment processes are applied to groundwater following extraction. As part of this technology, piping is needed to convey recovered groundwater to a treatment location. Also, a treatment building would be necessary. Chemical additives react with groundwater contaminants to reduce concentrations prior to discharge or filtration methods combined with liquid phase carbon absorption may be used.	This technology could help meet the RAO by actively treating and reducing PCE concentrations in extracted groundwater. However, the source of PCE in groundwater has not been identified. Therefore, the use of treatment technologies may not be effective in restoring groundwater quality.	This technology has been effective at reducing groundwater contaminant concentrations. However, often groundwater standards are not met as asymptotic concentration levels are reached over time.	Multiple contaminants can affect process performance. High suspended solids and oil and grease may cause fouling of the carbon or air stripper media and may require frequent media change-outs or pretreatment. Spent carbon, if used, needs to be properly disposed. The source of groundwater contamination has not been identified. Although groundwater may be treated anywhere in the plume, unless the source is identified, groundwater treatment will be ineffective in restoring the aquifer.	No.
Enhanced Biodegradation	Biodegradation is a process in which indigenous micro-organisms (e.g., fungi, bacteria, and other microbes) breakdown organic contaminants found in soil and/or ground water, converting them to innocuous end products. Under enhanced biodegradation, nutrients, oxygen, or other amendments are added to enhance bioremediation and contaminant desorption from subsurface materials.	This technology could meet the RAO by reducing the concentration of PCE in groundwater.	The RI report indicated, however, that natural attenuation was not prevalent at the Site. Thus, providing chemicals to enhance this process would not likely stimulate further microbial activity.	Injection/application may be affected by subsurface structures. Preferential flow paths may limit contact between injected fluids and contaminants. There is the potential for electron acceptor limitations. High concentrations of contaminants may be toxic to microorganisms. High hydraulic conductivity reduces residence time of injected biological enhancements.	No.
Soil Vapor Extraction	Horizontal wells would be installed below the basement of the Site building in order to extract and treat vapors associated with the contaminated groundwater.	The RAO would be met by preventing the inhalation of vapors.	Soil vapor extraction would remove the vapors from below the Site building and therefore address the RAO for the Site building. However, areas downgradient of the Site would not be addressed due to the impracticality of installing active vapor extraction systems in these locations. Additionally, it would not address any residual source in the saturated zone under the building.	This alternative is not readily implementable for downgradient locations. It would require the relocation of apartment rentees at the Site building. Instead, SSD would be a more practical, implementable solution that would accomplish the same goal.	No.

Specific technology descriptions obtained from Federal Remediation Technologies Roundtable, www.frtr.gov.

Technology	*Description*	*Ability to Meet the RAO*	*Effectiveness*	*Implementability*	*Technology Carried Forward?*
Ground Water Discharge 1. Reinjection Well 2. POTW 3. Recharge Basin 4. Seneca Lake	1. Water is injected below the water table. Groundwater flows to Seneca Lake, north of the Site, and the plume of VOCs extends in the same direction. Treated groundwater would need to be returned to the aquifer at an upgradient location (south of the boundary of the Site). 2.Discharge treated groundwater to the sanitary sewer for conveyance to the local publicly-owned treatment works (POTW). 3.This technology entails the discharge of treated groundwater to a local recharge basin (i.e., a sump) for subsequent groundwater recharge. Conveyance to the recharge basin may be accomplished via a storm sewer, or a separate pipe may need to be installed from the treatment plant to the recharge basin. Operation of this technology may include periodic clean out of the recharge basin due to the precipitation of metals. The presence of these metals in the treated effluent will depend on the selected groundwater treatment technology. 4. Discharge of treated groundwater to a stormwater basin, which empties via a canal into Seneca Lake.	This technology would help meet the RAO through discharge of treated groundwater.	Discharge to a recharge basin has been used for the discharge of treated groundwater from remediation sites. Discharging to the local POTW would require an evaluation of the ability of the local sanitary sewer piping, and the POTW, to handle the significant increase in flow. Although a reinjection well could be designed to handle the volume of water requiring discharge, there are some concerns regarding potential fouling of the formation around the injection well. Discharge to Seneca Lake is also an effective option.	Depends upon the selected option. All four options are technically implementable. However, there are significant concerns over the administrative implementability of each option and where groundwater would be in order to effectively restore the aquifer to pre-disposal conditions.	No. Since the other pump and treat technologies are not being carried forward, this is not a relevant technology to carry forward.
Soil Excavation	Assuming that a source of PCE contamination is below the Site building, the building could be demolished and soil excavated to the water table.	The RAO would be met in the apartment/basement of the Site building by eliminating the source. The PCE in downgradient groundwater would still have to be flushed from the aquifer for the RAO to be met in downgradient dwellings (estimated to be as long as 90 years).	If the source is beneath the Site building, soil removal would be effective in removing the source. Soil excavation would only have an effect on groundwater in the long-term.	Demolition and soil excavation is readily implementable.	No.

Specific technology descriptions obtained from Federal Remediation Technologies Roundtable, www.frtr.gov.

TABLE 8-1
COMPLIANCE OF ALTERNATIVES WITH SCGS
EFFECTIVENESS, AND IMPLEMENTABILITY
FORMER SCIORE'S DRY CLEANERS, WATKINS GLEN, NEW YORK
SITE NUMBER 8-49-003

Alternative	Prevent inhalation of VOCs volatilizing from contaminated groundwater	Compliance with SCGs	Long-term effectiveness and permanence	Reduction of toxicity, mobility, or volume	Implementability	Cost
Alternative I: No Action	This alternative does not prevent vapor intrusion into indoor air. Therefore, this RAO will not be met.	Would not meet the applicable action or chemical specific SCGs. Since no action, a number of the action and location specific SCGs would not be applicable.	Since this alternative does not address vapor intrusion, it would not provide long-term effectiveness or permanence.	Other than the natural breakdown of PCE, there would be no reduction of toxicity, mobility, or volume.	This alternative would be readily implementable.	$0
Alternative II: Groundwater Monitoring and Vapor Intrusion Abatement	Through installation of an SSD system, sealing a drain in one building, covering bare soil in the other building, and monitoring of groundwater, the RAO would be met.	This alternative would prevent vapor intrusion into indoor air and comply with the applicable associated SCGs. It does not comply with chemical specific SCGs for groundwater or restore the Site to pre-disposal conditions. However, groundwater concentrations would be monitored and are expected to decrease over time.	Through SSD beneath the two buildings, the installation of a cover over bare soil areas in one building, and institutional controls, long- term effectiveness and permanence can be expected.	The installation of an SSD system and a cover would limit toxic chemicals from entering indoor air. However, a significant reduction of the toxicity, mobility, and volume is not expected, beyond natural decrease in concentrations. Continuous groundwater monitoring would monitor decreasing concentrations over time.	Much of this alternative will be conducted as an IRM. Groundwater monitoring would continue for 15 years beyond this time. Activities associated with this alternative are readily implementable. Cost estimating for this Alternative assumes 15 years of groundwater monitoring.	$238,037
Alternative III: Groundwater Treatment via ZVI and ISCO and Vapor Intrusion Abatement.	The ZVI wall installation would reduce inhalation risks posed by contaminated groundwater volatization in areas immediately downgradient of the site. The ISCO injections would reduce contaminant concentrations in groundwater further downgradient from the site. Therefore, the RAO will be met as groundwater concentrations decrease. The IRM would address risks from inhalation of vapor.	This alternative would address the applicable chemical specific SCGs. In addition, it meets the remedial goal of restoring the Site to pre-disposal conditions.	In-situ treatment using a ZVI wall and ISCO injections would serve to mitigate chemical toxicity. SSD beneath the two buildings and institutional controls will result in long- term effectiveness and permanence.	The installation of a ZVI wall would result in a reduction of the toxicity, mobility, and volume of PCE in groundwater. The injection of oxidants would reduce the concentration of the PCE in the groundwater. However, there also is concern that breakdown of PCE will generate vinyl chloride to a limited degree, which is more toxic than PCE. Continuous groundwater monitoring would reflect the decreasing groundwater concentrations.	The main components of this alternative can be completed within a nine-month time frame. Additional ISCO injections may be necessary beyond this timeframe. All activities associated with this alternative are readily implementable. For cost estimation purposes, it has been assumed that the groundwater monitoring would be conducted for 10 years.	$6,280,715

TABLE 8-2
REMEDIAL ACTION ALTERNATIVE 2
GROUNDWATER MONITORING AND VAPOR INTRUSION ABATEMENT
FORMER SCIORE'S DRY CLEANERS, WATKINS GLEN, NEW YORK
SITE NUMBER 8-49-003

Item Description	Unit	Unit Cost	Quantity	Total Cost	Notes
CAPITAL COSTS					
Common Actions					
C1: Sub-Slab Depressurization System	ls	$13,150	1	$13,150	7
		Subtotal, Common Actions		**$13,150**	
Deed Restriction	ls	$5,000	1	**$5,000**	1
Groundwater Monitoring Well Installation					
Groundwater Monitoring Well Installation	well	$2,600	2	$5,200	3
Utility Clearing	ls	$2,400	1	$2,400	1
Waste Disposal from Well Installation	each	$1,200	1	$1,200	4
			Subtotal, Wells	**$8,800**	
			Remedial Action Cost Estimate		
			Subtotal Remedial Action Capital Cost	$26,950	
			Contingency (25%)	$6,738	
			SUBTOTAL	$33,688	
			Mobilization/Demobilization (5%)	$1,684	
			Remedial Design (20%)	$6,738	8
			Project Management (10%)	$3,369	8
			Construction Management (15%)	$5,053	8
			Total Remedial Action Capital Cost	**$50,531**	

OPERATIONS AND MAINTENANCE COSTS

Groundwater Monitoring	Unit	Unit Cost	Quantity	Present Value	Notes
Annual Sampling for 15 years for VOCs in 11 wells	yr	$ 13,964	15	$158,903	2
Subtotal, GW Monitoring Present Value at 5% Discount Rate				**$158,903**	
			Total O&M Costs	$158,903	
			Project Management Costs (8%)	$12,712	
			Contingency (10%)	$15,890	
Total Present Worth of Annual Operations and Maintenance Costs				**$187,506**	

TOTAL PRESENT WORTH OF COSTS $238,037

TABLE 8-3
REMEDIAL ACTION ALTERNATIVE 3
PRE-DISPOSAL GROUNDWATER TREATMENT VIA ZVI AND ISCO
AND VAPOR INTRUSION ABATEMENT
FORMER SCIORE'S DRY CLEANERS, WATKINS GLEN, NEW YORK
SITE NUMBER 8-49-003

Item Description	Unit	Unit Cost	Quantity	Total Cost	Reference
CAPITAL COSTS					
Common Actions					
C1: Sub-Slab Depressurization System	ls	$13,150	1	$13,150	7
		Subtotal, Common Actions		**$13,150**	
Deed Restriction	ls	$5,000	1	**$5,000**	1
Groundwater Monitoring					
Utility clearing	ls	$2,400	1	$2,400	3
Groundwater Monitoring Well Installation	well	$2,600	2	$5,200	1
Waste Disposal from Well Installation	each	$1,200	1	$1,200	4
			Subtotal, Wells	**$6,400**	
Pre-Design Studies					
ZVI Wall and ISCO Pre-Design	ls	$15,000	1	$15,000	
			Subtotal, Pre-Design	**$15,000**	
In-Situ Chemical Oxidation Injections					
ISCO Injection, Construction, Expenses, and Licensing	ls	$1,790,253	1	$1,790,253	6
			Subtotal, ISCO	**$1,790,253**	
Permeable Reactive Barrier for Groundwater Treatment					
ZVI Wall Design, Construction, Expenses, and Licensing	ls	$1,927,859	1	$1,927,859	5
			Subtotal, PRB	**$1,927,859**	

Remedial Action Cost Estimate		
Subtotal Remedial Action Capital Cost	$3,757,662	
Contingency (25%)	$939,416	
SUBTOTAL	$4,697,078	
Mobilization/Demobilization (5%)	$234,854	
Remedial Design (8%)	$375,766	8
Project Management (5%)	$234,854	8
Construction Management (6%)	$281,825	8
Total Remedial Action Capital Cost	**$5,824,376**	

TABLE 8-3
REMEDIAL ACTION ALTERNATIVE 3
PRE-DISPOSAL GROUNDWATER TREATMENT VIA ZVI AND ISCO
AND VAPOR INTRUSION ABATEMENT
FORMER SCIORE'S DRY CLEANERS, WATKINS GLEN, NEW YORK
SITE NUMBER 8-49-003

OPERATIONS AND MAINTENANCE COSTS

GROUNDWATER MONITORING FOR ISCO AND ZVI WALL EFFECTIVENESS	Unit	Unit Cost	Quantity	Present Value	
Quarterly Sampling for 2 years	event	25,000	8	$195,238	5
Semi-annual Sampling for 2 years	event	25,000	4	$88,543	5
Annual Sampling for 6 years	event	25,000	6	$109,614	5
Subtotal, Monitoring Present Value at 5% Discount Rate				**$393,396**	
Total O&M Costs				$393,396	
Project Management Costs (6%)				$23,604	
Contingency (10%)				$39,340	
Total Present Worth of Annual Operations and Maintenance Costs				**$456,339**	

TOTAL PRESENT WORTH OF COSTS **$6,280,715**

TABLES 8-2 AND 8-3
REMEDIAL ACTION ALTERNATIVE COST ESTIMATE NOTES
FORMER SCIORE'S DRY CLEANERS, WATKINS GLEN, NEW YORK
SITE NUMBER 8-49-003

Notes

1 Unit cost based on previous ERM experience.
2 Eleven wells would be sampled over the course of three 10-hour days with samples for VOCs by two field personnel. Unit cost includes preparation of a data summary memo, equipment rental, laboratory costs, and fieldwork. Assumes that groundwater would be containerized and disposed in one 55-gallon drum per sampling event.
3 Unit cost provided by Parratt-Wolff, Inc. of Syracuse, NY.
4 Unit cost provided by Environmental Service Group of Buffalo, NY.
5 Cost estimate provided by GeoSierra of Atlanta, GA. The proposed ZVI wall would be three inches thick, 380 feet long, and 36 feet high. Samples will be analyzed for VOCs, natural attenuation parameters, and metals.
6 Cost estimate developed by ERM based on previous project experience. Potassium permanganate will be used due to low, widespread concentrations of PCE. Twenty-nine injection points would be installed at a depth of 27 feet bgs. 4.5 gallons of 2% potassium permanganate solution would be delivered per minute. It would take approximately 548 days to inject the estimated 148,565 pounds of oxidant. Assuming that one-quarter of the dose would be applied annually, a total of 137 days per year for four years would be required.
7 Cost estimate obtained from Envirotesting of Binghamton, NY.
8 Professional/Technical Construction Management Service costs derived from the USEPA's "Guide to Developing and Documenting Cost Estimates During the Feasability Study," July 2000.

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ERM's Manhattan Office

475 Park Avenue South, 29th Floor
New York, NY 10016
Tel: 212-447-1900
Fax: 212-447-1904

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