FEASIBILITY STUDY

Former Silver Cleaners Site #828186

Rochester, New York

Work Assignment #D007618-31.2

NYSDEC Site No. 828186

January 31, 2020

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Mark Flusche, P.G., P.Hg.
Principal Hydrogeologist

Prepared for:

New York State Department of
Environmental Conservation
625 Broadway
Albany

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).

Daniel J. Loewenstein, P.E., BCEE
New York #066594

Prepared by:

Arcadis CE, Inc.
855 Route 146
Suite 210
Clifton Park
New York 12065
Tel 518 250 7300
Fax 518 250 7301

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ACRONYMS AND ABBREVIATIONS

Arcadis	Arcadis CE, Inc.
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAMP	Community Air Monitoring Plan
Class GA Standard	New York State Class GA Groundwater Standard
COPC	contaminant of potential concern
DER-10	Division of Environmental Remediation's Technical Guidance for Site Investigation and Remediation
ERD	Enhanced Reductive Dechlorination
ESA	Environmental Site Assessment
FS	Feasibility Study
ft	feet
ISCO	In-Situ Chemical Oxidation
ISTR	In-Situ Thermal Remediation
lbs	pounds
Leader	Leader Professional Services Inc.
LTM	Long-Term Monitoring
µg/L	micrograms per liter
ng/L	nanograms per liter
NYCRR	New York Codes, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OM&M	operation, maintenance, and monitoring
PCE	tetrachloroethene
ppm	parts per million
%	percent
PPE	personal protection equipment
PRAP	Proposed Remedial Action Plan
RAO	Remedial Action Objective
RCSD	Rochester City School District
REC	recognized environmental condition

RE&LS	Ravi Engineering & Land Surveying, P.C.
RI	Remedial Investigation
ROD	Record of Decision
SCG	Standards, Criteria, and Guidance
SCO	soil cleanup objective
SF	square foot
site	Former Silver Cleaners Site (Site #828186), located at 245 Andrews Street, 159-169 Pleasant Street, and 151 Pleasant Street in the City of Rochester, Monroe County, New York
SMP	Site Management Plan
SS	sub-slab
SVI	soil vapor intrusion
TCE	trichloroethene
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound

1 INTRODUCTION

On behalf of the New York State Department of Environmental Conservation (NYSDEC), Arcadis CE, Inc. (Arcadis) has prepared this Feasibility Study (FS) to evaluate remedial alternatives at the Former Silver Cleaners site (Site #828186), located at 245 Andrews Street, 159-169 Pleasant Street, and 151 Pleasant Street in the City of Rochester, Monroe County, New York (site) (Figures 1-1 and 1-2). The FS was conducted under NYSDEC State Superfund Standby Contract Work Assignment No. D007618-31.2. 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 Technical Guidance for Site Investigation and Remediation (DER-10) (NYSDEC 2010).

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

This FS was completed in accordance with DER-10 (NYSEC 2010); the NYSDEC's guidance on presumptive remedies as defined in 6 New York Codes, Rules and Regulations (NYCRR) Part 375; the NYSDEC's DER program policy for Presumptive/Proven Remedial Technologies; the NYSDEC's DER program policy for Green Remediation; and other appropriate NYSDEC and United States Environmental Protection Agency (USEPA) guidance.

1.1 Physical Setting

The site is located in downtown Rochester, New York (Figure 1-1), and consists of three contiguous parcels totaling 0.30 acres. The site consists of a one-story, vacant, commercial building and an asphalt parking lot that is currently used as a permit-only parking lot. The site is bordered to the north by Andrews Street, to the east by North Clinton Avenue, and a triangle-shaped parcel owned by the City of Rochester. Bordering to the west of the site, the building at 237-241 Andrews Street consists of a basement with utilities and storage, a first floor with businesses, and second and third floors with residential units. Bordering to the south of the site are the building at 113 North Clinton Avenue (also known as Elk Place), the building at 111 North Clinton Avenue, and a parking lot. The building at 113 North Clinton Avenue consists of a basement with a utility room and storage and residential apartment units on the first through fifth floors. The building at 111 North Clinton Avenue is owned by the Rochester City School District (RCSD) (RCSD School No. 90) and consists of a basement (utilities and storage) and two floors of classrooms, as well as a parking lot (Figure 1-2). Site topography is generally flat with approximate elevations of 530 to 526.4 feet (ft) above mean sea level.

1.2 Regional Geology/Hydrogeology

Surficial soils are mapped as lacustrine silt and clay deposits (Cadwell and Muller 1986). Characterization of soil samples collected during the Remedial Investigation (RI), as shown on the geological cross-sections for the site (Figures 1-3 through 1-5), confirmed the presence of subsurface materials consistent with pro-glacial lacustrine deposits (sand, silt, gravel, and clay) which overlies a dense glacial till (densely packed sand, silt, and gravel), followed by a thin layer of silty sand, and then bedrock. Bedrock beneath the site is mapped as the Penfield Dolostone Unit of the Upper Silurian Lockport Group (Fisher and

Rickard 1970). Rock core samples collected during the RI confirm that bedrock beneath the site is dolomite.

Figure 1-6 (shallow groundwater) and Figures 1-7 and 1-8 (deep groundwater) represent groundwater elevation contours and flow directions for the site (based on groundwater elevations collected in November 2018 and May 2019). Groundwater at the site generally flows to the north and (presumably) northwest where it ultimately discharges to the Genesee River, which is located approximately 1000 feet west of the site (Figure 1-1).

1.3 Previous Investigations

In 2012, Ravi Engineering & Land Surveying, P.C. (RE&LS) completed a Phase I Environmental Site Assessment (ESA) of the site for D4 Discovery and the City of Rochester through Rochester's Brownfield Assistance Program (RE&LS 2012). The Phase I ESA identified the following recognized environmental conditions (RECs) related to former operations at the site:

- Two 1,000-gallon gasoline underground storage tanks (USTs) and one (or two) 500-gallon USTs were utilized by several former service stations.
- Petroleum was potentially released to site soils and/or groundwater.
- The site building was occupied by a dry-cleaning business known to have used tetrachloroethene (PCE).
- PCE was potentially released to site soils and/or groundwater.

In 2012, Leader Professional Services Inc. (Leader) and RE&LS completed a Confirmatory Phase II ESA (Leader 2013) to confirm whether contaminants related to the above RECs had impacted the subsurface. The Phase II ESA included preforming a geophysical survey to locate former USTs and advancing soil borings to determine if RECs had impacted site soil and groundwater. The geophysical survey identified electromagnetic anomalies indicative of buried metal objects. A total of five soil borings were advanced to refusal at depths ranging from 2 to 13.8 ft below ground surface (bgs). Four of the locations were advanced in the building and one was advanced east of the building, near assumed locations of former USTs (Leader 2013).

Soil sample analytical results from borings advanced below the building slab (SB-1 at 7 ft bgs and SB-4 at 8 ft bgs) were less than unrestricted use soil cleanup objectives (SCOs). Analytical results from soil boring SB-5 at 8 ft bgs indicated that ethylbenzene (1.3 parts per million [ppm]), o-xylene (2.6 ppm), and m,p-xylene (5.9 ppm), near the former UST area, exceeded Part 375 unrestricted use SCOs. Soil samples were not collected from soil borings SB-2 and SB-3 for laboratory analysis. Analytical results for PCE concentrations in groundwater samples GW-1, collected from soil boring SB-1 at 7.5 ft bgs (7,890 micrograms/L [µg/L]) and GW-2, collected from soil boring SB-4 at 13.2 ft bgs (88,500 µg/L), exceeded the New York State Class GA Groundwater Standard (Class GA Standard) of 5 µg/L listed in the New York State Division of Water Technical and Operation Guidance Series version No. 1.1.1. Analytical results from groundwater sample GW-5, collected from soil boring SB-5 at 13.3 ft bgs, exceeded the respective Class GA Standard for ethylbenzene (1,040 µg/L), methylcyclohexane (826 µg/L), toluene (309 µg/L), naphthalene (699 µg/L), 1,2,4-trimethylbenzene (1,650 µg/L), 1,3,5-trimethylbenzene (630 µg/L), o-xylene (1,250 µg/L), and m,p-xylene (3,450 µg/L). Based on the concentrations of PCE in the groundwater collected at soil boring SB-4 (noted above), this area was suspected to be a potential source area, and further investigations were conducted, as detailed below, to further delineate this potential source area.

In June 2014, Empire Geo Services, Inc. completed an off-site soil vapor intrusion (SVI) investigation in a building located south of the site at 111 North Clinton Avenue. Five sub-slab (SS) vapor and five co-located indoor air samples were collected from various locations in the basement (Empire 2014). The following results were reported:

- Concentrations of PCE and 1,1,1-trichloroethane in the SS vapor samples were all less than values published in Matrix 2 of the 2006 New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York (100 µg/L).
- Indoor air sample results for PCE were reported as not detected.

Matrix 1 of the 2006 NYSDOH guidance document referenced above was used to evaluate both carbon tetrachloride and trichloroethene (TCE) concentration results:

- Carbon tetrachloride concentrations in the SS vapor samples were all less than 5 µg/L but greater than 0.25 µg/L in the indoor air samples.
- TCE concentrations in four of the SS vapor samples were less than 5 µg/L and less than 0.25 µg/L in the Indoor air samples. TCE results in the two remaining SS vapor samples (parent and duplicate) were between 5 µg/L and 50 µg/L but less than 0.25 µg/L in the corresponding indoor air samples.

Empire Geo Services completed the investigation and submitted a summary letter report to the NYSDEC. Recommendations for further investigation were not provided in the letter.

2 REMEDIAL INVESTIGATION SUMMARY

The scope of work for the RI was designed to further evaluate the nature and extent of PCE- and petroleum-related compounds in soil and groundwater at the site and the potential for SVI into adjacent properties as a result of former site operations. The scope of work included the following:

- Preliminary review of historical documents and an initial site walk
- Asbestos containing material survey
- Geophysical survey
- Soil boring advancement and soil sampling
- Test pit excavation
- Overburden piezometer and monitoring well and bedrock monitoring well installation
- Well development and hydraulic conductivity testing
- Groundwater and sump water sampling
- Off-site soil vapor sampling

The analytical results from the RI are summarized on Figures 2-1 through 2-4 (Arcadis 2020).

The primary contaminants of potential concern (COPCs) in both the soil and groundwater are PCE and its daughter product, TCE. Secondary COPCs consist of residual petroleum-related constituents, such as benzene, toluene, ethylbenzene, xylenes (BTEX); 1,2,4-trimethlybenzene; and naphthalene. These petroleum-related COPCs were detected at the highest concentrations in the shallow zone surrounding the UST excavation area.

Select groundwater samples were collected and analyzed for per- and polyfluoroalkyl substances and 1,4 dioxane. Perfluorooctanoic acid and perfluorooctanesulfonic acid were both detected at concentrations greater than the proposed maximum contaminant level of 10 nanograms per liter (ng/L) in injection well IW-1 (12 ng/L and 25 ng/L, respectively) and piezometer PZ-9 (19 ng/L and 25 ng/L, respectively). 1,4-dioxane was not detected at a concentration greater than the laboratory reporting limit in the select groundwater samples.

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

Concentrations of primary COPCs are greatest near the south side of the site building in the deep and shallow groundwater and decrease hydraulically downgradient of the PCE source area. The vertical extent of the chlorinated solvents is not fully delineated as analytical results from groundwater collected from bedrock well (BRW-2) showed PCE concentrations greater than the respective Class GA Standard. Concentrations of BTEX compounds are greatest in shallow overburden groundwater beneath and adjacent to the former service station area. The extent of dissolved-phase COPCs is not fully delineated as groundwater from the farthest sample locations downgradient to the north and cross-gradient to the west of the site contain chlorinated solvent COPCs at concentrations greater than the Class GA

Standard. Volatile organic compounds (VOCs) are also present in the indoor air and SS vapor at the adjacent properties (237-241 Andrews Street and 113 North Clinton Avenue).

The data indicates that there was a historical release of chlorinated solvents into the sand and fill material either beneath the site building slab, near the southern edge of the site building, or just outside the site building's south wall. Data also indicates a historical release of petroleum-related constituents (BTEX) to the shallow overburden in the vicinity of the former service station. PCE and TCE appear to have migrated through the silty sand and dense till and into bedrock. Preferential pathways in the till or bedrock fractures could be acting as a means for separate-phase and/or dissolved-phase COPC migration. Dissolved-phase VOCs in shallow and deep overburden have migrated north and northwest with groundwater flow. The extent of VOCs in the bedrock water is unknown. Concentrations of PCE in shallow and deep overburden groundwater indicate that residual separate-phase product is likely present, although it was not observed in groundwater or soil during the RI or previous investigations. Secondary COPCs are highest in the shallow overburden groundwater, but some BTEX has migrated to the deep overburden, indicating that the dense till is acting as a semi-confining layer.

3 QUALITATIVE EXPOSURE/RISK ASSESSMENT

A qualitative human health exposure pathway 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) a contaminant release and transport mechanism, (3) a point of exposure, (4) a route of exposure, and (5) a receptor population. The plausible exposure pathways are discussed below by medium.

3.1 Soil

Soil containing PCE at a concentration greater than its respective commercial SCO is present below the site building. The soil is covered by the building slab and approximately 12 ft of overburden; therefore, it is unlikely that a direct soil pathway exists. However, future excavation activities could expose workers to subsurface soils via dermal contact, incidental ingestion, and inhalation of airborne soil particulates.

Soils from beneath the parking area east of the site building contains benzo(a)pyrene at concentrations equal to or slightly greater than its respective commercial SCO. As described above, and because soils are covered by asphalt, there is no direct soil exposure pathway unless excavation activities occur.

3.2 Groundwater

No direct contact groundwater exposure pathways are known to exist. Groundwater is not used for potable, commercial, agricultural, or industrial purposes at or near the site. The City of Rochester Code states that “No person shall use for drinking purposes, or in the preparation of food intended for human consumption, any water except the potable water supply authorized for public use by the City of Rochester” (City of Rochester Code, Part II, Chapter 59, Article III, Section 59-27, A). The City of Rochester obtains its drinking water from Hemlock and Candice Lakes and supplements the supply with Lake Ontario water purchased from the Monroe County Water Authority (City of Rochester 2019).

Potential human receptors include on-site construction and utility workers who could be exposed to site groundwater. Complete exposure pathways for construction and utility workers include dermal contact and incidental ingestion.

There is a potential for direct contact with groundwater entering basement sumps in the surrounding buildings. Sump water is typically representative of water infiltration at the basement foundation walls from surface runoff or shallow groundwater. A sump’s pump is typically more active after heavy rain events or after periods of wetter-than-normal weather. As detailed above, several VOCs were detected at concentrations greater than the Class GA Standard, and there is a potential exposure pathway through dermal contact and incidental ingestion if precautions are not taken.

3.3 Soil Vapor

The basic model for SVI is vertical migration of vapors containing VOCs from a subsurface source to indoor air through cracks, foundation joints, or other openings in the floor. Indoor air COPC concentrations in samples collected from both buildings adjacent to the site during the RI are greater than the applicable NYSDOH air guideline values. Potential human receptors include occupants in the building west of the site and residents in the building southeast of the site. Potentially complete exposure pathways for off-site employees or residents related to SVI include inhalation of indoor air because of elevated VOC concentrations in SS vapor and the potential for SVI. As discussed in the RI, complete SVI pathways have been noted at two adjacent buildings. A sub-slub depressurization system (SSDS) has been installed in the building at 237-239 Andrews Street by the NYSDEC.

4 REMEDIAL ACTION OBJECTIVES AND EVALUATION CRITERIA

The remedial goal for the site is the restoration of the site to pre-release conditions, to the extent feasible, given the existing and potential future land use and the presence of historic fill. At this time, the end use of the property is not known. It is expected to either be consistent with commercial land use or has the potential in the future to be used for restricted residential land use.

4.1 Remedial Action Objectives

The Remedial Action Objectives (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.
- Potential for human exposure to in-situ contaminated media.

4.1.1 Soil

The RAOs for soil are listed below:

- Prevent ingestion/direct contact with contaminated soil.
- Prevent inhalation exposure to contaminants volatilizing from soil.
- Prevent migration of contaminants that would result in groundwater contamination.

4.1.2 Groundwater

The RAOs for groundwater are listed below:

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of, volatiles from contaminated groundwater.
- Remove the source of groundwater contamination, to the extent practicable.

4.2 Evaluation Criteria

In accordance with DER-10 (NYSDEC 2010), the remedial measure alternatives developed in this FS 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

4.2.1 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 CPOC is to be eliminated, reduced, or controlled for each alternative.

4.2.2 Compliance with Standards, Criteria, and Guidance

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

4.2.3 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.

4.2.4 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.

4.2.5 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.

4.2.6 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.

4.2.7 Cost

Cost estimates are prepared and evaluated for each alternative. The cost estimates include capital costs; operation, maintenance, and monitoring (OM&M) costs; and future closeout costs. A cost sensitivity analysis is performed, which includes the following factors: the effective life of the remedial action, the OM&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 FS generally have an expected accuracy range of -30% to +50% (USEPA 2000).

4.2.8 Community Acceptance

Following the 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 an 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 the 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.

4.3 Identification and Screening of Technologies

General response actions, which may be effective remedies for the remediation of groundwater and/or soil at the site, and remedial technologies are identified and screened in Tables 4-1 through 4-4. Remedial alternatives are identified and evaluated relative to multiple criteria in Tables 4-5 and 4-6, respectively.

5 REMEDIAL ALTERNATIVES ANALYSIS

Based on the site characteristics, technology screening, and in consultation with the NYSDEC, the following remedial alternatives are considered to be potentially applicable to address soil and groundwater contamination at the site:

Alternative 1: No Further Action

Alternative 2: Site Management and Long-Term Monitoring (LTM)

Alternative 3: In-Situ Thermal Remediation (ISTR)

Alternative 4: Enhanced Reductive Dechlorination (ERD)

Alternative 5: In-Situ Chemical Oxidation (ISCO)

Alternative 6: Excavation and ISCO via Injection Infiltration Gallery

Alternative 7: Restoration to Pre-Disposal Conditions

This section presents an analysis of the potential remedial alternatives for remediation of the site evaluated against the criteria described in Section 4.2. The active remediation alternatives (Alternatives 3 through 7) focus on addressing the PCE concentrations in soil and groundwater. Because a source of BTEX was not identified in the RI and the BTEX in soil and groundwater appear to be residual concentrations that will naturally attenuate over time, BTEX in soil and groundwater are not specifically addressed in the remedial alternatives presented below.

Except for Alternative 1, each alternative will require institutional controls in the form of a site management plan and an environmental easement that will be used to address monitoring requirements and future use of the site. It should be noted that each of the above remedial alternatives, including Alternative 1, assume that SVI mitigation is implemented where required by the NYSDEC/NYSDOH (include ongoing mitigation efforts) independently the chosen remedial action for the site. Therefore, SVI mitigation efforts are not discussed in the evaluation of remedial alternatives presented below.

5.1 Remedial Alternatives Evaluation

5.1.1 Alternative 1: No Further Action

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 (NYSDEC 2010), 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. The site building and its contents would remain in their current state.

Alternative 1 would include abandoning the 23 monitoring wells installed during the remedial investigations, which are depicted on Figure 5-1 and listed below:

Wells to Abandon

- BRW-1
- BRW-2
- BRW-3
- IW-1
- MW-1
- MW-2
- OBW-1
- OBW-2
- OBW-3
- OBW-5
- OBW-6
- OBW-7
- OBW-8
- OBW-9
- PZ-1
- PZ-2
- PZ-3
- PZ-4
- PZ-5
- PZ-6
- PZ-7
- PZ-8
- PZ-9

5.1.1.1 Overall Protection of Human Health and the Environment

Alternative 1 would not be protective of public health and the environment as soil and groundwater containing CPOCs at concentrations greater than applicable soil and groundwater standards would remain at the site. Although the nearest receptors are supplied with public drinking water and are prohibited from using groundwater as a source of potable water, the potential for future exposure to contaminated soil and groundwater via construction/excavation activities at the site would also remain.

5.1.1.2 Compliance with Standards, Criteria, and Guidance

Alternative 1 would not meet the SCGs as contamination would persist at concentrations greater than standards/guidelines in soil and groundwater.

5.1.1.3 Long-Term Effectiveness and Permanence

Alternative 1 would not meet the SCGs over the long term as contamination would persist at concentrations greater than standards/guidelines in soil and groundwater.

5.1.1.4 Reduction of Toxicity, Mobility, and Volume

Alternative 1 would not reduce the toxicity or mobility of the contaminants. The volume of the contamination may be reduced over the long-term through natural attenuation.

5.1.1.5 Short-Term Effectiveness

Community Protection

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

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 that 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 require less than one year to implement.

5.1.1.6 Implementability

The No Further Action alternative can be easily implemented.

5.1.1.7 Cost

The capital and present worth costs for Alternative 1 are presented in Table 5-1. There are no OM&M costs.

- Capital Costs: The probable capital cost to construct and implement Alternative 1 is approximately $38,000.
- Present Worth Cost: The probable net present worth for this alternative is approximately $38,000.

5.1.1.8 Community Acceptance

Community acceptance evaluation criteria will be addressed during the public comment period before the ROD is issued.

5.1.2 Alternative 2: Site Management and Long-Term Monitoring

Alternative 2 includes the following elements, which are depicted on Figure 5-2.

- Implementation of deed and access restrictions and institutional controls to limit site and groundwater use and limit access to soil through the establishment of a Site Management Plan (SMP).
- LTM implementation, which includes annual groundwater monitoring of the 23 existing wells for VOCs, to be conducted for 30 years.
- Annual inspections to ensure institutional controls are maintained.
- Abandonment of all 23 on-site monitoring wells after 30 years, as listed in Section 5.1.1.

5.1.2.1 Overall Protection of Human Health and the Environment

Alternative 2 would potentially be protective of public health and the environment as exposures would be mitigated by site restrictions; however, soil and groundwater containing CPOCs at concentrations greater than applicable soil and groundwater standards 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. However, maintaining institutional controls would reduce potential exposure to residual concentrations.

5.1.2.2 Compliance with Standards, Criteria, and Guidance

Alternative 2 would not meet the SCGs as contamination would persist at concentrations greater than standards/guidelines in soil and groundwater.

5.1.2.3 Long-Term Effectiveness and Permanence

Alternative 2 would not meet the SCGs over the long term as contamination would persist at concentrations greater than standards/guidelines in soil and groundwater.

5.1.2.4 Reduction of Toxicity, Mobility, and Volume

Alternative 2 would not reduce the toxicity or mobility of the contaminants. The volume of the contamination may be reduced over the long-term through natural attenuation.

5.1.2.5 Short-Term Effectiveness

Community Protection

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

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 that 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 be implemented for 30 years.

5.1.2.6 Implementability

Alternative 2 can be easily implemented.

5.1.2.7 Cost

The capital, OM&M, and present worth costs for Alternative 2 are presented in Table 5-2. A 30-year implementation period was chosen for this alternative.

- Capital Costs: The probable capital cost to construct and implement this alternative is approximately $65,000.

- OM&M Costs: The probable annual OM&M cost for this alternative is $20,000. The final year's OM&M cost for this alternative is $23,000.
- Present Worth Cost: Over a 30-year implementation period, the probable net present worth for this alternative is approximately $393,000. This was calculated using a 5% annual discount rate.

5.1.2.8 Community Acceptance

Community acceptance evaluation criteria will be addressed during the public comment period before the ROD is issued.

5.1.3 Alternative 3: In-Situ Thermal Remediation

Alternative 3 includes the following elements, which are depicted on Figure 5-3:

- Demolition of the existing site building and abandonment of 13 on-site wells.
- Installation of 10 pre-heater wells, with an 8inch diameter, to a depth of approximately 15 ft below grade (to till). Each pre-heater well includes heater elements, carbon-steel casings, stainless-steel sleeves, and control boxes.
- Installation of 81 heater wells, with an 8-inch diameter, to a depth of approximately 35 ft below grade (5 ft below the target treatment depth). Each heater well includes heater elements, carbon-steel casings, stainless-steel sleeves, and control boxes. The heater wells will have a spacing distance of up to 12 ft.
- Installation of 40 vertical vapor extraction wells, with a 4-inch diameter, to a depth of approximately 30 ft below grade (to bedrock). The materials needed to install vertical extraction wells include carbon-steel casings, sand packs, and stainless-steel screens. The number of vertical extraction wells is estimated based on the surface area of the treatment zone.
- Installation of 15 temperature monitoring points, with a 4-inch diameter, to a depth of approximately 30 ft below grade. The materials needed to install temperature monitoring points include high temperature grout and carbon-steel pipe.
- Installation of 15 pressure monitoring points, with a 4-inch diameter, to a depth of approximately 10 ft below grade (to the water table). The materials needed to install pressure monitoring points include high temperature grout and carbon-steel pipe.
    - Abandonment of these wells and points following remedy implementation.
- Installation of a 6,300 square foot (SF), 12-inch- thick concrete vapor cover.
- Installation of wellfield piping and electrical wiring (including, but not limited to: vapor/water conveyance lines, power/gas connections to heater wells/electrodes and heater/electrode control systems, and electrical connections and components to construct a functional ISTR well field) around the former building area in groundwater that exceeds the Class GA Standard.

- Installation of an above-grade in-situ treatment system, which includes but is not limited to: electrical/mechanical gear, cabling, wiring, piping, primary/secondary distribution panels, instrumentation control systems, back-up generator(s), and liquid/vapor treatment systems.
- LTM implementation, including annual groundwater monitoring of the 10 on-site wells for VOCs, which would be conducted for 5 years.
- Abandonment of all 10 remaining on-site monitoring wells after 5 years, as listed in Section 5.1.1.

5.1.3.1 Overall Protection of Human Health and the Environment

Alternative 3 would be protective of public health and the environment as the source of the impacted soil and groundwater would be treated through ISTR.

5.1.3.2 Compliance with Standards, Criteria, and Guidance

Alternative 3 would meet soil SCGs and groundwater SCGs over the long-term by treating the source of the impacted soil and groundwater.

5.1.3.3 Long-Term Effectiveness and Permanence

Alternative 3 would be effective in the long-term through treating the source of the impacted soil and groundwater.

5.1.3.4 Reduction of Toxicity, Mobility, and Volume

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

5.1.3.5 Short-Term Effectiveness

Community Protection

Enhanced protection measures for mitigation of environmental impacts and nuisance conditions would be implemented during all active phases of this alternative. These measures include, but are not limited to, implementation of a community air monitoring plan (CAMP), a dust control plan, vapor cover, temperature and pressure monitoring points, geotechnical monitoring of surrounding buildings, and erosion and sedimentation controls and installation of temporary fencing.

Worker Protection

Implementation of this alternative would be undertaken using enhanced procedures for worker protection, including the establishment of a health and safety plan, which would outline the appropriate protective measures that should be undertaken during all on-site work. In addition, daily job briefing meetings would be held to discuss the anticipated work to be completed each day. Health and safety controls will be implemented to ensure electrical or heat-related injuries do not occur.

Environmental Impacts

Implementation of this alternative could create adverse environmental impacts through the volatilization of VOCs and the dewatering/heating of the subsurface; however, these impacts would be mitigated through the monitoring and controls described above.

Time Required to Implement

It is anticipated that this alternative would be implemented and completed within 2 years from the start of construction, and the LTM would occur for 5 years.

5.1.3.6 Implementability

Alternative 3 could be implemented using readily available technologies, but would require extensive site controls and remedial infrastructure.

5.1.3.7 Cost

The capital, OM&M, and present worth costs for Alternative 3 are presented in Table 5-3. A 5-year implementation period was chosen for this alternative.

- Capital Costs: The probable capital cost to construct and implement this alternative is approximately $3,170,000.
- OM&M Costs: The probable annual OM&M cost for this alternative is $20,000. The final year's OM&M cost for this alternative is $10,000.
- Present Worth Cost: Over a 5-year implementation period, the probable net present worth for this alternative is approximately $3,270,000. This was calculated using a 5% annual discount rate.

5.1.3.8 Community Acceptance

Community acceptance evaluation criteria will be addressed during the public comment period before the ROD is issued.

5.1.4 Alternative 4: Enhanced Reductive Dechlorination

Alternative 4 includes the following elements, which are depicted on Figure 5-4:

- Demolition of the existing building.
- Installation of 28 four-inch shallow and intermediate injection wells and 12 two-inch shallow and intermediate performance monitoring wells around the former building area in overburden groundwater that exceeds the unrestricted SCOs. The shallow injection and performance monitoring wells will be 13 ft and 15 ft in depth, respectively, and the intermediate injection and performance monitoring wells will be 30 ft in depth.
- Injection of 5,000 pounds (lbs) of emulsified vegetable oil in a 5,700 SF area twice per year for 3 year

s

for a total of 6 injection events.

- Semi-annual monitoring of 35 on-site wells during a 3-year timeframe.

- LTM implementation, including annual groundwater monitoring of the 35 on-site wells for VOCs, which would be conducted for 10 years.
- Abandonment of all site monitoring and injection wells after 10 years.

5.1.4.1 Overall Protection of Human Health and the Environment

Alternative 4 would be protective of public health and the environment as the source of the impacted soil and groundwater would be treated through ERD.

5.1.4.2 Compliance with Standards, Criteria, and Guidance

Alternative 4 would meet soil SCGs and groundwater SCGs over the long-term by treating the source of the impacted soil and groundwater.

5.1.4.3 Long-Term Effectiveness and Permanence

Alternative 4 would be effective in the long-term through treating the source of the impacted soil and groundwater.

5.1.4.4 Reduction of Toxicity, Mobility, and Volume

Alternative 4 would reduce the toxicity and volume of the contaminants over time through multiple injections of emulsified vegetable oil.

5.1.4.5 Short-Term Effectiveness

Community Protection

Standard protection measures for mitigation of environmental impacts and nuisance conditions would be implemented during all phases of this alternative. These measures include, but are not limited to, implementation of a CAMP, a dust control plan, secured and ventilated chemical storage area, chemical secondary containment, and erosion and sedimentation controls and installation of temporary fencing.

Worker Protection

Implementation of this alternative would be undertaken using enhanced procedures for worker protection, including the establishment of a health and safety plan, which would outline the appropriate protective measures that should be undertaken during any all on-site work. In addition, daily job briefing meetings would be held to discuss the anticipated work to be completed each day. During the EVO injection, modified Level C personal protection equipment (PPE) will be required for handling, storing, and injecting the chemical. As EVO is injected, pressures will be monitored and recorded to avoid pressure buildups and injuries.

Environmental Impacts

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

Time Required to Implement

It is anticipated that this alternative would be implemented and completed within 4 years, and the LTM would occur for 10 years.

5.1.4.6 Implementability

Alternative 4 can be implemented using readily available technologies, such as hollow stem auger drilling via easily maneuverable drill rigs and temporary injection system set ups.

5.1.4.7 Cost

The capital, OM&M, and present worth costs for Alternative 4 are presented in Table 5-4. A 10-year implementation period was chosen for this alternative.

- Capital Costs: The probable capital cost to construct and implement this alternative is approximately $2,480,000.
- OM&M Costs: The probable annual OM&M cost for this alternative is $25,000. The final year's OM&M cost for this alternative is $63,000.
- Present Worth Cost: Over a 10-year implementation period, the probable net present worth for this alternative is approximately $2,730,000. This was calculated using a 5% annual discount rate.

5.1.4.8 Community Acceptance

Community acceptance evaluation criteria will be addressed during the public comment period before the ROD is issued.

5.1.5 Alternative 5: In-Situ Chemical Oxidation

Alternative 5 includes the following elements, which are depicted on Figure 5-5:

- Demolition of the existing building.
- Installation of 26 two-inch shallow and intermediate injection wells and 12 two-inch shallow and intermediate performance monitoring wells around the former building area in locations with groundwater concentrations exceeding the Class GA Standard. The shallow injection and performance monitoring wells will be 13 ft and 15 ft in depth, respectively, and the intermediate injection and performance monitoring wells will be 30 ft in depth.
- Injection of 48,000 lbs of 4 percent (%) sodium permanganate in a 5,700 SF area once every 6 to 9 months for 3 years, for a total of four injection events.
- Quarterly monitoring for the first 2 years and semi-annual monitoring for the last 2 years of 35 on-site wells during a 4-year timeframe.
- LTM implementation, including annual groundwater monitoring of the 35 on-site wells for VOCs, which would be conducted for 10 years.
- Abandonment of all monitoring and injection wells after 10 years.

5.1.5.1 Overall Protection of Human Health and the Environment

Alternative 5 would be protective of public health and the environment as the source of the impacted soil and groundwater would be treated through ISCO.

5.1.5.2 Compliance with Standards, Criteria, and Guidance

Alternative 5 would meet soil SCGs and groundwater SCGs over the long-term by treating the source of the impacted soil and groundwater.

5.1.5.3 Long-Term Effectiveness and Permanence

Alternative 5 would be effective in the long-term through treating the source of the impacted soil and groundwater.

5.1.5.4 Reduction of Toxicity, Mobility, and Volume

Alternative 5 would reduce the toxicity and volume of the contaminants over time through multiple injections of sodium permanganate.

5.1.5.5 Short-Term Effectiveness

Community Protection

Enhanced protection measures for mitigation of environmental impacts and nuisance conditions would be implemented during all phases of this alternative. These measures include, but are not limited to, implementation of a CAMP, a dust control plan, secured and ventilated chemical storage area, chemical secondary containment, and erosion and sedimentation controls and installation of temporary fencing.

Worker Protection

Implementation of this alternative would be undertaken using enhanced procedures for worker protection, including the establishment of a health and safety plan, which would outline the appropriate protective measures that should be undertaken during any all on-site work. In addition, daily job briefing meetings would be held to discuss the anticipated work to be completed each day. Due to the chemical strength of sodium permanganate, modified Level C personal protection equipment (PPE) will be required for handling, storing, and injecting the chemical. As sodium permanganate is injected, pressures will be monitored and recorded to avoid pressure buildups and injuries.

Environmental Impacts

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

Time Required to Implement

It is anticipated that this alternative would be implemented and completed within 5 years, and the LTM would occur for 10 years.

5.1.5.6 Implementability

Alternative 5 can be implemented using readily available technologies, such as hollow stem auger drilling via easily maneuverable drill rigs and temporary injection system set ups.

5.1.5.7 Cost

The capital, OM&M, and present worth costs for Alternative 5 are presented in Table 5-5. A 10-year implementation period was chosen for this alternative.

- Capital Costs: The probable capital cost to construct and implement this alternative is approximately $2,940,000.
- OM&M Costs: The probable annual OM&M cost for this alternative is $25,000. The final year's OM&M cost for this alternative is $61,000.
- Present Worth Cost: Over a 10-year implementation period, the probable net present worth for this alternative is approximately $3,190,000. This was calculated using a 5% annual discount rate.

5.1.5.8 Community Acceptance

Community acceptance evaluation criteria will be addressed during the public comment period before the ROD is issued.

5.1.6 Alternative 6: Excavation and In-Situ Chemical Oxidation via Infiltration Gallery

Alternative 6 includes the following elements, which are depicted on Figure 5-6:

- Abandoning the 10 monitoring wells and piezometers shown on Figure 5-6:

  Wells to Abandon

  - BRW-2
  - BRW-3
  - IW-1
  - OBW-2
  - OBW-3
  - PZ-1
  - PZ-6
  - PZ-7
  - PZ-8
  - PZ-9
- Demolition of the existing building
- Excavation of approximately 1,950 cubic yards of soil below the former building area to a depth of 20 ft below finished floor.
- Sloping and/or shoring, as required, for safe working conditions.
- Dewatering of approximately 40,000 gallons of groundwater below the former building area that exceed the groundwater SCOs, and disposing of groundwater off site in accordance with applicable federal, state, and local regulations.

- Disposing excavated soil off site in accordance with applicable federal, state, and local regulations.
- Installing chemical injection and conveyance piping in a permeable backfill layer in the bottom of the excavation in the former building area to a common header at grade.
- Backfilling of excavation with clean off-site fill.
- Installing eight 2-inch performance monitoring wells.
- Injecting 12,000 lbs of 4% sodium permanganate within the excavated area using chemical injection piping once every 6 to 9 months for 3 years, for a total of 3 injection events.
- Quarterly monitoring for the first 2 years and semi-annual monitoring for the last 2 years of 35 on-site wells during a 4-year timeframe.
- LTM implementation, including annual monitoring of the 31 on-site wells for VOCs, which would be conducted for 5 years.
- Abandonment of all on-site wells and grouting/sealing of the infiltration gallery after 5 years, as listed in Section 5.1.1.

This alternative assumes that the on-site electrical lines in the vicinity of the excavation area would be protected or relocated.

5.1.6.1 Overall Protection of Human Health and the Environment

Alternative 6 would be protective of public health and the environment as the source of the impacted soil and groundwater would be removed with excavation and treated through subsequent ISCO.

5.1.6.2 Compliance with Standards, Criteria, and Guidance

Alternative 6 would meet soil SCGs over the short-term and should meet groundwater SCGs over the long-term by treating the source of the impacted soil and groundwater.

5.1.6.3 Long-Term Effectiveness and Permanence

Alternative 6 would be effective in the long-term through treating the source of the impacted soil and groundwater.

5.1.6.4 Reduction of Toxicity, Mobility, and Volume

Alternative 6 would reduce the toxicity, mobility, and volume of the contaminants as excavation into the till would limit and reduce the mobility and concentration of VOCs from the till into the groundwater matrix by less matrix diffusion. Injection of sodium permanganate into the chemical conveyance and injection piping would also reduce residual VOC concentrations in the till.

5.1.6.5 Short-Term Effectiveness

Community Protection

Enhanced protection measures for mitigation of environmental impacts and nuisance conditions would be implemented during all phases of this alternative. These measures include, but are not limited to, implementation of a CAMP, a dust control plan, secured and ventilated chemical storage area, chemical secondary containment, and erosion and sedimentation controls and installation of temporary fencing.

Worker Protection

Implementation of this alternative would be undertaken using enhanced procedures for worker protection, including the establishment of a health and safety plan, which would outline the appropriate protective measures that should be undertaken during any all on-site work. In addition, daily job briefing meetings would be held to discuss the anticipated work to be completed each day. Due to the chemical strength of sodium permanganate, modified Level C personal protection equipment (PPE) will be required for handling, storing, and injecting the chemical. As sodium permanganate is injected, pressures will be monitored and recorded to avoid pressure buildups and injuries.

Environmental Impacts

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

Time Required to Implement

It is anticipated that this alternative would be implemented and completed within 5 years, and the LTM would occur for 5 years.

5.1.6.6 Implementability

Alternative 6 can be implemented using readily available technologies, such as excavators, hollow stem auger drilling via easily maneuverable drill rigs, and temporary injection system set ups. However, it is likely that extensive shoring would be required to stabilize the excavation and prevent damage to surrounding buildings and/or subsurface infrastructure.

5.1.6.7 Cost

The capital, OM&M, and present worth costs for Alternative 6 are presented in Table 5-6. A 5-year implementation period was chosen for this alternative.

- Capital Costs: The probable capital cost to construct and implement this alternative is approximately $3,170,000.
- OM&M Costs: The probable annual OM&M cost for this alternative is $25,000. The final year's OM&M cost for this alternative is $31,000.
- Present Worth Cost: Over a 5-year implementation period, the probable net present worth for this alternative is approximately $3,310,000. This was calculated using a 5% annual discount rate.

5.1.6.8 Community Acceptance

Community acceptance evaluation criteria will be addressed during the public comment period before the ROD is issued.

5.1.7 Alternative 7: Restoration to Pre-Disposal Conditions

Alternative 7 includes the following elements, which are depicted on Figure 5-7:

- Demolition of the existing building and abandonment of 17 on-site wells.
- Installation of 256 heater wells, with an 8-inch diameter, to a depth of approximately 50 ft below grade (5 ft below the target treatment depth). Each heater well includes heater elements, carbon-steel casings, stainless-steel sleeves, and control boxes. The wells will have a spacing distance of up to 12 ft.
- Installation of 30 pre-heater wells, with an 8-inch diameter, to a depth of approximately 15 ft below grade (to till). Each pre-heater well includes heater elements, carbon-steel casings, stainless-steel sleeves, and control boxes.
- Installation of 120 vertical vapor extraction wells, with a 4-inch diameter, to a depth of approximately 30 ft below grade (to bedrock). The materials needed to install vertical extraction wells include carbon-steel casings, sand packs, and stainless-steel screens. The number of vertical extraction wells is estimated based on the surface area of the treatment zone.
- Installation of 50 temperature monitoring points, with a 4-inch diameter, to a depth of approximately 45 ft below grade. The materials needed to install temperature monitoring points include high temperature grout and carbon-steel pipe.
- Installation of 50 pressure monitoring points, with a 4-inch diameter, to a depth of approximately 10 ft below grade (to the water table). The materials needed to install pressure monitoring points include high temperature grout and carbon-steel pipe.
    - Abandonment of these wells and points following remedy implementation.
- Installation of a 30,100 SF, 12-inch-thick concrete vapor cover.
- Wellfield piping and electrical wiring (including, but not limited to: vapor/water conveyance lines, power/gas connections to heater wells/electrodes and heater/electrode control systems, and electrical connections and components to construct a functional ISTR well field) around the former building area in groundwater that exceeds the Class GA Standard.
- Installation of an above-grade in-situ treatment system, which includes but is not limited to: electrical/mechanical gear, cabling, wiring, piping, primary/secondary distribution panels, instrumentation control systems, back-up generator(s), and liquid/vapor treatment systems.
- Abandonment of all 6 remaining on-site monitoring wells after 3 years, as listed in Section 5.1.1.

5.1.7.1 Overall Protection of Human Health and the Environment

Alternative 7 would be protective of public health and the environment as impacted soil and groundwater would be treated through ISTR.

5.1.7.2 Compliance with Standards, Criteria, and Guidance

Alternative 7 would meet soil SCGs over the short-term and should meet groundwater SCGs over the long-term by treating the impacted soil and groundwater.

5.1.7.3 Long-Term Effectiveness and Permanence

Alternative 7 would be effective in the long-term through treating remaining impacted soil and groundwater.

5.1.7.4 Reduction of Toxicity, Mobility, and Volume

Alternative 7 would reduce the toxicity, mobility, and volume of the contaminants.

5.1.7.5 Short-Term Effectiveness

Community Protection

Enhanced protection measures for mitigation of environmental impacts and nuisance conditions would be implemented during all active phases of this alternative. These measures include, but are not limited to, implementation of a community air monitoring plan (CAMP), a dust control plan, vapor cover, temperature and pressure monitoring points, geotechnical monitoring of surrounding buildings, and erosion and sedimentation controls and installation of temporary fencing.

Worker Protection

Implementation of this alternative would be undertaken using enhanced procedures for worker protection, including the establishment of a health and safety plan, which would outline the appropriate protective measures that should be undertaken during all on-site work. In addition, daily job briefing meetings would be held to discuss the anticipated work to be completed each day. Health and safety controls will be implemented to ensure electrical or heat-related injuries do not occur.

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 3 years to implement.

5.1.7.6 Implementability

Alternative 7 can be implemented using readily available technologies.

5.1.7.7 Cost

The capital, OM&M, and present worth costs for Alternative 7 are presented in Table 5-7. A 3-year implementation period was chosen for this alternative.

- Capital Costs: The probable capital cost to construct and implement this alternative is approximately $10,580,000.
- OM&M Costs: The final year's OM&M cost for this alternative is $6,000.
- Present Worth Cost: Over a 3-year implementation period, the probable net present worth for this alternative is approximately $10,590,000. This was calculated using a 5% annual discount rates.

5.1.7.8 Community Acceptance

Community acceptance evaluation criteria will be addressed during the public comment period before the ROD is issued.

5.2 Comparative Analysis

5.2.1 Overview

The RAOs for the site are concerned with the prevention of contact with contaminated soil and groundwater and the remediation of the affected media to pre-release conditions, Commercial SCOs, and the Class GA Standard, to the extent practicable. The alternatives presented for the site provide varying levels of remedial actions and are summarized in the table below.

Alternative	Name	Description	Likelihood of Meeting RAOs
1	No Further Action	Minimum steps for remediation.	Will not meet
2	Site Management Plan and LTM	Groundwater monitoring to document contaminant distribution and degradation over time.	May meet
3	In-Situ Thermal Remediation	Building demolition and active groundwater remediation.	Likely meet
4	Enhanced Reductive Dechlorination	Building demolition and active groundwater remediation.	Likely meet
5	In-Situ Chemical Oxidation	Building demolition and active groundwater remediation.	Likely meet
6	Excavation and Injection Infiltration Gallery	Building demolition and active groundwater remediation.	Likely meet
7	Restoration to Pre-Disposal or Groundwater Conditions	Building demolition and active groundwater remediation.	Will meet

5.2.2 Overall Protection of Public Health

Alternative 1 would not be protective of human health and the environment. CPOCs would remain in soil and groundwater. Alternative 2 would potentially be protective of human health and the environment as exposures would be mitigated by site restrictions, but CPOCs would remain in the soil and groundwater.

Alternatives 3, 4, and 5 provide more protection than Alternatives 1 and 2 in that direct contact exposure with residual soil and groundwater contamination would be reduced or eliminated through active groundwater treatment.

Alternatives 6 and 7 provide more protection than Alternatives 3, 4, 5, and 7 in that direct contact exposure with residual soil and groundwater contamination would be eliminated through active groundwater treatment in addition to excavation in Alternative 6.

5.2.3 Compliance with Standards, Criteria, and Guidance

Alternatives 1 and 2 would likely not meet the SCGs in a reasonable time period. Alternatives 3, 4, and 5 would meet the SCGs over the long term. Alternatives 6 and 7 are capable of meeting SCGs in less time than Alternatives 3, 4, and 5.

5.2.4 Long-Term Effectiveness and Permanence

Alternatives 1 and 2 would likely not be effective in the long-term. Alternatives 3, 4, and 5 would likely be effective in the long-term. Alternatives 6 and 7 would be effective in the long-term.

5.2.5 Reduction of Toxicity, Mobility, and Volume

Alternatives 1 and 2 would not reduce the toxicity or mobility of the contaminants. Alternatives 1 and 2 would reduce the contaminant volume over time through natural attenuation (i.e. no active remediation). Alternatives 3, 4, and 5 would reduce the contaminant volume over time. Alternatives 6 and 7 would reduce the toxicity, mobility, and volume of the contaminants.

5.2.6 Short-Term Effectiveness

The ranking of each of the alternatives, in order of Short-Term Effectiveness (from least impact to greatest), is shown below:

1. Alternative 1 – No Further Action.
2. Alternative 2 – Site Management and Long-Term Monitoring.
3. Alternative 4 – Enhanced Reductive Dechlorination.
4. Alternative 5 – In-Situ Chemical Oxidation.
5. Alternative 3 – In-Situ Thermal Remediation.
6. Alternative 6 – Excavation and Injection Infiltration Gallery.
7. Alternative 7 – Restoration to Pre-Disposal or Groundwater Conditions.

5.2.7 Implementability

Each of the alternatives could be implemented using available resources.

5.2.8 Cost

A comparison of the costs for each alternative is provided in Table 5-8. The ranking of each of the alternatives, in order of total cost (from lowest to highest) is shown below.

1. Alternative 1 – No Further Action.
2. Alternative 2 – Site Management and Long-Term Monitoring.
3. Alternative 4 – Enhanced Reductive Dichlorination.
4. Alternative 5 – In-Situ Chemical Oxidation.
5. Alternative 3 – In-Situ Thermal Remediation.
6. Alternative 6 – Excavation and Injection Infiltration Gallery.
7. Alternative 7 – Restoration to Pre-Disposal or Groundwater Conditions.

5.2.9 Community Acceptance

Community acceptance evaluation criteria will be addressed during the public comment period before the ROD is issued.

5.3 Comparative Evaluation of Alternatives

The No Further Action alternative (Alternative 1) is the least expensive and easiest to implement, but would like not meet the RAOs. The Site Management and LTM alternative (Alternative 2) is relatively inexpensive and easy to implement, and would be protective of human health and the environment. However , Alternative 2 would not results in the achievement of SCGs in a reasonable time period (i.e., less than 30 years). The In-Situ Thermal Remediation alternative (Alternative 3) would be effective at remediating CPOCs, but has high capital costs and will require extensive OM&M efforts. The ERD and ISCO alternatives (Alternatives 4 and 5, respectively) would be effective at minimizing CPOCs, but the low permeability of the soil will require multiple injection events, adding to the capital costs. The Restoration to Pre-Disposal or Groundwater Conditions alternative (Alternative 7) would be the most effective, most protective of human health and the environment, and most likely to produce uniform treatment, but its high capital cost and logistical constraints make this alternative impracticable.

Based on the overall protection of human health and the environment; compliance with SCGs; long-term effectiveness and permanence; reduction of toxicity, mobility, and volume; short-term effectiveness; implementability; and cost, the Excavation and Infiltration Gallery alternative (Alternative 6) would be the preferred alternative for reducing site contamination and meeting RAOs. The Excavation and Injection Infiltration Gallery alternative (Alternative 6) would be effective at minimizing CPOCs through removal and treatment of impacted soil and groundwater and would be protective of human health and the environment. Alternative 6 would be in compliance with SCGs in the treatment area and would reduce the toxicity, mobility, and volume of the impacted soil and groundwater. Removing the impacted soil and groundwater through excavation would also be effective in the short-term as this would limit VOC migration from the till into the groundwater matrix. Assuming uniform treatment of the impacted soil and groundwater can be achieved, the targeted ISCO treatment would be effective in the long- and short-term, even though multiple injection events will be required. This alternative can be implemented with readily availability technologies, and the associated costs are reasonable. Overall, Alternative 6 would be the most reasonable, cost-effective, and time-efficient remedy to implement.

The public's comments, concerns, and overall perception of the proposed remedial alternative will be evaluated by the NYSDEC following issuance of a PRAP in a format that responds to all questions that are raised. Community acceptance of the proposed remedy for the site will be evaluated after the public comments have been received.

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TABLES

Table 4-1
Preliminary Evaluation of Corrective Measure Technologies for Groundwater

Feasibility Study
Former Silver Cleaners
Rochester, New York

Response Actions	Remedial Technologies	Process Options	Description	Retained: Yes or No	Decision Rationale
No Action	Not Applicable	Not Applicable	Not Applicable	Yes	Use as a baseline for comparison to other alternatives or regulations.
Institutional Control	Not Applicable	Deed Restrictions	Deed restrictions limiting the property use. Implement a Site Management Plan.	Yes	Minimize potential for exposure to residual concentrations.
Monitoring	Groundwater Monitoring	Long-Term Groundwater Monitoring	Monitor groundwater quality.	Yes	Monitor groundwater concentrations over time.
		Monitored Natural Attenuation	Monitor natural attenuation parameters and groundwater quality.	Yes	Some, but not significant, breakdown of VOCs over time.
Containment	Infiltration Control or Capping	Impermeable Cover	Impermeable cover (concrete and asphalt) to minimize infiltration.	Yes	Asphalt and concrete cover can be used to reduce infiltration.
	Barriers (Horizontal or Vertical)	Grout Injection	Pressure Injection of grout to provide a low permeability confining unit.	No	Ineffective in lower permeability soils because of distribution challenges and the lack of variability between the installed features and the soil.
		Trenched Cut-off Wall	Low permeability wall to prevent horizontal migration of groundwater. May be combined with groundwater extraction and treatment or similar technology.	No	Minimize preferential pathways; however, groundwater extraction and hydraulic control behind the cut-off wall would be difficult to implement. Also, there would be a minimal difference in hydraulic conductivity between the glacial till and the cut-off wall.
		Sheet Piling	Sheet pile wall preventing horizontal migration of groundwater. May be combined with groundwater extraction and treatment or similar technology.	No	Impractical for the area and site use.
		Permeable Reactive Barrier or Funneling Gate	A passive treatment wall across the groundwater flow path.	Yes	Effective but difficult to implement.
		Groundwater Extraction	Hydraulic containment through the extraction of groundwater from vertical wells.	Yes	Effective but difficult to implement.
		Groundwater Recovery Trenches	Trenches, drains and piping used to passively collect groundwater.	Yes	Effective but difficult to implement.
In-Situ Treatment	Physical	Thermal Treatment	Subsurface heating. May require total fluids recovery, including vapor extraction and treatment of vapor stream.	Yes	Effective but requires collection and treatment of VOCs.
		Air Sparging	Strip VOCs using air injection wells.	No	Ineffective in lower permeability soils because of distribution challenges and the lack of a verifiable pathway for the air from the injection point to a point of recovery.
		In-well Stripping	Strip VOCs in a dual-screened well that controls groundwater flow.	No	Ineffective in lower permeability soils where the flow of groundwater cannot be relied upon to move a large enough portion of the mass through the target area.
	Chemical	Oxidation	Oxidize contaminants.	Yes	Ineffective in lower permeability soils because of distribution challenges associated with injecting the oxidant and the need to have direct contact with the chemical of concern. However, injections can occur above and below the dense till.
		Chemical Reduction	Use a reductant or reductant generating material (i.e., zero valent iron) to degrade contaminants.	Yes	Ineffective in lower permeability soils because of distribution challenges associated with injecting the oxidant and the need to have direct contact with the chemical of concern. However, injections can occur above and below the dense till.
	Biological	Enhanced Reductive Dechlorination	Inject a degradable substrate to facilitate biodegradation of chlorinated compounds by microorganisms.	Yes	Effective and implementable technology for in-situ groundwater treatment of VOCs. Difficult to inject into lower permeability soils.

See Notes on Page 2.

Table 4-1
Preliminary Evaluation of Corrective Measure Technologies for Groundwater

Feasibility Study
Former Silver Cleaners
Rochester, New York

Response Actions	Remedial Technologies	Process Options	Description	Retained: Yes or No	Decision Rationale
Removal	Removal	Excavation/ Dewatering	Remove soil and/or groundwater through excavation and dewatering.	Yes	Applicable in areas where the elevated soil and groundwater concentrations are co-located.
		MPE	Apply a moderate to high vacuum (i.e. higher than 10 mmHg) to a series of extraction wells for enhanced total fluids recovery. Requires ex-situ treatment and disposal of extracted fluids.	No	Ineffective if the source area is unknown.
		Groundwater Extraction	Pump and treat the groundwater.	Yes	Easily implementable technology.
Ex-Situ Treatment	Physical	Air Stripping	Transfer contaminants from an aqueous to a vapor phase. Off-gas may require additional treatment.	Yes	Effective and implementable technology for ex-situ groundwater treatment of VOCs.
		Carbon Adsorption	Remove contaminants from the aqueous or vapor phase onto activated carbon.	Yes	Effective and implementable technology for ex-situ groundwater treatment of VOCs.
	Chemical	UV/Chemical Oxidation	Destroy VOCs by changing the oxidation state of target contaminants using UV radiation and chemical oxidants.	Yes	Effective and implementable technology for ex-situ groundwater treatment of VOCs.
		Ozone	Oxidize contaminants.	Yes	Effective and implementable technology for ex-situ groundwater treatment of VOCs.
		Oxidation	Oxidize contaminants.	Yes	Effective and implementable technology for ex-situ groundwater treatment of VOCs.
	Biological	Aerobic Bioreactor	Aerobic biodegradation performed in an engineered bioreactor for contaminant removal from a process stream.	No	Ineffective technology for chlorinated VOCs.
		Anaerobic Bioreactor	Biodegradation in the absence of oxygen performed in an engineered bioreactor for contaminant removal from a process stream.	No	Long hydraulic retention times for complete mineralization of chlorinated ethenes require large reactor volumes.
		Phytoremediation/Wetlands Construction	Provide biological treatment for susceptible constituents.	No	Technically impractical because of space requirements.
Disposal/ Discharge	Disposal	POTW	Off-site discharge to a POTW.	Yes	Effective but may require on-site pretreatment and permits with the POTW.
		Treatment Facility for Off-site Groundwater Treatment	Off-site disposal of liquids to be containerized and treated by a second party.	Yes	Effective and implementable technology for ex-situ groundwater treatment of VOCs.
		Off-site Disposal of Soil (Landfill)	Disposal of soil or remediation process residuals off-site.	Yes	Effective. Disposal location will depend soil concentrations. May be combined with other process options.
	Reuse	Facility Use	Non-potable on-site reuse of treated groundwater.	No	No ability to reuse the treated groundwater.
		Reinjections	Reinject treated groundwater.	No	Ineffective in lower permeable soil.
	Discharge	Surface Water Discharge	Discharge treated groundwater to a surface waterbody	No	Potential discharge area is not close to the site.
		Air Discharge	Discharge from air treatment system.	Yes	Granular activated carbon or air stripper can be used to achieve regulatory air discharge standards.

Notes:
MPE - Multi-Phase Extraction
POTW - Public Owned Treatment Works
UV - Ultraviolet
VOCs - Volatile Organic Compounds

Table 4-2
Preliminary Evaluation of Corrective Measure Technologies for Soil

Feasibility Study
Former Silver Cleaners
Rochester, New York

Response Actions	Remedial Technologies	Process Options	Description	Retained: Yes or No	Decision Rationale
No Action	Not Applicable	No Action	Not Applicable	Yes	Use as a baseline for comparison to other alternatives.
Institutional Control	Not Applicable	Deed Restrictions	Deed restrictions to limit the property use and implementation of a SMP.	Yes	Minimize potential for exposure to residual concentrations.
Engineering Control	Not Applicable	Access Restrictions	Place access restrictions along the property boundary (i.e., fencing and signage).	Yes	Minimize potential for exposure to residual concentrations.
Containment	Infiltration Control or Capping	Soil, Asphalt and Concrete Cover	Prevent direct contact through the use of cover.	Yes	Asphalt and concrete cover can be used to reduce infiltration.
	Barriers (Horizontal or Vertical)	Grout Injection	Pressure Inject grout at depth to provide a low permeability confining unit and prevent migration	No	Ineffective in low permeability soils because of the difficulty in injecting grout into the subsurface.
Removal	Excavation	Excavation	Remove soil through mechanical methods.	Yes	Applicable in areas where the groundwater concentrations are co-located with soil concentrations above cleanup levels.
	Removal	SVE	Apply a vacuum to extraction wells to enhance the VOC volatilization. Recover and treat vapor.	No	Limited effectiveness in low permeability soils.
		MPE	Apply a vacuum to extraction wells to enhance fluids recovery. Treat and dispose of extracted fluids.	No	Ineffective if the source area is unknown.
In Situ Treatment	Physical	Soil Flushing	Flush soil with liquid to desorb contaminants.	No	Ineffective in lower permeability soils because of distribution and injection challenges and the need to have direct contact with the contaminant mass.
		Surfactant Flushing	Flush soil with surfactant solution to promote the desorption and solubilization of hydrophobic contaminants.	No	Ineffective in lower permeability soils because of distribution and injection challenges and the need to have direct contact with the contaminant mass.
		Thermal Treatment	Heat the subsurface. May require extraction and treatment of vapor stream.	Yes	Effective but requires collection and treatment of VOCs.
In Situ Treatment	Chemical	Oxidation (Injection)	Use oxidizing agent to oxidize contaminants.	Yes	Ineffective in lower permeability soils because of distribution challenges associated with injecting the oxidant and the need to have direct contact with the chemical of concern. However, injections can occur above and below the dense till.
		Stabilization/ Solidification	Treatment/Fixation of soil and contaminants by mixing.	No	Ineffective in lower permeability soils because of distribution and injection challenges and the need to have direct contact with the contaminant mass.
	Biological	Enhanced Reductive Dechlorination	Inject a substrate to facilitate biodegradation of chlorinated compounds by microorganisms.	Yes	Effective and implementable technology for in-situ soil treatment of VOCs.
		Bio-venting	Add oxygen to vadose zone to stimulate aerobic microorganisms for the catabolization of contaminants.	No	Ineffective in lower permeability soils because of distribution challenges. PCE and TCE do not have a viable aerobic pathway to ethane and ethene.

See Notes on Page 2.

Table 4-2
Preliminary Evaluation of Corrective Measure Technologies for Soil

Feasibility Study
Former Silver Cleaners
Rochester, New York

Response Actions	Remedial Technologies	Process Options	Description	Retained: Yes or No	Decision Rationale
Ex Situ Treatment	Physical	Soil Washing	Move high quantities of liquids through soil to desorb contaminants.	No	Ineffective in lower permeability soils because of distribution challenges (i.e., mass being trapped in interior pore space and the need for intense mixing and breaking down of soils).
		Low-Temperature Thermal Treatment	Heat soil using a conveyor and burner system to promote the volatilization of VOCs and some SVOCs. Heat of hydration [heat generated when water mixes with calcium oxide (e.g., quicklime)] can also promote volatilization.	No	Impractical for the site, a large area is needed for a treatment building, not a cost effective solution, and the concentration of VOCs in the soil is not high.
		On-site Incineration	Heat soil using a conveyor and burner system to thermally oxidize VOCs.	No	Although effective for on-site soil treatment for VOCs, the cost per unit volume of treated soil would make incineration infeasible.
	Chemical	Stabilization/ Solidification	Fixation of soil and contaminants by mixing.	No	Impractical for the site, not a cost effective solution, and the concentration of VOCs in the soil is not high.
		Oxidation	Oxidize contaminants	No	Impractical for the site, not a cost effective solution, and the concentration of VOCs in the soil is not high.
	Biological	Land Farming	Stockpile and till soils to promote aerobic biodegradation.	No	Not effective for contaminants that degrade under anaerobic conditions (e.g., chlorinated solvents) or metals.
Disposal	Disposal	On-site	Disposal or reuse of soil on-site. Generally requires treatment prior to disposal - See ex situ treatment options above.	No	Would only be used in conjunction with ex-situ technologies, which have been eliminated.
		Off-site (Landfill)	Disposal of soil or remediation process residuals off-site.	Yes	Effective. Disposal location will depend on soil concentrations. May be combined with other process options.

Notes:
MPE - Multi-Phase Extraction
SMP - Site Management Plan
SVE - Soil Vapor Extraction
VOCs - Volatile Organic Compounds

Table 4-3
Process Options Screening for Groundwater

Feasibility Study
Former Silver Cleaners
Rochester, New York

Remedial Technologies	Process Options	Effectiveness Evaluation		Implementability Evaluation		Relative Cost Evaluation		Retained for Consideration	
Not Applicable	No Action	Low	Effectiveness, if any, is attributed to naturally occurring processes.	High	Easily implemented	Low	No additional costs.	Yes	Use as a baseline for comparison to other alternatives and regulations.
Not Applicable	Deed Restrictions	Moderate	No effect on groundwater concentrations. Maintaining the Site Management Plan will reduce potential exposure to residual concentrations.	High	Easily implemented	Low	Negligible costs.	Yes	May be considered in conjunction with other process options.
Groundwater Monitoring	Long-Term Monitoring	Low	Effectiveness, if any, is attributed to naturally occurring processes.	High	Easily implemented	Low	Low capital cost because of existing monitor well network. Limited long term OM&M required.	Yes	May be considered in conjunction with other process options.
	MNA	Low	Natural attenuation processes would require an extended timeframe to reduce concentrations to cleanup goals. Some, but not significant, degradation possible.	High	Easily implemented	Low/ Moderate	Low capital cost because of existing monitor well network. Long term OM&M required.	No	Not effective in treating the groundwater quickly and there is not strong evidence of natural attenuation.
Containment Barriers (Horizontal or Vertical)	Impermeable Cover	Moderate/ High	Effective for containment.	Moderate/ High	Easily implemented	Low	Low capital costs because of existing asphalt.	No	Urban setting site will always be capped with asphalt, and runoff will in storm drains and not run into ground because of the site setting.
	Permeable Reactive Barrier or Funneling Gate	Moderate/ High	Effective for containment.	Low	Difficult to implement due to buildings in surrounding area.	High	High capital cost.	No	Not easily implemented and expensive.
	Groundwater Extraction	Moderate/ High	Effective for containment.	Low	Difficult to implement due to buildings in surrounding area.	High	High capital cost.	No	Not easily implemented and expensive.
	Groundwater Recovery Trenches	Moderate/ High	Effective for containment.	Low	Difficult to implement due to buildings in surrounding area.	High	High capital cost.	No	Not easily implemented and expensive.
Removal	Excavation/ Dewatering	Moderate/ High	Effective for source mass removal in areas where soil concentrations are contributing to groundwater concentrations.	Moderate	Predesign sampling needed to confirm treatment area. Could require the relocation of some site features.	High	Relatively high capital cost based on proposed area for treatment.	Yes	May be considered in conjunction with other process options.
	Groundwater Extraction	Moderate	Effective for containment, but not for mass removal	High	Easily implemented	Low	Low capital cost because of existing monitor well network. Long term OM&M required.	No	Ineffective for mass removal.
In-Situ Physical Treatment	Thermal Treatment	High	Effective at treating contaminants in groundwater. Effectively reach treatment goals in a short time frame.	Moderate	Require electrodes or heater wells. Utility conflicts and potential increased vapors during treatment.	High	High capital cost for installation of electrodes and off-gas treatment. High OM&M costs.	Yes	May be considered in conjunction with other process options.

See Notes on Page 3.

Remedial Technologies	Process Options	Effectiveness Evaluation		Implementability Evaluation		Relative Cost Evaluation		Retained for Consideration	
In-Situ Chemical Treatment	Oxidation (Injection)	Low	Low permeability soil minimizes the effectiveness; however, inject into the sand and bedrock above and below the till, respectively. Combine with other process option.	Low/ Moderate	Implementation would require a close well network because of low permeability soil.	Moderate	High capital cost to install injection wells in very close proximity to each other. Low operations and maintenance costs. Assumed several injection events.	Yes	May be considered in conjunction with other process options.
	Chemical Reduction	Low	Low permeability soil minimizes the effectiveness; however, inject into the sand and bedrock above and below the till, respectively. Combine with other process option.	Low/ Moderate	Implementation would require a close well network because of low permeability soil.	Moderate	High capital cost to install injection wells in very close proximity to each other. Low operations and maintenance costs. Assumed several injection events.	No	Expensive alternative compared to oxidation injections.
In-Situ Biological Treatment	Enhanced Reductive Dechlorination	Low	Low permeability soil minimizes the effectiveness; however, inject into the sand and bedrock above and below the till, respectively. Combine with other process option.	Low/ Moderate	Implementation would require a close well network because of low permeability soil.	Moderate	High capital cost to install injection wells in very close proximity to each other. Low operations and maintenance costs. Assumed several injection events.	Yes	May be considered in conjunction with other process options.
Ex-Situ Physical Treatment	Air Stripping	High	Effective for ex-situ treatment of VOCs in groundwater.	High	Implemented using an air stripping unit.	Low	Low capital cost.	No	Would only be used in conjunction with removal technologies which have been eliminated.
	Carbon Adsorption	Low	Effective for ex-situ treatment of VOCs in groundwater.	Low/ Moderate	Carbon can be impregnated with permanganate to improve performance but carbon absorption capacity is reduced.	Moderate /High	High infrastructure costs; moderate long-term OM&M cost because of carbon regeneration.	No	Difficult to extract groundwater from low permeability soils. Increased capital and OM&M costs without substantial increase in effectiveness.
Ex-Situ Chemical Treatment	UV/Chemical Oxidation	Moderate/ High	Moderately effective for ex-situ treatment of VOCs in groundwater	Moderate	Implementability contingent upon addressing health & safety concerns from strong oxidant.	High	Moderate capital cost; high OM&M cost	No	Would only be used in conjunction with removal technologies which have been eliminated.
	Ozone	Moderate/ High	Moderately effective for ex-situ treatment of VOCs in groundwater. May require longer treatment time compared with other oxidation methods.	Low/ Moderate	Implementability contingent upon addressing health & safety concerns from strong oxidant. Requires production or delivery of ozone in a gaseous state.	High	High capital cost; low to moderate OM&M cost	No	Would only be used in conjunction with removal technologies which have been eliminated.
	Fenton's Reagent/ Hydrogen Peroxide	Moderate/ High	Moderately effective for ex-situ treatment of VOCs in groundwater.	Moderate	Implementability contingent upon addressing health & safety concerns from strong oxidant.	High	Moderate capital cost; high OM&M cost	No	Would only be used in conjunction with removal technologies which have been eliminated.
	Potassium Permanganate	Moderate/ High	Moderately effective for ex-situ treatment of VOCs in groundwater.	Moderate	Implementability contingent upon addressing health & safety concerns from strong oxidant.	High	Moderate capital cost; high OM&M cost	No	Would only be used in conjunction with removal technologies which have been eliminated.

See Notes on Page 3.

Table 4-3
Process Options Screening for Groundwater

Feasibility Study
Former Silver Cleaners
Rochester, New York

Remedial Technologies	Process Options	Effectiveness Evaluation		Implementability Evaluation		Relative Cost Evaluation		Retained for Consideration	
Disposal	POTW (Dewatering for Excavation)	High	Requires the lowest level of treatment prior to discharge.	Moderate	Requires permitting and construction of discharge line to discharge to POTW.	Moderate	Moderate capital cost and moderate OM&M cost	Yes	May be considered in conjunction with other process options.
	Treatment Facility for Off-site Groundwater Treatment	High	Removes the contaminated media from the site.	Low	Requires acceptance from disposal facility and daily removal.	High	High transport cost, disposal cost dependent on the concentrations.	No	Impractical and expensive, would require daily removal and treatment.
	Off-site Disposal of Soil (Landfill)	High	Removes the contaminants.	Moderate	Used in conjunction with excavation. Requires coordination and acceptance of material at an off-site location.	Moderate /High	Cost dependent on the classification of the soil for disposal.	Yes	May be considered in conjunction with other process options.
Discharge	Air Discharge	High	If necessary, diverting air stripper gaseous effluent through GAC will remove most VOCs.	High	Carbon vessels can be sized and installed.	Low	Low capital cost; low OM&M cost	No	Would only be used in conjunction with removal technologies which have been eliminated.

Notes:
GAC - Granulated Activated Carbon
MNA - Monitored Natural Attenuation
OM&M - Operations & Maintenance
POTW - Public Owned Treatment Works
UV - Ultraviolet
VOCs - Volatile Organic Compounds

Table 4-4
Process Options Screening for Soil

Feasibility Study
Former Silver Cleaners
Rochester, New York

Remedial Technologies	Process Options	Effectiveness Evaluation		Implementability Evaluation		Relative Cost Evaluation		Retained?	
Not Applicable	No Action	Low	No effect on soil concentrations. Effectiveness is attributed to the naturally occurring processes.	High	Easily implemented.	Low	No additional costs.	Yes	Use as a baseline for comparison to other alternatives
Not Applicable	Deed Restrictions	Moderate	No effect on soil concentrations. Maintaining the Site Management Plan will reduce potential exposure to residual concentrations.	High	Easily implemented.	Low	Negligible costs.	Yes	Considered in conjunction with other process options
	Access Restrictions	Moderate	Limiting site access and maintaining the Site Management Plan will reduce potential for exposure to residual concentrations.	High	Easily implemented.	Low	Negligible costs.	Yes	Considered in conjunction with other process options
Containment Barriers (Horizontal or Vertical)	Impermeable Cover	Moderate/ High	Effective for containment.	Moderate/ High	Easily implemented	Low	Low capital costs because of existing asphalt.	No	Urban setting site will always be capped with asphalt, and runoff will in storm drains and not run into ground because of the site setting.
In-Situ Physical Treatment	Thermal Treatment	High	Effective at treating contaminants in groundwater. Effectively reach treatment goals in a short time frame.	Moderate	Require electrodes or heater wells. Utility conflicts and potential increased vapors during treatment.	High	High capital cost for installation of electrodes and off-gas treatment. High OM&M costs.	Yes	May be considered in conjunction with other process options.
In-Situ Chemical Treatment	Oxidation (Injection)	Low	Low permeability soil minimizes the effectiveness; however, inject into the sand and bedrock above and below the till, respectively. Combine with other process option.	Low/ Moderate	Implementation would require a close well network because of low permeability soil.	Moderate	High capital cost to install injection wells in very close proximity to each other. Low operations and maintenance costs. Assumed several injection events.	Yes	May be considered in conjunction with other process options.
In-Situ Biological Treatment	Enhanced Reductive Dechlorination	Low	Low permeability soil minimizes the effectiveness; however, inject into the sand and bedrock above and below the till, respectively. Combine with other process option.	Low/ Moderate	Implementation would require a close well network because of low permeability soil.	Moderate	High capital cost to install injection wells in very close proximity to each other. Low operations and maintenance costs. Assumed several injection events.	Yes	May be considered in conjunction with other process options.
Removal	Excavation	Moderate/ High	Effective for source mass removal in areas where soil concentrations are contributing to groundwater concentrations.	Moderate	Predesign sampling needed to confirm treatment area. Could require the relocation of some site features.	High	Relatively high capital cost based on proposed area for treatment.	Yes	Considered in conjunction with other process options.
Disposal	Off-site (Landfill)	High	Removes the contaminants.	Moderate	Used in conjunction with excavation. Requires coordination and acceptance of material at an off-site location.	Moderate /High	Cost dependent on the classification of the soil for disposal.	Yes	Considered in conjunction with other process options.

Notes:
O&M - Operations & Maintenance

Table 4-5
Summary of Corrective Measure Alternatives

Feasibility Study
Former Silver Cleaners
Rochester, New York

Alternative 1	No Further Action	This alternative includes abandoning the existing monitoring wells and does not provide any additional protection of the environment.
Alternative 2	Site Management and Long-Term Monitoring (LTM)	Site Management (30 Years): • Implement deed and access restrictions and institutional controls to limit site and groundwater use and limit access to soil. • Annual monitoring of site wells and LTM implementation (30 Years). • Annual inspections to ensure institutional controls are maintained. • Abandon monitoring wells after 30 years of LTM.
Alternative 3	In-Situ Thermal Remediation (ISTR)	Demolition (<1 Year): • Demolish existing building. Thermal Remediation (1 Year): • Implement thermal remediation around former building area, approximately 5,700 SF, in groundwater that exceeds the commercial standard. • Install points approximately 30 ft below ground surface, above the bedrock. Long-Term Monitoring (5 Years): • Annual monitoring of site wells. (Secondary treatment from thermal remediation) • Abandon monitoring wells after 5 years of LTM.
Alternative 4	Enhanced Reductive Dechlorination (ERD)	Demolition (<1 year): • Demolish existing building. Enhanced Reductive Dechlorination (3 Years): • Install 28 injection wells across the former building area. Assuming a 10 ft radius of influence. • Install 12 performance monitoring wells across the former building area. • Use approximately 5,000 lbs of EVO per event for a total of 6 injection events. • Semi-annual monitoring of ERD program. Long-Term Monitoring (10 Years): • Annual monitoring of site wells after ERD injections completed. • Abandon monitoring wells after 10 years of LTM.
Alternative 5	In-Situ Chemical Oxidation (ISCO)	Demolition (<1 Year): • Demolish existing building. In-Situ Chemical Oxidation (4 Years): • Install 26 injection wells across the former building area. Assuming a 10 ft radius of influence. • Use approximately 48,000 lbs of Remox L (4% sodium permanganate) per event for a total of 4 injection events. • Quarterly monitoring for the first 2 years and semi-annual monitoring for the last 2 years of all site wells. Long-Term Monitoring (10 Years): • Annual monitoring of site wells after ISCO injections completed. • Abandon monitoring wells after 10 years of LTM.
Alternative 6	Excavation and ISCO via Injection Infiltration Gallery	Demolition (<1 Year): • Demolish existing building. Excavation (<1 Year): • Abandon 7 existing monitoring wells. • Demolish existing building. • Excavate approximately 1,950 CY of soil below the former building area that exceed the commercial standard. • Dewater and treat approximately 40,000 gal of groundwater below the former building area that exceeds the groundwater standard. In-Situ Chemical Oxidation (4 Years): • Install Infiltration Gallery and 8 performance monitoring wells. • Use approximately 12,000 lbs of Remox L (4% sodium permanganate) per event for a total of 3 injection events. • Quarterly monitoring for the first 2 years and semi-annual monitoring for the last 2 years of all site wells. Long-Term Monitoring (5 Years): • Annual monitoring of site wells after ISCO injections completed. • Abandon monitoring wells after 5 years of LTM.
Alternative 7	Restoration to Pre-Disposal Conditions	Demolition (<1 Year): • Demolish existing building. Thermal Remediation (3 Years): • Implement thermal remediation within 27,300 SF of the site, located within the site boundaries. • Install points from approximately 45 ft below ground surface, into the bedrock.

Notes:
LTM - Long-Term Monitoring
UST - Underground Storage Tank

Table 4-6
Summary of Alternatives

Feasibility Study
Former Silver Cleaners
Rochester, New York

Alternative	Description	Overall Protection of Public Health and Environment	Standards, Criteria and Guidance (SCGs)	Long-Term Effectiveness	Reduction in TMV of Wastes	Short-Term Effectiveness	Implementability	Cost	Land Use	Sustainability
		Balancing Criteria								
1	No further action	Not an effective alternative.	Not an effective alternative.	Not an effective alternative.	Does not reduce the TMV of wastes.	Not an effective alternative.	Requires no implementation.	$38,000	Alternative 1 will not allow for commercial use of the site.	Sustainable, but includes no active remediation or monitoring.
2	Site Management Plan and LTM	- Not an effective alternative. - Residual risk remains until soil and groundwater COPC concentrations reach standards. - Maintaining Institutional controls reduces potential exposure to residual concentrations.	- A passive alternative. - Has no effect on COPC concentrations so reductions in toxicity and volume are attributed to naturally occurring processes.	- Should not be affected by site conditions. - Institutional and engineered components of the SMP have a long useful life with routine operations and maintenance. - Residual risk remains until soil and groundwater COPC concentrations reach standards. - Maintaining Institutional controls reduces potential exposure to residual concentrations.	- A passive alternative. - Has no effect on COPC concentrations so reductions in toxicity and volume are attributed to naturally occurring processes. - No additional reduction in mobility can be attributed to Alternative 2.	- Poses minimal risk to the public, workers, and the environment. - Not effective in the short-term for achieving standards or guidance values. - Minimal contaminant-related risk of fire and exposure to hazardous substances.	- No construction necessary. - SMP requires minimal administrative activities. - Does not require off-site treatment or storage. - Minimal disposal of purge water associated with annual sampling will be required. - Does not require special technologies.	$393,000	Alternative 2 will not allow for commercial use of the site.	- Requires the extended creation of waste during sampling and consumption of fuel for site visits over the long life span of the remedy. - Has a long useful life which extends the environmental burden of the remedy (i.e. materials, fuel, etc. are used for a long period of time).
3	In-Situ Thermal Remediation	- An effective alternative. - The source mass is destroyed or removed as part of thermal remediation. - Maintaining Institutional controls reduces the potential exposure to residual concentrations.	- An active treatment alternative. - Thermal remediation would result in removal of mass, reducing toxicity below the applicable soil cleanup objectives and improving progress toward groundwater standards.	- An effective alternative. - The institutional and engineered components of the SMP have a long useful life with routine operations and maintenance. - Residual risk remains until groundwater COPC concentrations reach standards. - Thermal remediation should shorten the timeframe to reach standards. - The source mass is destroyed or removed as part of thermal remediation. - Maintaining Institutional controls reduces the potential exposure to residual concentrations.	- An active treatment alternative. - Thermal remediation would result in removal of mass, reducing toxicity below the applicable soil cleanup objectives and improving progress toward groundwater standards. - Removal of mass in soils and groundwater eliminates the volume and mobility of the chemicals of concern sorbed to soils and dissolved in the groundwater.	- Poses minimal risk to the public and the environment. - Some risk to workers from elevated temperatures and volatilized chemicals of concern in soil vapors. - Risk is minimized by personal protective equipment and engineered controls. - Effective in the short-term for reducing mass and achieving standards. - Minimal contaminant-related risk of fire and exposure to hazardous substances.	- Well and electrode installation and temporary system construction are necessary to implement the thermal treatment. - Requires off-site treatment, storage, or disposal of groundwater removed from the treatment area. - Immediate beneficial results. - No construction is necessary to implement the SMP. - SMP requires minimal administrative activities. Expected wastes include the soil from well installation, purge water during monitoring, and extracted groundwater. - Shorter timeframe is expected for the reduction of contaminants compared to no further action or LTM because this is an active remediation alternative.	$3,270,000	Alternative 3 will allow for commercial use of the site.	- High energy requirements. - Thermal remediation creates water consumption, air emissions, and waste to manage. - Installation of the system will require the operation of fuel-powered equipment. - The effectiveness of the thermal treatment reduces the expected length of the remedy eliminating long term energy use and water consumption. - SMP requires fuel consumption and waste generation throughout the length of the remedy.
4	Enhanced Reductive Dechlorination	- An effective alternative. - ERD treats the source area without the need of removing soil or groundwater. - Maintaining Institutional controls reduces potential exposure.	- An active treatment alternative. - Treatment of soil and groundwater results in an gradual reduction in mass and will reduce the toxicity below the applicable soil cleanup objectives and will improve progress toward groundwater standards.	- An effective alternative. - The institutional and engineered components of the SMP have a long useful life with routine operations and maintenance. - Residual risk remains until groundwater concentrations site wide reach standards. - ERD should shorten the timeframe to reach standards. - The source mass is destroyed as part of ERD. - Maintaining Institutional controls reduces potential exposure.	- An active treatment alternative. - Treatment of soil and groundwater results in an gradual reduction in mass and will reduce the toxicity below the applicable soil cleanup objectives and will improve progress toward groundwater standards. - Treatment of the soils and water reduces the volume of the chemicals of concern sorbed to soils and dissolved in the removed groundwater. - No additional reduction in mobility can be attributed to Alternative 4.	- Poses minimal risk to the public, and the environment. - Some risk is posed to the workers through the handling of sodium permanganate. - Effective in the short-term for achieving soil and groundwater standards or guidance values. - Minimal contaminant-related risk of fire and exposure to hazardous substances.	- Injection wells are necessary to implement ERD. - Immediate beneficial results. - No construction is necessary to implement the SMP. - SMP requires minimal administrative activities. expected wastes include the soil from well installation, purge water during monitoring, and extracted groundwater. - Shorter timeframe is expected for the reduction of contaminants compared to no further action or LTM because this is an active remediation alternative.	$2,730,000	Alternative 4 will allow for commercial use of the site.	- Requires the extended creation of waste during injection and sampling and consumption of fuel for site visits over the long life span of the remedy. - Has a long useful life which extends the environmental burden of the remedy (i.e. materials, fuel, etc. are used for a long period of time).
5	In-Situ Chemical Oxidation	- An effective alternative. - ISCO treats the source area without the need of removing soil or groundwater. - Maintaining Institutional controls reduces potential exposure.	- An active treatment alternative. - Treatment of soil and groundwater results in an gradual reduction in mass and will reduce the toxicity below the applicable soil cleanup objectives and will improve progress toward groundwater standards.	- An effective alternative. - The institutional and engineered components of the SMP have a long useful life with routine operations and maintenance. - Residual risk remains until groundwater concentrations site wide reach standards. - ISCO should shorten the timeframe to reach standards. - The source mass is destroyed as part of ISCO. - Maintaining Institutional controls reduces potential exposure.	- An active treatment alternative. - Treatment of soil and groundwater results in an gradual reduction in mass and will reduce the toxicity below the applicable soil cleanup objectives and will improve progress toward groundwater standards. - Treatment of the soils and water reduces the volume of the chemicals of concern sorbed to soils and dissolved in the removed groundwater. - No additional reduction in mobility can be attributed to Alternative 5.	- Poses minimal risk to the public, and the environment. - Some risk is posed to the workers through the handling of sodium permanganate. - Effective in the short-term for achieving soil and groundwater standards or guidance values. - Minimal contaminant-related risk of fire and exposure to hazardous substances.	- Injection wells are necessary to implement ISCO. - Immediate beneficial results. - No construction is necessary to implement the SMP. - SMP requires minimal administrative activities. expected wastes include the soil from well installation, purge water during monitoring, and extracted groundwater. - Shorter timeframe is expected for the reduction of contaminants compared to no further action or LTM because this is an active remediation alternative.	$3,190,000	Alternative 5 will allow for commercial use of the site.	- Requires the extended creation of waste during injection and sampling and consumption of fuel for site visits over the long life span of the remedy. - Has a long useful life which extends the environmental burden of the remedy (i.e. materials, fuel, etc. are used for a long period of time).

See Notes on Page 2.

Table 4-6
Summary of Alternatives

Feasibility Study
Former Silver Cleaners
Rochester, New York

Alternative	Description	Balancing Criteria								
		Overall Protection of Public Health and Environment	Standards, Criteria and Guidance (SCGs)	Long-Term Effectiveness	Reduction in TMV of Wastes	Short-Term Effectiveness	Implementability	Cost	Land Use	Sustainability
6	Excavation and Injection Infiltration Gallery	- An effective alternative. - Excavation removes the mass from the source area eliminating the portion of mass that is in the planned excavation footprint. - ISCO provides secondary treatment to the source area. - Maintaining Institutional controls reduces potential exposure.	- An active treatment alternative. - Removal of soil and groundwater results in an immediate reduction in mass and will reduce the toxicity below the applicable soil cleanup objectives and will improve progress toward groundwater standards. - ISCO provides secondary treatment to the source area.	- An effective alternative. - The institutional and engineered components of the SMP have a long useful life with routine operations and maintenance. - Residual risk remains until groundwater concentrations site wide reach standards. - Excavation with subsequent ISCO should shorten the timeframe to reach standards. - Excavation removes the mass from the source area eliminating the portion of mass that is in the planned excavation footprint. - Maintaining Institutional controls reduces potential exposure.	- An active treatment alternative. - Removal of soil and groundwater results in an immediate reduction in mass and will reduce the toxicity below the applicable soil cleanup objectives and will improve progress toward groundwater standards. - Removal of the soils and water eliminates the volume of the chemicals of concern sorbed to soils and dissolved in the removed groundwater with ISCO as a secondary treatment.	- Poses minimal risk to the public, and the environment. - Some risk is posed to the workers through the use of heavy equipment and the depth of excavation required to reach the volatile organic compound-containing soil, in addition to handling sodium permanganate. - Effective in the short-term for achieving soil and groundwater standards or guidance values. - Minimal contaminant-related risk of fire and exposure to hazardous substances.	- Excavation requires both administrative activities and construction. - Requires off-site treatment, storage, or disposal of soil and groundwater removed from the excavated area. - Requires shoring for deep excavation. - Immediate beneficial results. - No construction is necessary to implement the SMP. - SMP requires minimal administrative activities. Expected wastes include the excavated soil, water from the excavation, and purge water. - Shorter timeframe is expected for the reduction of contaminants compared to no further action or LTM because this is an active remediation alternative.	$3,310,000	Alternative 6 will allow for commercial use of the site.	- Uses large-scale fuel-powered construction equipment with high energy requirements and air emissions. - Requires the extended creation of waste during sampling and consumption of fuel for site visits over the long life span of the remedy. - Has a long useful life which extends the environmental burden of the remedy (i.e. materials, fuel, etc. are used for a long period of time). - Excavation involves the generation of considerable amounts of waste materials and the use of materials and resources for construction and restoration. - Movement of soil requires truck transport of soil to the disposal site. - The effectiveness of the excavation reduces the expected length of the remedy eliminating long term energy use and water consumption. - SMP requires fuel consumption and waste generation throughout the length of the remedy.
7	Restoration to Pre-Disposal or Groundwater Conditions	- An effective alternative. - The source mass is destroyed or removed as part of thermal remediation. - Maintaining Institutional controls reduces potential exposure.	- An active treatment alternative. - Thermal remediation would result in removal of mass, reducing toxicity below the applicable soil cleanup objectives and improving progress toward groundwater standards.	- An effective alternative. - The institutional and engineered components of the SMP have a long useful life with routine operations and maintenance. - Residual risk remains until groundwater COPC concentrations reach standards. - Thermal remediation should shorten the timeframe to reach standards. - The source mass is destroyed or removed as part of thermal remediation. - Maintaining Institutional controls reduces the potential exposure to residual concentrations.	- An active treatment alternative. - Thermal remediation would result in removal of mass, reducing toxicity below the applicable soil cleanup objectives and improving progress toward groundwater standards. - Removal of mass in soils and groundwater eliminates the volume and mobility of the chemicals of concern sorbed to soils and dissolved in the groundwater.	- Poses minimal risk to the public and the environment. - Some risk to workers from elevated temperatures and volatilized chemicals of concern in soil vapors. - Risk is minimized by personal protective equipment and engineered controls. - Effective in the short-term for reducing mass and achieving standards. - Minimal contaminant-related risk of fire and exposure to hazardous substances.	- Well and electrode installation and temporary system construction are necessary to implement the thermal treatment. - Requires off-site treatment, storage, or disposal of groundwater removed from the treatment area. - Immediate beneficial results. - No construction is necessary to implement the SMP. - SMP requires minimal administrative activities. Expected wastes include the soil from well installation, purge water during monitoring, and extracted groundwater. - Shorter timeframe is expected for the reduction of contaminants compared to no further action or LTM because this is an active remediation alternative.	$10,590,000	Alternative 7 will allow for commercial use of the site.	- High energy requirements. - Thermal remediation creates water consumption, air emissions, and waste to manage. - Installation of the system will require the operation of fuel-powered equipment. - The effectiveness of the thermal treatment reduces the expected length of the remedy eliminating long term energy use and water consumption. - SMP requires fuel consumption and waste generation throughout the length of the remedy.

Notes:
TMV - Toxicity, mobility and volume
SCO - Soil Cleanup Objectives
COPC - Contaminant of potential concern
SMP - Site Management Plan
LTM - Long-Term Monitoring
ISCO - In-situ chemical oxidation

Table 5-1
Opinion of Probable Cost – Alternative 1

Feasibility Study
Former Silver Cleaners
Rochester, New York

Alternative 1

NO FURTHER ACTION — **OPINION OF PROBABLE COST**

Site: Former Silver Cleaners, 245 Andrews Street
Location: Rochester, New York
Phase: Alternatives Analysis (-30% to +50%)
Base Year: 2020
Date: January 2020

Description: Alternative 1 consists of abandoning all site wells. Capital costs are incurred in Year 1. There are no OM&M costs.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Well Abandoning					
Abandonment of Piezometers, Monitoring, Injection, Overburden, and Bedrock Wells	23	EA	$1,000	$23,000	
SUBTOTAL				$23,000	
Contingency	30%			$7,000	
SUBTOTAL				$30,000	
Project Management	10%			$3,000	
Remedial Oversight/Reporting	15%			$5,000	
TOTAL CAPITAL COST				**$38,000**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	PRESENT VALUE	NOTES:
Capital	1	$38,000	$38,000	$38,000	
		$38,000		$38,000	
TOTAL PRESENT VALUE OF ALTERNATIVE - POINT ESTIMATE				**$38,000**	
TOTAL PRESENT VALUE OF ALTERNATIVE - RANGE ESTIMATE LOW (-30%)				**$26,600**	
TOTAL PRESENT VALUE OF ALTERNATIVE - RANGE ESTIMATE HIGH (+50%)				**$57,000**	

Table 5-2
Opinion of Probable Cost – Alternative 2

Feasibility Study
Former Silver Cleaners
Rochester, New York

Alternative 2

SITE MANAGEMENT AND LONG-TERM MONITORING — **OPINION OF PROBABLE COST**

Site: Former Silver Cleaners, 245 Andrews Street
Location: Rochester, New York
Phase: Alternatives Analysis (-30% to +50%)
Base Year: 2020
Date: January 2020

Description: Alternative 2 consists of implementing deed and access restrictions, institutional controls, and annual groundwater sampling. Capital costs are incurred in Year 1. OM&M costs are incurred in Years 1-30.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	LS	$25,000	$25,000	
Site Management Plan	1	LS	$15,000	$15,000	
SUBTOTAL				$40,000	
Contingency	25%			$10,000	
SUBTOTAL				$50,000	
Project Management	10%			$5,000	
Remedial Oversight/Reporting	15%			$10,000	
TOTAL CAPITAL COST				**$65,000**	

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

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Site Monitoring					
Groundwater Sampling & Analysis	1	YR	$10,000	$10,000	Annual sampling of 23 wells
Data Evaluation and Reporting	1	YR	$10,000	$10,000	
SUBTOTAL				$20,000	
TOTAL ANNUAL O&M COST				**$20,000**	
Well Abandoning					
Abandonment of Piezometers, Monitoring, Injection, Overburden, and Bedrock Wells	23	EA	$1,000	$23,000	
SUBTOTAL				$23,000	
TOTAL CLOSEOUT COST - YEAR 30				**$23,000**	

Table 5-2
Opinion of Probable Cost – Alternative 2

Feasibility Study
Former Silver Cleaners
Rochester, New York

Alternative 2

SITE MANAGEMENT AND LONG-TERM MONITORING					OPINION OF PROBABLE COST
PRESENT VALUE ANALYSIS:					
COST TYPE	**YEAR**	**TOTAL COST**	**TOTAL COST PER YEAR**	**PRESENT VALUE DISCOUNT (5%)**	**NOTES:**
Capital	1	$85,000	$85,000	$85,000	Capital + 1st Year O&M Costs
Annual OM&M	2-30	$580,000	$20,000	$303,000	Annual GW sampling
Closeout	30	$23,000	$23,000	$5,000	Closeout
		$688,000		$393,000	
TOTAL PRESENT VALUE OF ALTERNATIVE				**$393,000**	
TOTAL PRESENT VALUE OF ALTERNATIVE - RANGE ESTIMATE LOW (-30%)				**$280,000**	
TOTAL PRESENT VALUE OF ALTERNATIVE - RANGE ESTIMATE HIGH (+50%)				**$589,500**	

Table 5-3
Opinion of Probable Cost – Alternative 3

Feasibility Study
Former Silver Cleaners
Rochester, New York

Alternative 3

IN-SITU THERMAL REMEDIATION — **OPINION OF PROBABLE COST**

Site: Former Silver Cleaners, 245 Andrews Street
Location: Rochester, New York
Phase: Alternatives Analysis (-30% to +50%)
Base Year: 2020
Date: January 2020

Description: Alternative 3 consists of demolishing the existing building, followed by in-situ thermal remediation via thermal conductive heating with pre-heater wells, and annual groundwater sampling. Capital costs are incurred in Year 1. OM&M costs are incurred in Years 1-5.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	LS	$25,000	$25,000	
Site Management Plan	1	LS	$15,000	$15,000	
SUBTOTAL				$40,000	
Demolition					Assume normal business hours
Design	1	LS	$10,000	$10,000	
Subcontracting and oversight	1	LS	$44,000	$44,000	
Well abandoning	13	EA	$1,000	$13,000	
Subcontractor	1	LS	$159,000	$159,000	
Reporting	1	LS	$10,000	$10,000	
SUBTOTAL				$236,000	
In-situ Thermal					Assume normal business hours
ISTR System Design/Final Reporting	1	LS	$120,000	$120,000	
Permitting/Procurement	1	LS	$100,000	$100,000	
Mobilization/Demobilization	1	LS	$150,000	$150,000	
Installation of Heater Wells	81	EA	$4,000	$324,000	$120/LF 35 ft deep
Installation of Pre-Heater Wells	10	EA	$2,000	$20,000	$120/LF 15 ft deep
Installation of Vertical Extraction Wells	40	EA	$5,000	$200,000	$160/LF 30 ft deep
Installation of Temperature Monitoring Points	15	EA	$2,000	$30,000	$60/LF 35 ft deep
Pressure Monitoring Point Installation	15	EA	$1,000	$15,000	$100/LF 10 ft deep
Vapor Cover Installation	6,300	SF	$8	$50,000	
Installation of Wellfield Piping and Electrical Wiring / Connections	1	LS	$240,000	$240,000	
Installation of Above-Grade In-Situ Treatment System Components	1	LS	$120,000	$120,000	
O&M - Electrical Usage	2,090,000	kW/hr	$0.06	$130,000	Average commercial electricity rate in Rochester, NY
O&M - Labor and Expenses	6	MO	$76,000	$456,000	
Well Decommissioning	4,900	LF	$6	$30,000	$80/hr*person, 2 people 8 hr/day
Vapor Cover Removal and Handling	6,300	SF	$2	$10,000	
Transportation and Disposal - Spent Granular Activated Carbon	30,000	LB	$4	$120,000	
Transportation and Disposal - Vapor Cover Debris	500	TON	$75	$40,000	2 tons/CY
Transportation and Disposal - Waste Water	350,000	GAL	$0.10	$35,000	3% porosity
Transportation and Disposal - Soil Cuttings	290	TON	$75	$22,000	2 tons/CY
SUBTOTAL				$2,210,000	

Table 5-3
Opinion of Probable Cost – Alternative 3

Feasibility Study
Former Silver Cleaners
Rochester, New York

Alternative 3

IN-SITU THERMAL REMEDIATION					OPINION OF PROBABLE COST
SUBTOTAL				$2,490,000	
Contingency	15%			$370,000	
SUBTOTAL				$2,860,000	
Project Management	5%			$140,000	
Remedial Oversight/Reporting	6%			$170,000	
TOTAL CAPITAL COST				**$3,170,000**	
OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS					
DESCRIPTION	**QTY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES:**
Site Monitoring					
Groundwater Sampling & Analysis	1	YR	$10,000	$10,000	Annual sampling of 10 wells
Data Evaluation and Reporting	1	YR	$10,000	$10,000	
SUBTOTAL				$20,000	
TOTAL ANNUAL O&M COST				**$20,000**	
Well Abandoning					
Abandonment of Piezometers, Monitoring, Injection, Overburden, and Bedrock Wells	10	EA	$1,000	$10,000	
SUBTOTAL				$10,000	
TOTAL CLOSEOUT COST - YEAR 5				**$10,000**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	PRESENT VALUE (DISCOUNT 5%)	NOTES:
Capital	1	$3,190,000	$3,190,000	$3,190,000	Capital + 1st Year O&M Costs
Annual OM&M	2-5	$80,000	$20,000	$71,000	Annual GW sampling
Closeout	5	$10,000	$10,000	$8,000	Closeout
		$3,280,000		$3,270,000	
TOTAL PRESENT VALUE OF ALTERNATIVE				**$3,270,000**	
TOTAL PRESENT VALUE OF ALTERNATIVE - RANGE ESTIMATE LOW (-30%)				**$2,290,000**	
TOTAL PRESENT VALUE OF ALTERNATIVE - RANGE ESTIMATE HIGH (+50%)				**$4,910,000**	

Table 5-4
Opinion of Probable Cost – Alternative 4

Feasibility Study
Former Silver Cleaners
Rochester, New York

Alternative 4

ENHANCED REDUCTIVE DECHLORINATION — **OPINION OF PROBABLE COST**

Site: Former Silver Cleaners, 245 Andrews Street
Location: Rochester, New York
Phase: Alternatives Analysis (-30% to +50%)
Base Year: 2020
Date: January 2020

Description: Alternative 4 consists of demolishing the existing building, followed by groundwater polishing via enhanced reductive dechlorination using EVO and annual groundwater sampling. Capital costs are incurred in Year 1. OM&M costs are incurred in Years 1-10.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	LS	$25,000	$25,000	
Site Management Plan	1	LS	$15,000	$15,000	
SUBTOTAL				$40,000	
Demolition					Assume normal business hours
Design	1	LS	$10,000	$10,000	
Subcontracting and oversight	1	LS	$44,000	$44,000	
Subcontractor	1	LS	$159,000	$159,000	
Reporting	1	LS	$10,000	$10,000	
SUBTOTAL				$223,000	
Enhanced Reductive Dechlorination					Assume normal business hours
ERD Design	1	LS	$180,000	$180,000	
Permitting/Procurement	1	LS	$30,000	$30,000	
Utility Markout, Protection, and/or Relocation	1	LS	$10,000	$10,000	
Baseline Sampling	1	LS	$20,000	$20,000	
Treatability Study	1	LS	$75,000	$75,000	
Mobilization/Demobilization	1	LS	$30,000	$30,000	
Installation of Monitoring Wells	12	EA	$4,500	$54,000	
Installation of Injection Wells	28	EA	$4,000	$112,000	
EVO Injection Fluid	6	EA	$15,000	$90,000	
Injection Field Equipment-Purchased	1	LS	$16,000	$16,000	
Injection Field Equipment-Rental	6	EA	$30,000	$180,000	
Injection Labor, Lodging, Per Diem & Transportation	6	EA	$100,000	$600,000	
Water Use	8,950,000	GAL	$0.00362	$33,000	Average commercial water rate in Rochester, NY per 1000 gallons
Injection Well Backflush/Maintenance	28	EA	$3,000	$84,000	
Semi-Annual Sampling	6	EA	$20,000	$120,000	
ERD Data Evaluation/Reporting	4	YR	$15,000	$60,000	
SUBTOTAL				$1,690,000	
SUBTOTAL				$1,950,000	
Contingency	15%			$290,000	
SUBTOTAL				$2,240,000	

Table 5-4
Opinion of Probable Cost – Alternative 4

Feasibility Study
Former Silver Cleaners
Rochester, New York

Alternative 4

ENHANCED REDUCTIVE DECHLORINATION					OPINION OF PROBABLE COST
Project Management	5%			$110,000	
Remedial Oversight/Reporting	6%			$130,000	
TOTAL CAPITAL COST				**$2,480,000**	
OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS					
DESCRIPTION	**QTY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES:**
Site Monitoring					
Groundwater Sampling & Analysis	1	YR	$15,000	$15,000	Annual sampling of 35 wells
Data Evaluation and Reporting	1	YR	$10,000	$10,000	
SUBTOTAL				$25,000	
TOTAL ANNUAL O&M COST				**$25,000**	
Well Abandoning					
Abandonment of Piezometers, Monitoring, Injection, Overburden, and Bedrock Wells	63	EA	$1,000	$63,000	
SUBTOTAL				$63,000	
TOTAL CLOSEOUT COST - YEAR 10				**$63,000**	

PRESENT VALUE ANALYSIS:

COST TYPE	**YEAR**	**TOTAL COST**	**TOTAL COST PER YEAR**	**PRESENT VALUE (DISCOUNT 5%)**	**NOTES:**
Capital	1	$2,510,000	$2,510,000	$2,510,000	Capital + 1st Year O&M Costs
Annual OM&M	2-10	$225,000	$25,000	$180,000	Annual GW sampling
Closeout	10	$63,000	$63,000	$39,000	Closeout
		$2,800,000		$2,730,000	
TOTAL PRESENT VALUE OF ALTERNATIVE				**$2,730,000**	
TOTAL PRESENT VALUE OF ALTERNATIVE - RANGE ESTIMATE LOW (-30%)				**$1,910,000**	
TOTAL PRESENT VALUE OF ALTERNATIVE - RANGE ESTIMATE HIGH (+50%)				**$4,100,000**	

Table 5-5
Opinion of Probable Cost – Alternative 5

Feasibility Study
Former Silver Cleaners
Rochester, New York

Alternative 5

IN-SITU CHEMICAL OXIDATION — **OPINION OF PROBABLE COST**

Site: Former Silver Cleaners, 245 Andrews Street
Location: Rochester, New York
Phase: Alternatives Analysis (-30% to +50%)
Base Year: 2020
Date: January 2020

Description: Alternative 5 consists of demolishing the existing building, followed by groundwater polishing via in-situ chemical oxidation using sodium permanganate, and annual groundwater sampling. Capital costs are incurred in Year 1. OM&M costs are incurred in Years 1-10.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	LS	$25,000	$25,000	
Site Management Plan	1	LS	$15,000	$15,000	
SUBTOTAL				$40,000	
Demolition					Assume normal business hours
Design	1	LS	$10,000	$10,000	
Subcontracting and oversight	1	LS	$44,000	$44,000	
Subcontractor	1	LS	$159,000	$159,000	
Reporting	1	LS	$10,000	$10,000	
SUBTOTAL				$223,000	
In-Situ Chemical Oxidation					Assume normal business hours
ISCO Design	1	LS	$180,000	$180,000	
Permitting/Procurement	1	LS	$30,000	$30,000	
Utility Markout, Protection, and/or Relocation	1	LS	$10,000	$10,000	
Baseline Sampling	1	LS	$20,000	$20,000	
Treatability Study	1	LS	$75,000	$75,000	
Mobilization/Demobilization	1	LS	$30,000	$30,000	
Installation of Monitoring Wells	12	EA	$4,500	$54,000	
Installation of Injection Wells	26	EA	$4,000	$104,000	
Sodium Permanganate Injection Fluid	4	EA	$124,000	$496,000	
Injection Field Equipment-Purchased	1	LS	$16,000	$16,000	
Injection Field Equipment-Rental	4	EA	$30,000	$120,000	
Injection Labor, Lodging, Per Diem & Transportation	4	EA	$125,000	$500,000	
Water Use	6,000,000	GAL	$0.00362	$22,000	Average commercial water rate in Rochester, NY per 1000 gallons
Injection Well Backflush/Maintenance	26	EA	$3,000	$78,000	
Quarterly Sampling	8	EA	$20,000	$160,000	
Semi-Annual Sampling	4	EA	$20,000	$80,000	
ISCO Data Evaluation/Reporting	4	YR	$15,000	$60,000	
SUBTOTAL				$2,040,000	

Table 5-5
Opinion of Probable Cost – Alternative 5

Feasibility Study
Former Silver Cleaners
Rochester, New York

Alternative 5

IN-SITU CHEMICAL OXIDATION					OPINION OF PROBABLE COST
SUBTOTAL				$2,300,000	
Contingency	15%			$350,000	
SUBTOTAL				$2,650,000	
Project Management	5%			$130,000	
Remedial Oversight/Reporting	6%			$160,000	
TOTAL CAPITAL COST				**$2,940,000**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS					
DESCRIPTION	**QTY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES:**
Site Monitoring					
Groundwater Sampling & Analysis	1	YR	$15,000	$15,000	Annual sampling of 35 wells
Data Evaluation and Reporting	1	YR	$10,000	$10,000	
SUBTOTAL				$25,000	
TOTAL ANNUAL O&M COST				**$25,000**	
Well Abandoning					
Abandonment of Piezometers, Monitoring, Injection, Overburden, and Bedrock Wells	61	EA	$1,000	$61,000	
SUBTOTAL				$61,000	
TOTAL CLOSEOUT COST - YEAR 10				**$61,000**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	PRESENT VALUE (DISCOUNT 5%)	NOTES:
Capital	1	$2,970,000	$2,970,000	$2,970,000	Capital + 1st Year O&M Costs
Annual OM&M	2-10	$225,000	$25,000	$178,000	Annual GW sampling
Closeout	10	$61,000	$61,000	$37,000	Closeout
		$3,260,000		$3,190,000	
TOTAL PRESENT VALUE OF ALTERNATIVE				**$3,190,000**	
TOTAL PRESENT VALUE OF ALTERNATIVE - RANGE ESTIMATE LOW (-30%)				**$2,230,000**	
TOTAL PRESENT VALUE OF ALTERNATIVE - RANGE ESTIMATE HIGH (+50%)				**$4,790,000**	

Table 5-6
Opinion of Probable Cost – Alternative 6

Feasibility Study
Former Silver Cleaners
Rochester, New York

Alternative 6

EXCAVATION AND IN-SITU CHEMICAL OXIDATION VIA INFILTRATION GALLERY — **OPINION OF PROBABLE COST**

Site: Former Silver Cleaners, 245 Andrews Street
Location: Rochester, New York
Phase: Alternatives Analysis (-30% to +50%)
Base Year: 2020
Date: January 2020

Description: Alternative 6 consists of demolishing the existing building and excavating the contaminated soil, followed by chemical oxidation via injection infiltration gallery and annual groundwater sampling. Capital costs are incurred in Year 1. OM&M costs are incurred in Years 1-5.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	LS	$25,000	$25,000	
Site Management Plan	1	LS	$15,000	$15,000	
SUBTOTAL				$40,000	
Demolition					Assume normal business hours
Design	1	LS	$10,000	$10,000	
Subcontracting and oversight	1	LS	$44,000	$44,000	
Subcontractor	1	LS	$159,000	$159,000	
Reporting	1	LS	$9,000	$9,000	
SUBTOTAL				$222,000	
Excavation					Assume normal business hours
Mobilization/Demobilization	1	LS	$100,000	$100,000	
Maintenance of Temporary Services	60	DAY	$1,000	$60,000	
Implementation of Site-Specific Health and Safety Program and Community Air Monitoring Program (CAMP)	40	DAY	$500	$20,000	
Utility Location	1	LS	$4,000	$4,000	
Well and Vapor Point Abandoning	10	EA	$1,000	$10,000	
Structural Surveys	1	LS	$15,000	$15,000	
Preparation and Installation of Excavation Support Plan	1	LS	$250,000	$250,000	Install 190 LF of sheeting, depth ~25', and engineer's design/plan costs
Maintenance of Excavation Support Plan	30	DAY	$2,000	$60,000	
Demolition, Removal, Characterization, Transportation and Disposal of Concrete and Asphalt Debris	365	TON	$200	$73,000	
Characterization for Disposal Approval for Soil and Liquid	1	LS	$4,000	$4,000	Sampling costs only.
Removal, Transportation and Disposal of Soil as Non-Hazardous	1,438	TON	$125	$180,000	1,917 CY, assume 50% non-haz, 1.5 tons/CY
Removal, Transportation and Disposal of Soil as Hazardous	1,438	TON	$300	$430,000	
Removal, Transportation and Disposal of Hazardous Water or Non-Aqueous Phase Liquid	40,000	GAL	$10	$400,000	
Backfill with General Fill	1,442	CY	$30	$40,000	
Backfill with Clay Fill/CLSM	417	CY	$100	$40,000	
Backfill with Sand	167	CY	$15	$3,000	

Table 5-6
Opinion of Probable Cost – Alternative 6

Feasibility Study
Former Silver Cleaners
Rochester, New York

ARCADIS Design & Consultancy for natural and built assets

Alternative 6

EXCAVATION AND IN-SITU CHEMICAL OXIDATION VIA INFILTRATION GALLERY					**OPINION OF PROBABLE COST**
Asphalt Installation	12,540	SF	$4	$50,000	
Site Survey	1	LS	$3,000	$3,000	
SUBTOTAL				$1,740,000	
Injection Infiltration Gallery					
ISCO Design	1	LS	$20,000	$20,000	
Chemical Injection Piping	1	LS	$6,000	$6,000	
Permitting/Procurement	1	LS	$10,000	$10,000	
Baseline Sampling	1	LS	$20,000	$20,000	
Treatability Study	1	LS	$40,000	$40,000	
Mobilization/Demobilization	1	LS	$20,000	$20,000	
Installation of Monitoring Wells	8	EA	$4,500	$36,000	
Sodium Permanganate Injection Fluid	3	EA	$30,000	$90,000	
Injection Field Equipment-Rental	3	EA	$5,000	$15,000	
Injection Labor, Lodging, Per Diem & Transportation	3	EA	$20,000	$60,000	
Water Use	250,000	GAL	$0.00362	$1,000	Average commercial water rate in Rochester, NY per 1000 gallons
Injection Well Backflush/Maintenance	1	EA	$3,000	$3,000	
Quarterly Sampling	8	EA	$20,000	$160,000	
Semi-Annual Sampling	4	EA	$10,000	$40,000	
Infiltration Gallery Abandonment	1	LS	$20,000	$20,000	
SUBTOTAL				$540,000	
SUBTOTAL				$2,540,000	
Contingency	15%			$380,000	
SUBTOTAL				$2,920,000	
Project Management	5%			$150,000	
Remedial Oversight/Reporting	6%			$100,000	Six percent of the excavation subtotal
TOTAL CAPITAL COST				**$3,170,000**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS					
DESCRIPTION	**QTY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES:**
Site Monitoring					
Groundwater Sampling & Analysis	1	YR	$15,000	$15,000	Annual sampling of 31 wells
Data Evaluation and Reporting	1	YR	$10,000	$10,000	
SUBTOTAL				$25,000	
TOTAL ANNUAL O&M COST				**$25,000**	

Table 5-6
Opinion of Probable Cost – Alternative 6

Feasibility Study
Former Silver Cleaners
Rochester, New York

Alternative 6

EXCAVATION AND IN-SITU CHEMICAL OXIDATION VIA INFILTRATION GALLERY					OPINION OF PROBABLE COST
Well Abandoning					
Abandonment of Piezometers, Monitoring, Injection, Overburden, and Bedrock Wells	31	EA	$1,000	$31,000	
SUBTOTAL				$31,000	
TOTAL CLOSEOUT COST - YEAR 5				**$31,000**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	PRESENT VALUE (DISCOUNT 5%)	NOTES:
Capital	1	$3,200,000	$3,200,000	$3,200,000	Capital + 1st Year O&M Costs
Annual OM&M	2-5	$100,000	$25,000	$89,000	Annual GW sampling
Closeout	5	$31,000	$31,000	$24,000	Closeout
		$3,330,000		$3,310,000	
TOTAL PRESENT VALUE OF ALTERNATIVE				**$3,310,000**	
TOTAL PRESENT VALUE OF ALTERNATIVE - RANGE ESTIMATE LOW (-30%)				**$2,320,000**	
TOTAL PRESENT VALUE OF ALTERNATIVE - RANGE ESTIMATE HIGH (+50%)				**$4,970,000**	

Table 5-7
Opinion of Probable Cost – Alternative 7

Feasibility Study
Former Silver Cleaners
Rochester, New York

ARCADIS Design & Consultancy for natural and built assets

Alternative 7

RESTORATION TO PRE-DISPOSAL CONDITIONS | **OPINION OF PROBABLE COST**

Site: Former Silver Cleaners, 245 Andrews Street
Location: Rochester, New York
Phase: Alternatives Analysis (-30% to +50%)
Base Year: 2020
Date: January 2020

Description: Alternative 7 consists of demolishing the existing building, followed by in-situ thermal remediation via thermal conductive heating with pre-heater wells. Capital costs are incurred in Years 1-2. OM&M costs are incurred in Year 3.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	LS	$25,000	$25,000	
Site Management Plan	1	LS	$15,000	$15,000	
SUBTOTAL				$40,000	
Demolition					Assume normal business hours
Design	1	LS	$10,000	$10,000	
Subcontracting and oversight	1	LS	$44,000	$44,000	
Well abandonment	17	EA	$1,000	$17,000	
Subcontractor	1	LS	$159,000	$159,000	
Reporting	1	LS	$10,000	$10,000	
SUBTOTAL				$240,000	
In-situ Thermal					Assume normal business hours
ISTR System Design/Final Reporting	1	LS	$150,000	$150,000	
Permitting/Procurement	1	LS	$400,000	$400,000	
Mobilization/Demobilization	1	LS	$560,000	$560,000	
Installation of Heater Wells	236	EA	$6,000	$1,416,000	$120/LF 50 ft deep
Installation of Pre-Heater Wells	30	EA	$2,000	$60,000	$120/LF 15 ft deep
Installation of Vertical Extraction Wells	120	EA	$5,000	$600,000	$160/LF 30 ft deep
Installation of Temperature Monitoring Points	50	EA	$3,000	$150,000	$60/LF 50 ft deep
Pressure Monitoring Point Installation	50	EA	$1,000	$50,000	$100/LF 10 ft deep
Vapor Cover Installation	30,100	SF	$8	$240,000	
Installation of Wellfield Piping and Electrical Wiring / Connections	1	LS	$1,160,000	$1,160,000	
Installation of Above-Grade In-Situ Treatment System Components	1	LS	$350,000	$350,000	
O&M - Electrical Usage	2,090,000	kW/hr	$0.06	$130,000	Average commercial electricity rate in Rochester, NY
O&M - Labor and Expenses	6	MO	$230,000	$1,380,000	$80/hr*person, 2 people 8 hr/day
Well Decommissioning	18,900	LF	$6	$113,000	
Vapor Cover Removal and Handling	30,100	SF	$2	$60,000	
Transportation and Disposal - Spent Granular Activated Carbon	160,000	LB	$4	$640,000	
Transportation and Disposal - Vapor Cover Debris	2,300	TON	$75	$173,000	2 tons/CY
Transportation and Disposal - Waste Water	2,900,000	GAL	$0.10	$290,000	3% porosity
Transportation and Disposal - Soil Cuttings	1,160	TON	$75	$87,000	2 tons/CY
SUBTOTAL				$8,010,000	

Table 5-7
Opinion of Probable Cost – Alternative 7

Feasibility Study
Former Silver Cleaners
Rochester, New York

ARCADIS Design & Consultancy for natural and built assets

Alternative 7

RESTORATION TO PRE-DISPOSAL CONDITIONS					OPINION OF PROBABLE COST
SUBTOTAL				$8,290,000	
Contingency	15%			$1,240,000	
SUBTOTAL				$9,530,000	
Project Management	5%			$480,000	
Remedial Oversight/Reporting	6%			$570,000	
TOTAL CAPITAL COST				**$10,580,000**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS					
DESCRIPTION	**QTY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES:**
Well Abandoning					
Abandonment of Piezometers, Monitoring, Injection, Overburden, and Bedrock Wells	6	EA	$1,000	$6,000	
SUBTOTAL				$6,000	
TOTAL CLOSEOUT COST - YEAR 3				**$6,000**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	PRESENT VALUE (DISCOUNT 5%)	NOTES:
Capital	1-2	$10,580,000	$10,580,000	$10,580,000	Capital
Closeout	3	$6,000	$6,000	$6,000	Closeout
		$10,590,000		$10,590,000	
TOTAL PRESENT VALUE OF ALTERNATIVE				**$10,590,000**	
TOTAL PRESENT VALUE OF ALTERNATIVE - RANGE ESTIMATE LOW (-30%)				**$7,410,000**	
TOTAL PRESENT VALUE OF ALTERNATIVE - RANGE ESTIMATE HIGH (+50%)				**$15,890,000**	

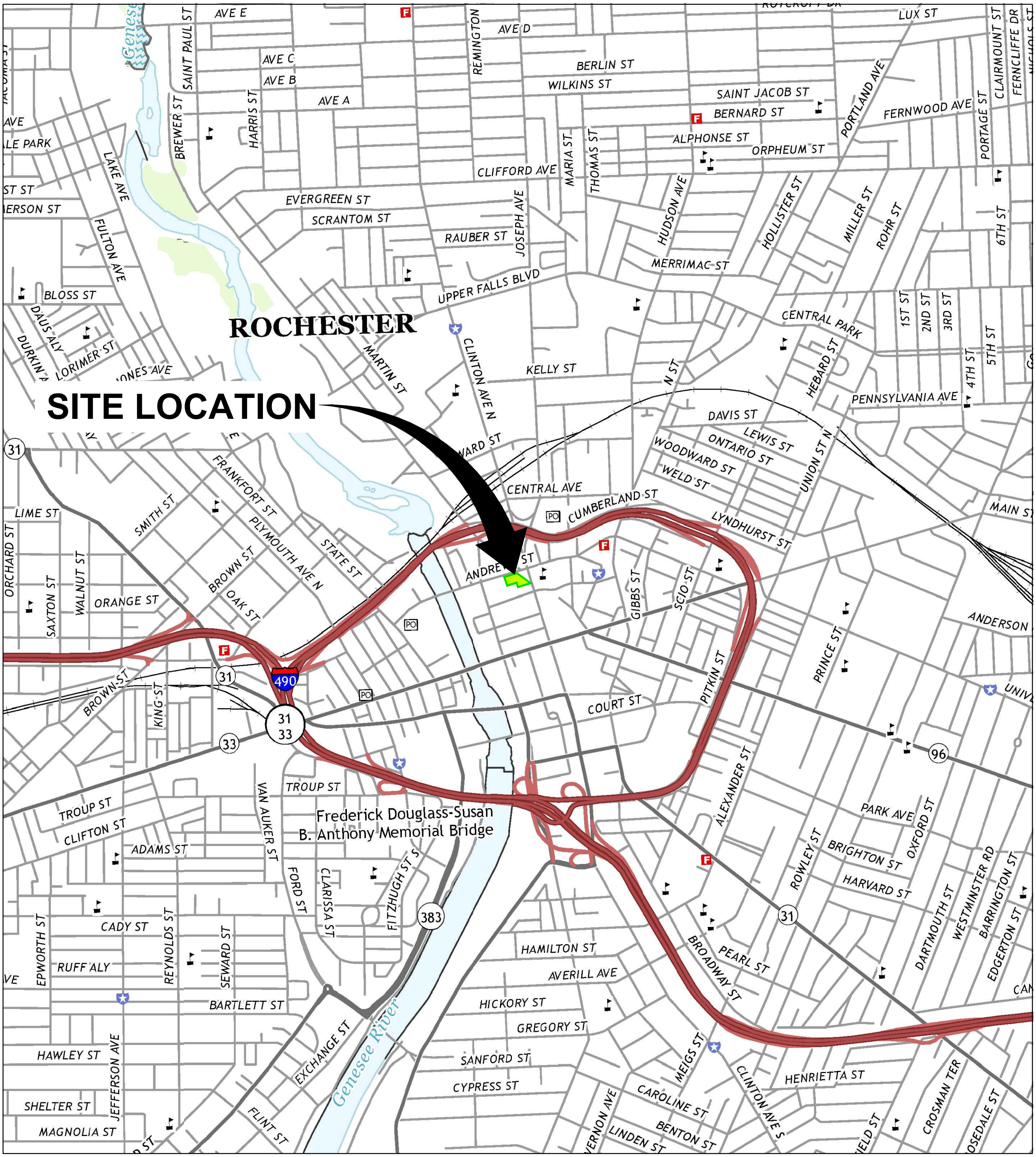
Table 5-8
Remedial Alternative Cost Summary

Feasibility Study
Former Silver Cleaners
Rochester, New York

Site: Former Silver Cleaners, 245 Andrews Street
Location: Rochester, New York
Phase: Alternatives Analysis (-30% to +50%)
Base Year: 2020
Date: January 2020

Alternative	Description	Capital Costs and 1st Year O&M	Annual O&M Costs	Closeout O&M Costs	Assumed Remediation Time (years)	Total Cost	Total Present Value
Alternative 1	NO FURTHER ACTION	$38,000	NA	NA	NA	$38,000	$38,000
Alternative 2	SITE MANAGEMENT AND LONG-TERM MONITORING	$85,000	$20,000	$23,000	30	$688,000	$393,000
Alternative 3	IN-SITU THERMAL REMEDIATION	$3,190,000	$20,000	$10,000	5	$3,280,000	$3,270,000
Alternative 4	ENHANCED REDUCTIVE DECHLORINATION	$2,510,000	$25,000	$63,000	10	$2,800,000	$2,730,000
Alternative 5	IN-SITU CHEMICAL OXIDATION	$2,970,000	$25,000	$61,000	10	$3,260,000	$3,190,000
Alternative 6	EXCAVATION AND IN-SITU CHEMICAL OXIDATION VIA INFILTRATION GALLERY	$3,200,000	$25,000	$31,000	5	$3,330,000	$3,310,000
Alternative 7	RESTORATION TO PRE-DISPOSAL CONDITIONS	$10,580,000	NA	$6,000	3	$10,590,000	$10,590,000

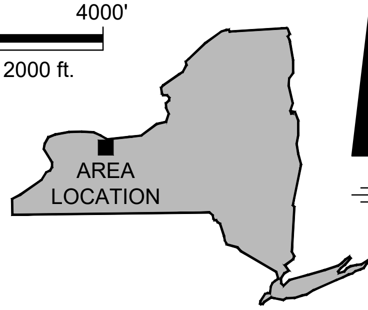
FIGURES



REFERENCE: BASE MAP USGS 7.5. MIN. TOPO. QUAD., ROCHESTER EAST & WEST, NEW YORK, 2016.

0 2000' 4000'

Approximate Scale: 1 in. = 2000 ft.



NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK
FEASIBILITY STUDY

SITE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-1

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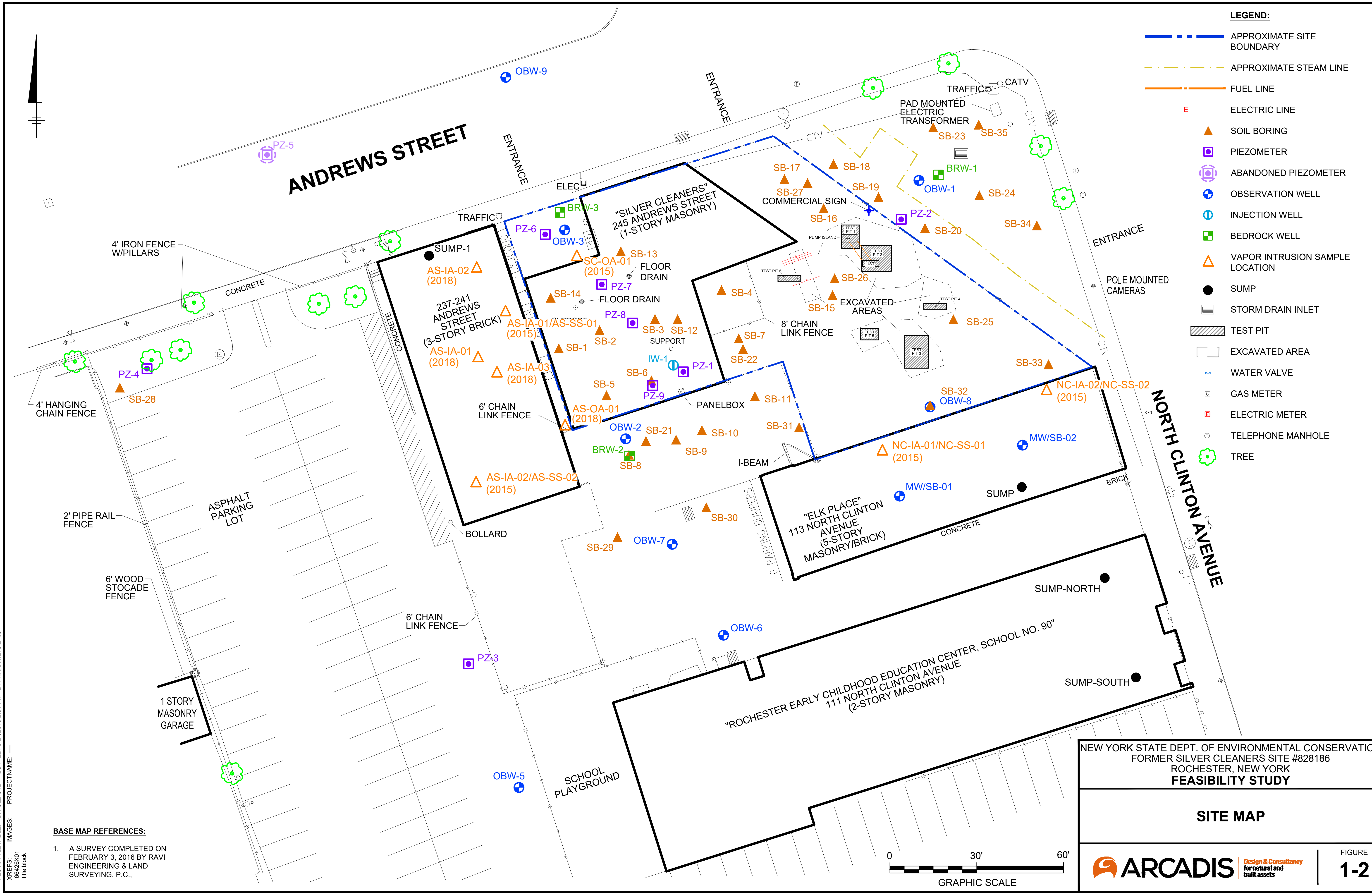


BASE MAP REFERENCES:

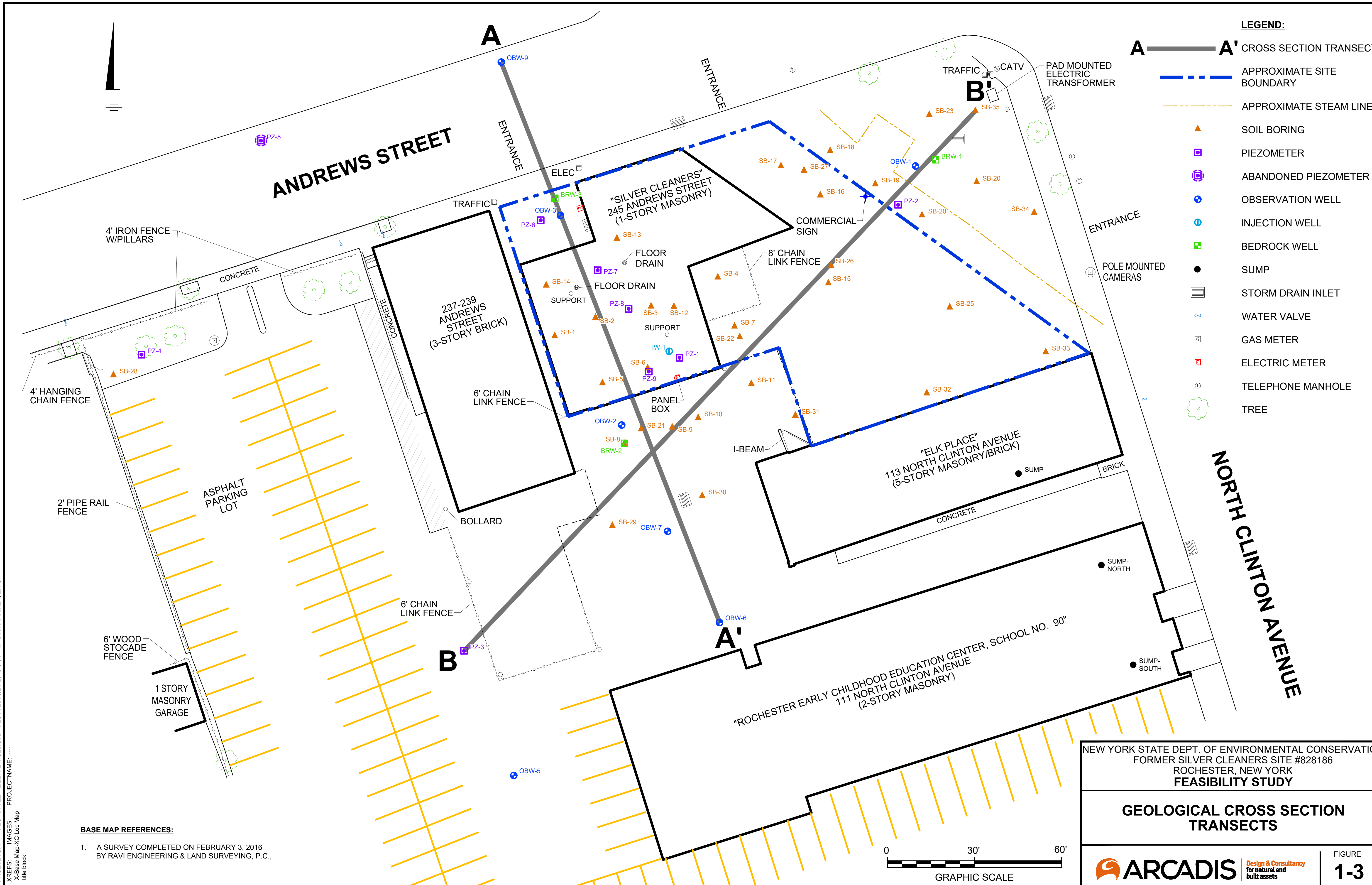
1. A SURVEY COMPLETED ON FEBRUARY 3, 2016 BY RAVI ENGINEERING & LAND SURVEYING, P.C.,

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK
FEASIBILITY STUDY

SITE MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-2



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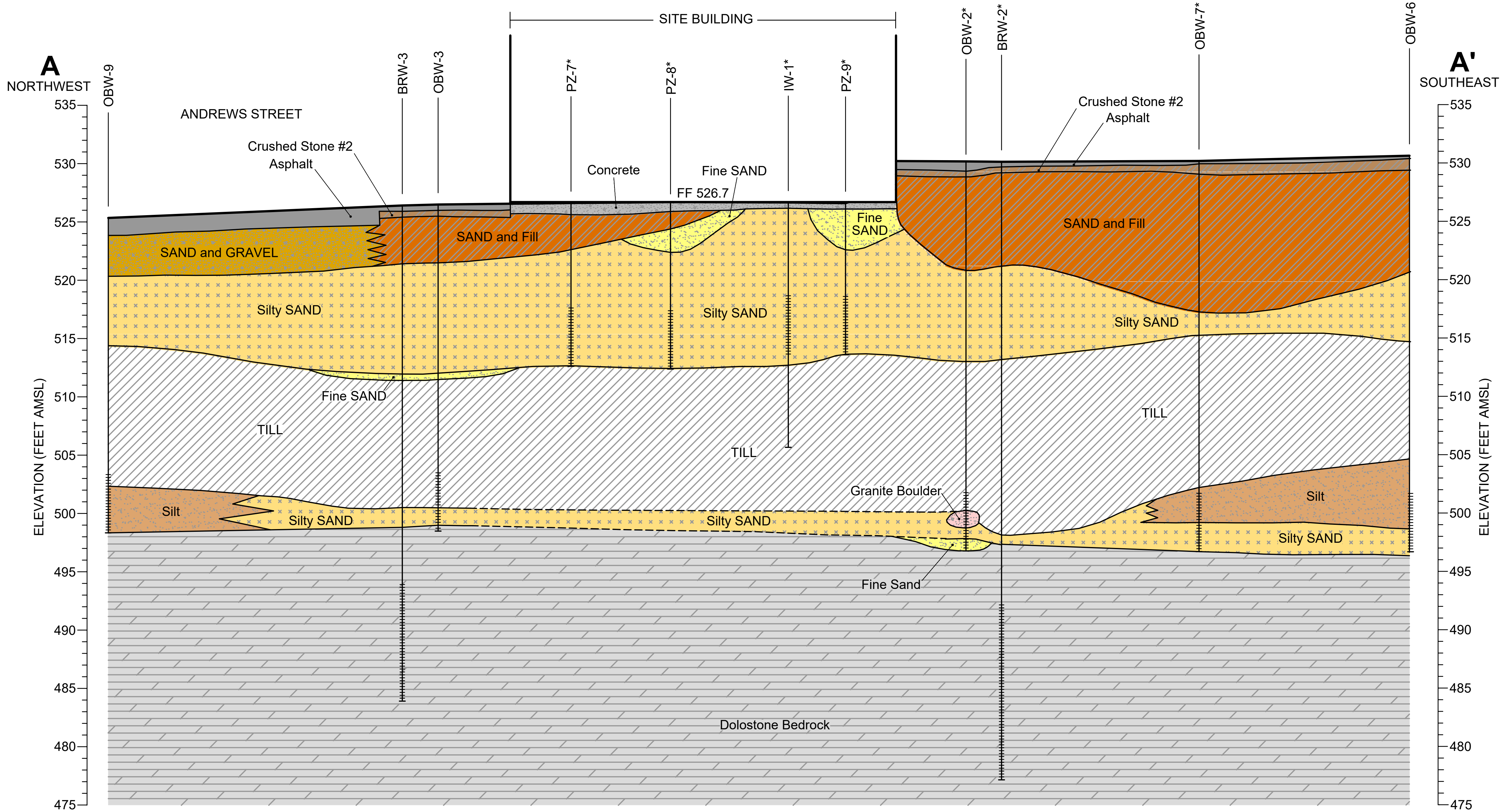

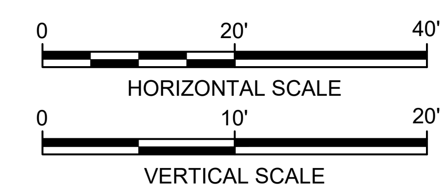

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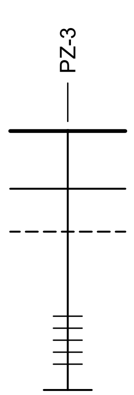

WELL/BORING ID

APPROXIMATE GROUND SURFACE

LITHOLOGIC CONTACT

INFERRED LITHOLOGIC CONTACT

WELL SCREEN

WELL/BORING BOTTOM

LITHOGRAPHIC KEY:

- Asphalt
- Concrete
- Crushed Stone #2
- Sand and Fill
- Sand and Gravel
- Silty SAND
- Fine SAND
- TILL
- Granite Boulder
- Silt
- Dolostone Bedrock

NOTES:

1. CROSS SECTION BASED ON AVAILABLE LITHOLOGY DATA FROM REMEDIAL INVESTIGATION BORING LOGS.
2. FF = FINSHED FLOOR.
3. * = TRANSPOSED ON TO TRANSECT.

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK
FEASIBILITY STUDY

CROSS-SECTION A-A'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-4

CITY:SYRACUSE NY DIV/GROUP: IMDV/CAD DB: E. KRAHMER LD:(Opt) PIC:(Opt) PM: TM: TR: M. BURKHART LYR:(Opt)ON=*;OFF=*REF*
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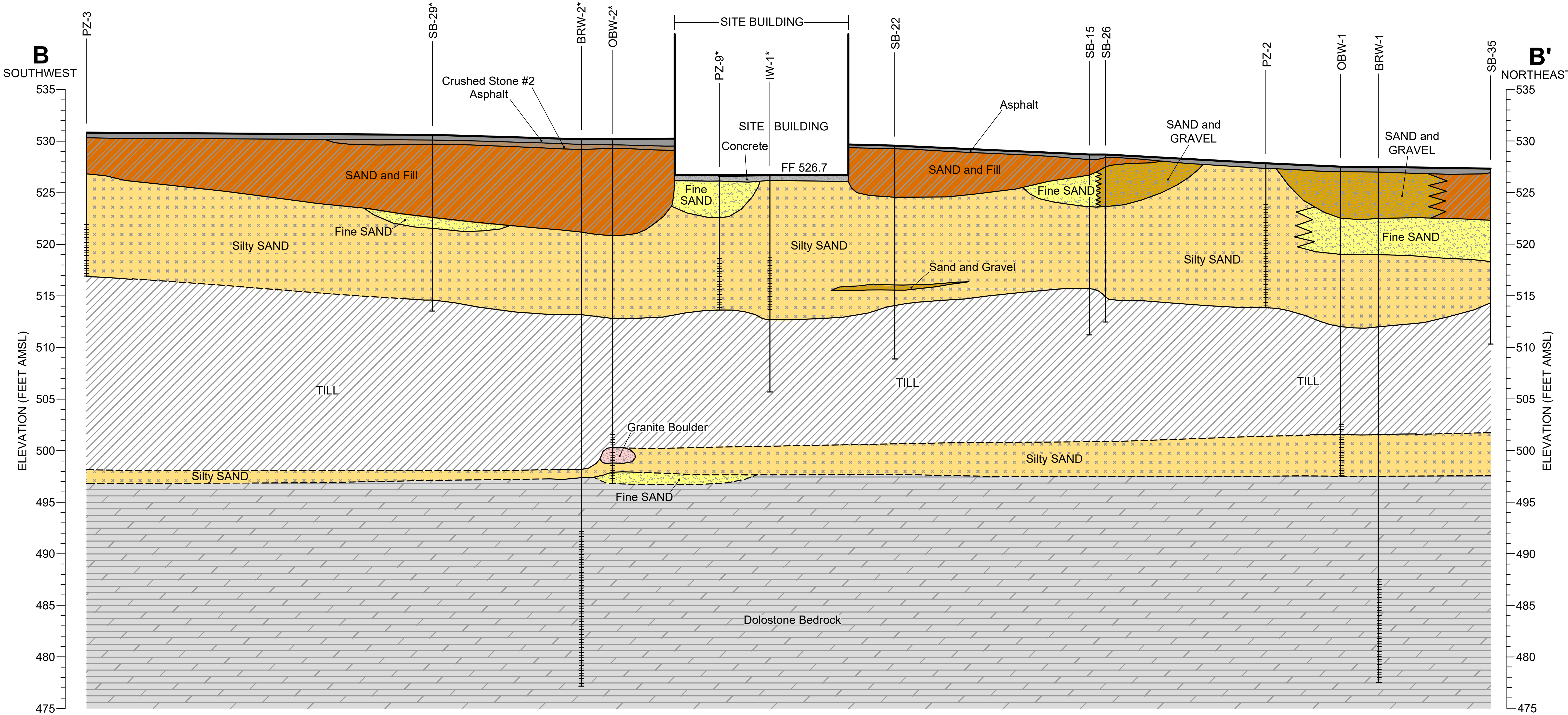
X-X-Sec Shading
RIFS_SCC_Lith X-Sections



0 20' 40'
HORIZONTAL SCALE

0 10' 20'
VERTICAL SCALE

LEGEND:

PZ-3 — WELL/BORING ID

APPROXIMATE GROUND SURFACE

LITHOLOGIC CONTACT

INFERRED LITHOLOGIC CONTACT

WELL SCREEN

WELL/BORING BOTTOM

LITHOGRAPHIC KEY:

- Asphalt
- Concrete
- Crushed Stone #2
- Sand and Fill
- Sand and Gravel
- Silty SAND
- Fine SAND
- TILL
- Granite Boulder
- Silt
- Dolostone Bedrock

NOTES:

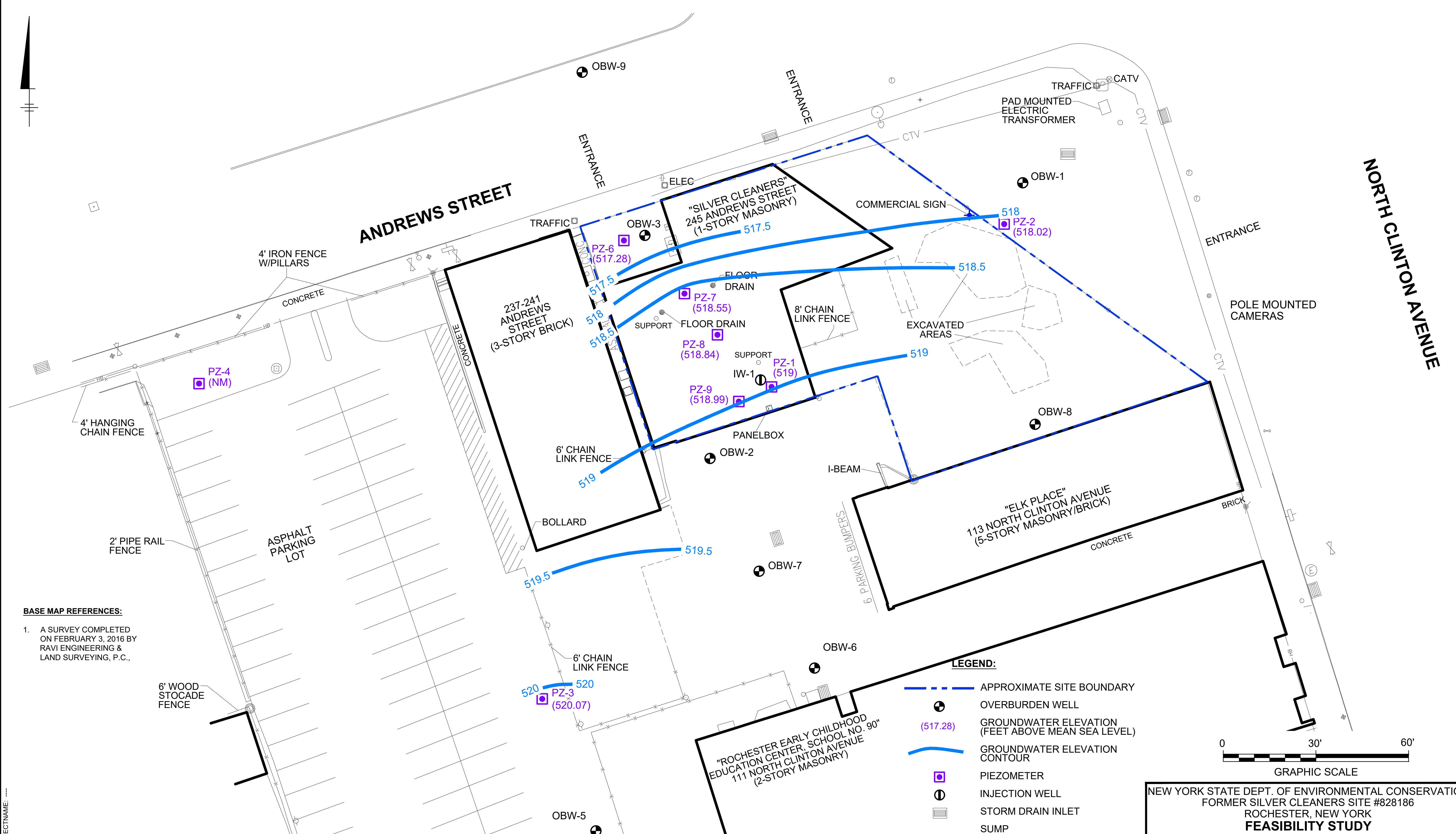
1. CROSS SECTION BASED ON AVAILABLE LITHOLOGY DATA FROM REMEDIAL INVESTIGATION BORING LOGS.
2. FF = FINSHED FLOOR.
3. * = TRANSPOSED ON TO TRANSECT.

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK
FEASIBILITY STUDY

CROSS-SECTION B-B'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-5



BASE MAP REFERENCES:

1. A SURVEY COMPLETED ON FEBRUARY 3, 2016 BY RAVI ENGINEERING & LAND SURVEYING, P.C.,

LEGEND:

- APPROXIMATE SITE BOUNDARY
- OVERBURDEN WELL
- (517.28) GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
- GROUNDWATER ELEVATION CONTOUR
- PIEZOMETER
- INJECTION WELL
- STORM DRAIN INLET
- SUMP
- EXCAVATED AREA
- WATER VALVE
- GAS METER
- ELECTRIC METER
- TELEPHONE MANHOLE
- NM NOT MEASURED

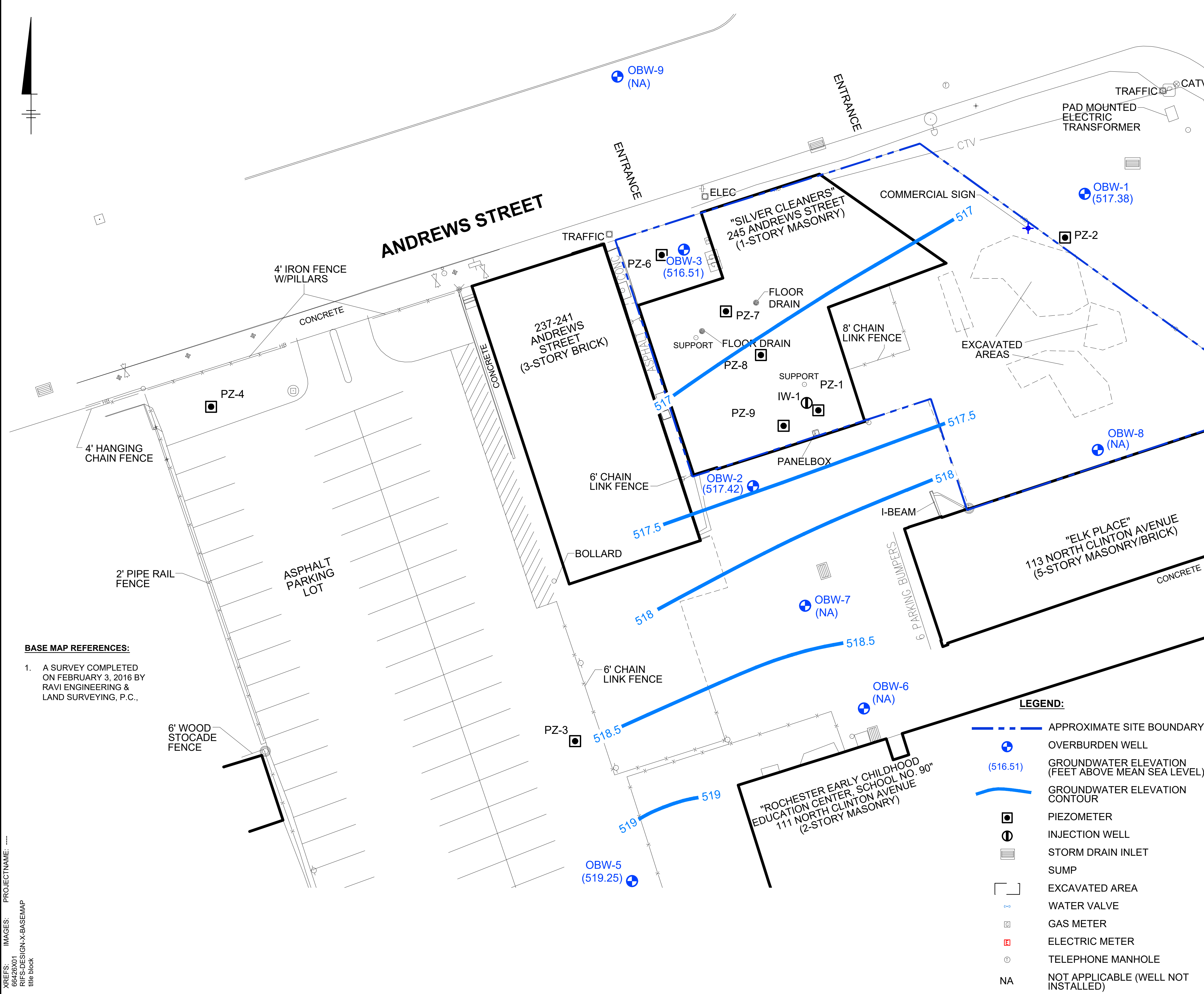
0 30' 60'
GRAPHIC SCALE

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK
FEASIBILITY STUDY

SHALLOW PIEZOMETER GROUNDWATER ELEVATIONS NOVEMBER 19, 2018

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-6



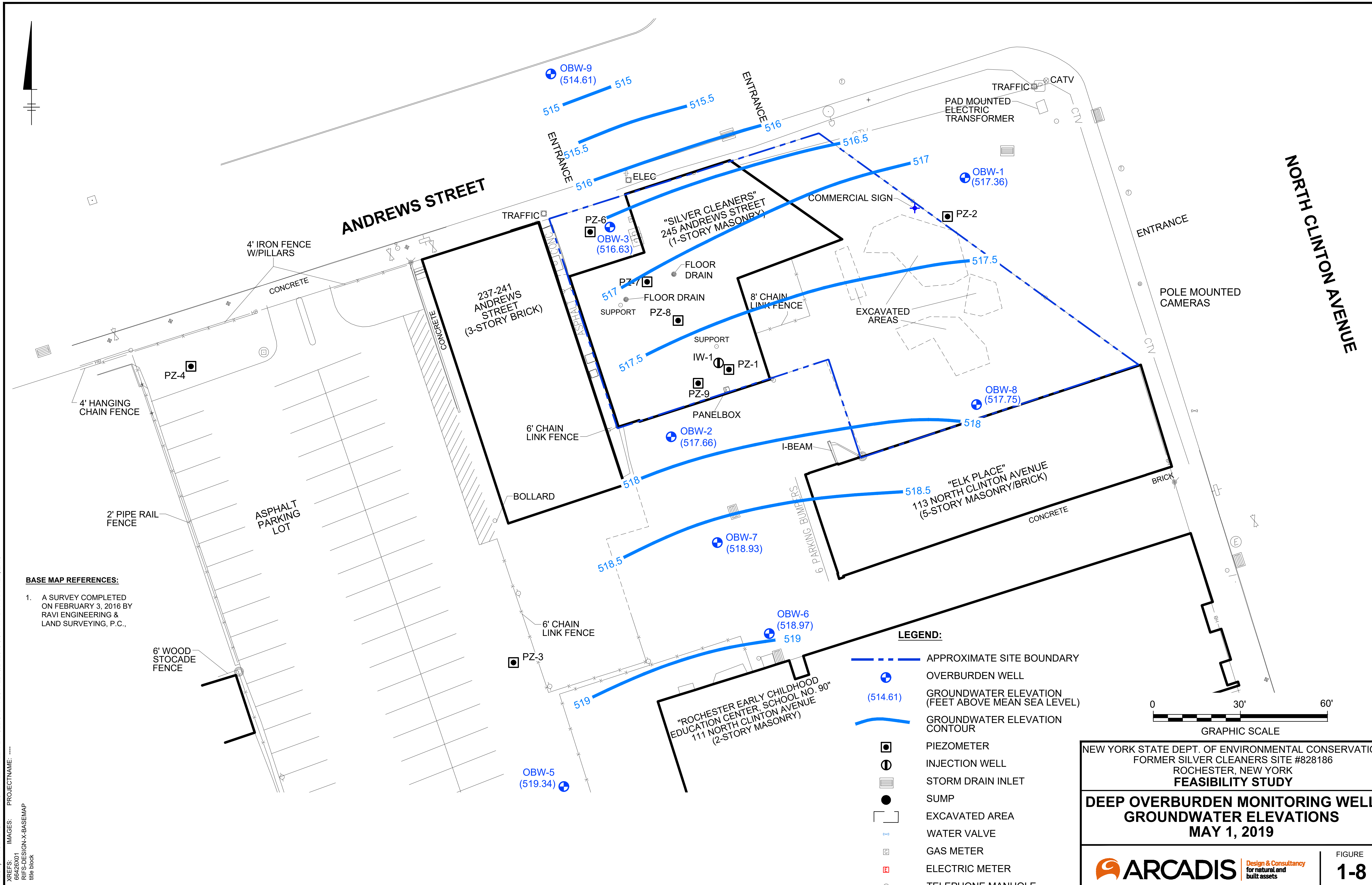
NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK

FEASIBILITY STUDY

DEEP OVERBURDEN MONITORING WELL GROUNDWATER ELEVATIONS NOVEMBER 19, 2018

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-7

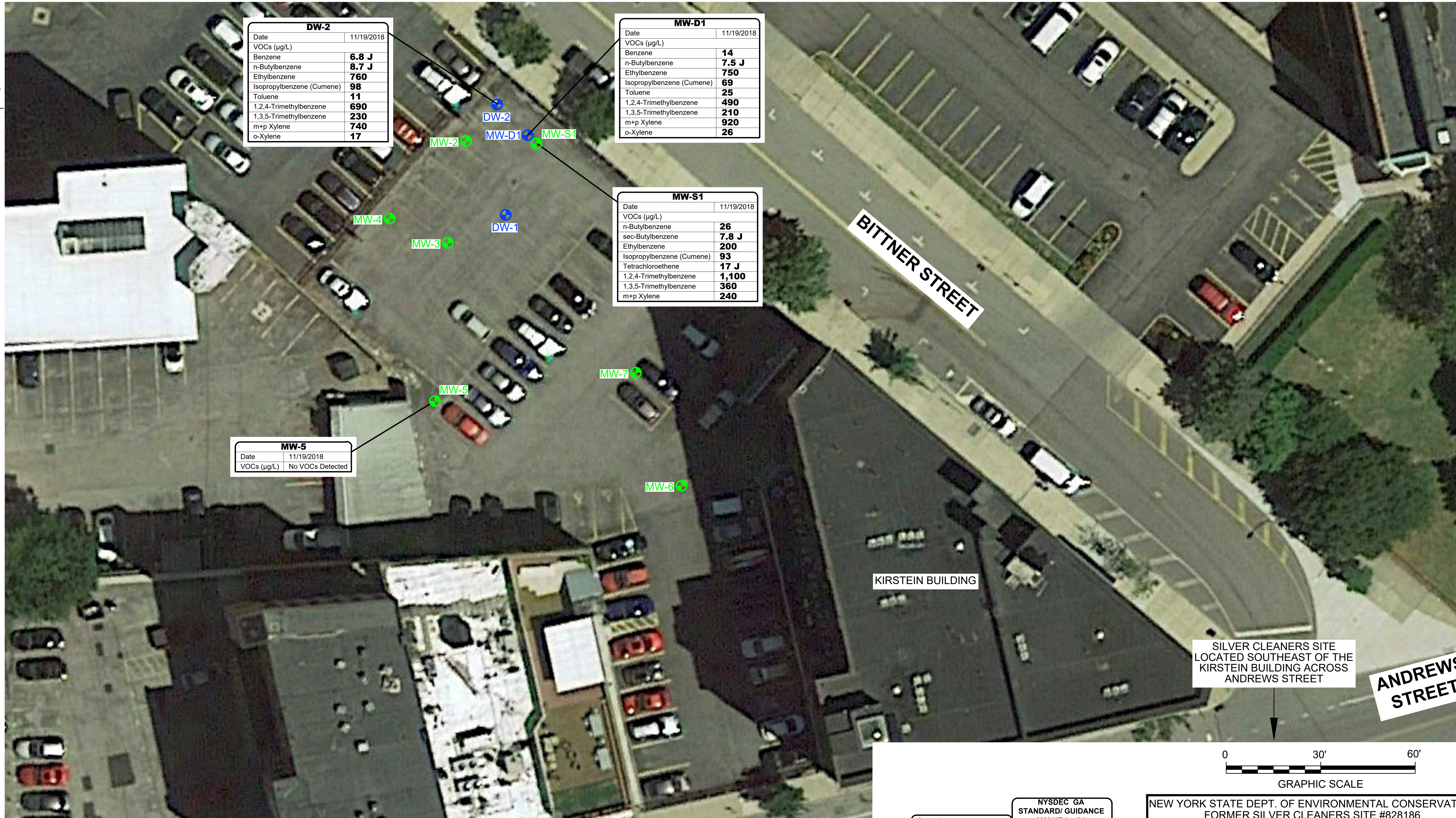


NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK
FEASIBILITY STUDY

DEEP OVERBURDEN MONITORING WELL GROUNDWATER ELEVATIONS MAY 1, 2019

ARCADIS Design & Consultancy for natural and built assets

FIGURE 1-8



DW-2	
Date	11/19/2018
VOCs (µg/L)	
Benzene	**6.8 J**
n-Butylbenzene	**8.7 J**
Ethylbenzene	**760**
Isopropylbenzene (Cumene)	**98**
Toluene	**11**
1,2,4-Trimethylbenzene	**690**
1,3,5-Trimethylbenzene	**230**
m+p Xylene	**740**
o-Xylene	**17**

MW-D1	
Date	11/19/2018
VOCs (µg/L)	
Benzene	**14**
n-Butylbenzene	**7.5 J**
Ethylbenzene	**750**
Isopropylbenzene (Cumene)	**69**
Toluene	**25**
1,2,4-Trimethylbenzene	**490**
1,3,5-Trimethylbenzene	**210**
m+p Xylene	**920**
o-Xylene	**26**

MW-S1	
Date	11/19/2018
VOCs (µg/L)	
n-Butylbenzene	**26**
sec-Butylbenzene	**7.8 J**
Ethylbenzene	**200**
Isopropylbenzene (Cumene)	**93**
Tetrachloroethene	**17 J**
1,2,4-Trimethylbenzene	**1,100**
1,3,5-Trimethylbenzene	**360**
m+p Xylene	**240**

MW-5	
Date	11/19/2018
VOCs (µg/L)	No VOCs Detected

NOTES:

1. ALL CONCENTRATIONS ARE SHOWN IN MICROGRAMS PER LITER (µg/L).
2. BOLDED CONCENTRATIONS EXCEED THE NYSDEC GA STANDARDS OR GUIDANCE VALUE.
3. J = ESTIMATED
4. ANALYTES DETECTED AT CONCENTRATIONS LESS THAN CLASS GA GROUNDWATER STANDARDS ARE NOT SHOWN.
5. VOC = VOLATILE ORGANIC COMPOUNDS.

LEGEND:

DEEP OVERBURDEN WELL

SHALLOW OVERBURDEN WELL

Constituent	NYSDEC GA STANDARD/ GUIDANCE VALUE (µg/L)
Benzene	1
n-Butylbenzene	5
sec-Butylbenzene	5
Ethylbenzene	5
Isopropylbenzene (Cumene)	5
Tetrachloroethene	5
Toluene	5
1,2,4-Trimethylbenzene	5
1,3,5-Trimethylbenzene	5
m+p Xylene	5
o-Xylene	5

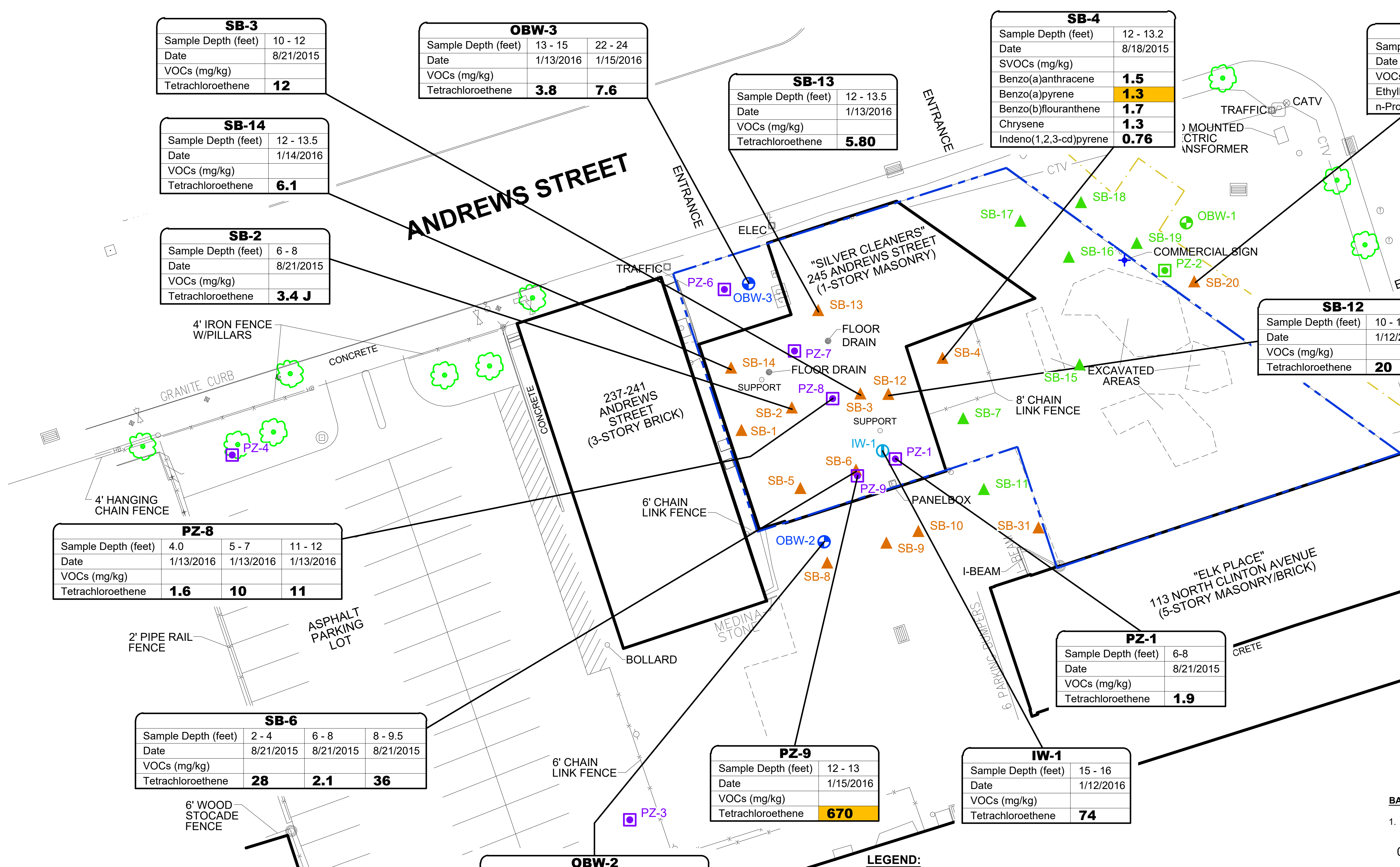
NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK
FEASIBILITY STUDY

37 BITTNER STREET SHALLOW AND DEEP GROUNDWATER VOC CONCENTRATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-1

XREFS: title block IMAGES: AERIAL SITE.jpg PROJECTNAME: ---



SB-3

Sample Depth (feet)	10 - 12
Date	8/21/2015
VOCs (mg/kg)	
Tetrachloroethene	**12**

SB-14

Sample Depth (feet)	12 - 13.5
Date	1/14/2016
VOCs (mg/kg)	
Tetrachloroethene	**6.1**

SB-2

Sample Depth (feet)	6 - 8
Date	8/21/2015
VOCs (mg/kg)	
Tetrachloroethene	**3.4 J**

OBW-3

Sample Depth (feet)	13 - 15	22 - 24
Date	1/13/2016	1/15/2016
VOCs (mg/kg)		
Tetrachloroethene	**3.8**	**7.6**

SB-13

Sample Depth (feet)	12 - 13.5
Date	1/13/2016
VOCs (mg/kg)	
Tetrachloroethene	**5.80**

SB-4

Sample Depth (feet)	12 - 13.2
Date	8/18/2015
SVOCs (mg/kg)	
Benzo(a)anthracene	**1.5**
Benzo(a)pyrene	**1.3**
Benzo(b)flouranthene	**1.7**
Chrysene	**1.3**
Indeno(1,2,3-cd)pyrene	**0.76**

SB-20

Sample Depth (feet)	11 - 13
Date	1/15/2016
VOCs (mg/kg)	
Ethylbenzene	**19**
n-Propylbenzene	**7.7**

SB-12

Sample Depth (feet)	10 - 12
Date	1/12/2016
VOCs (mg/kg)	
Tetrachloroethene	**20**

PZ-8

Sample Depth (feet)	4.0	5 - 7	11 - 12
Date	1/13/2016	1/13/2016	1/13/2016
VOCs (mg/kg)			
Tetrachloroethene	**1.6**	**10**	**11**

PZ-1

Sample Depth (feet)	6-8
Date	8/21/2015
VOCs (mg/kg)	
Tetrachloroethene	**1.9**

SB-6

Sample Depth (feet)	2 - 4	6 - 8	8 - 9.5
Date	8/21/2015	8/21/2015	8/21/2015
VOCs (mg/kg)			
Tetrachloroethene	**28**	**2.1**	**36**

PZ-9

Sample Depth (feet)	12 - 13
Date	1/15/2016
VOCs (mg/kg)	
Tetrachloroethene	**670**

IW-1

Sample Depth (feet)	15 - 16
Date	1/12/2016
VOCs (mg/kg)	
Tetrachloroethene	**74**

OBW-2

Sample Depth (feet)	24 - 25	25 - 26
Date	1/14/2016	1/14/2016
VOCs (mg/kg)		
Tetrachloroethene	**3.0**	**9.3**

Constituent	6 NYCRR Part 375 Unrestricted Use SCO (mg/kg) (BOLD)	6 NYCRR PART 375 PROTECTION OF PUBLIC HEALTH - COMMERCIAL SCO (mg/kg)
Tetrachloroethene	1.3	150
Ethylbenzene	1	390
n-Propylbenzene	3.9	500
Benzo(a)anthracene	1	5.6
Benzo(a)pyrene	1	1
Benzo(b)fluoranthene	0.8	5.6
Chrysene	1	56
Indeno(1,2,3-cd)pyrene	0.5	5.6

NOTES:

1. ALL CONCENTRATIONS ARE SHOWN IN MILLIGRAMS PER KILOGRAM (mg/kg).
2. BOLDED CONCENTRATIONS EXCEED THE 6 NYCRR PART 375 UNRESTRICTED USE SCO.
3. ORANGE SHADED CONCENTRATIONS EXCEED 6 NYCRR PART 375 PROTECTION OF PUBLIC HEALTH - COMMERCIAL SCO
4. J = ESTIMATED BELOW LABORATORY REPORTING LIMIT.
5. NO SCO EXCEEDANCES AT SOIL BORINGS WITH NO DATA SHOWN.
6. ANALYTES DETECTED AT CONCENTRATIONS LESS THAN UNRESTRICTED USE SCO ARE NOT SHOWN.
7. VOC = VOLATILE ORGANIC COMPOUNDS. SVOC = SEMIVOLATILE ORGANIC COMPOUNDS. SCO = SOIL CLEANUP OBJECTIVES.

BASE MAP REFERENCES:

1. A SURVEY COMPLETED ON FEBRUARY 3, 2016 BY RAVI ENGINEERING & LAND SURVEYING, P.C.,

0 30' 60'

GRAPHIC SCALE

LEGEND:

- APPROXIMATE SITE BOUNDARY
- APPROXIMATE STEAM LINE
- SOIL BORING
- PIEZOMETER
- OVERBURDEN WELL
- INJECTION WELL
- ANALYTICAL DATA HAD NO VOC EXCEEDANCES
- STORM DRAIN INLET
- EXCAVATED AREA
- WATER VALVE
- GAS METER
- ELECTRIC METER
- TELEPHONE MANHOLE

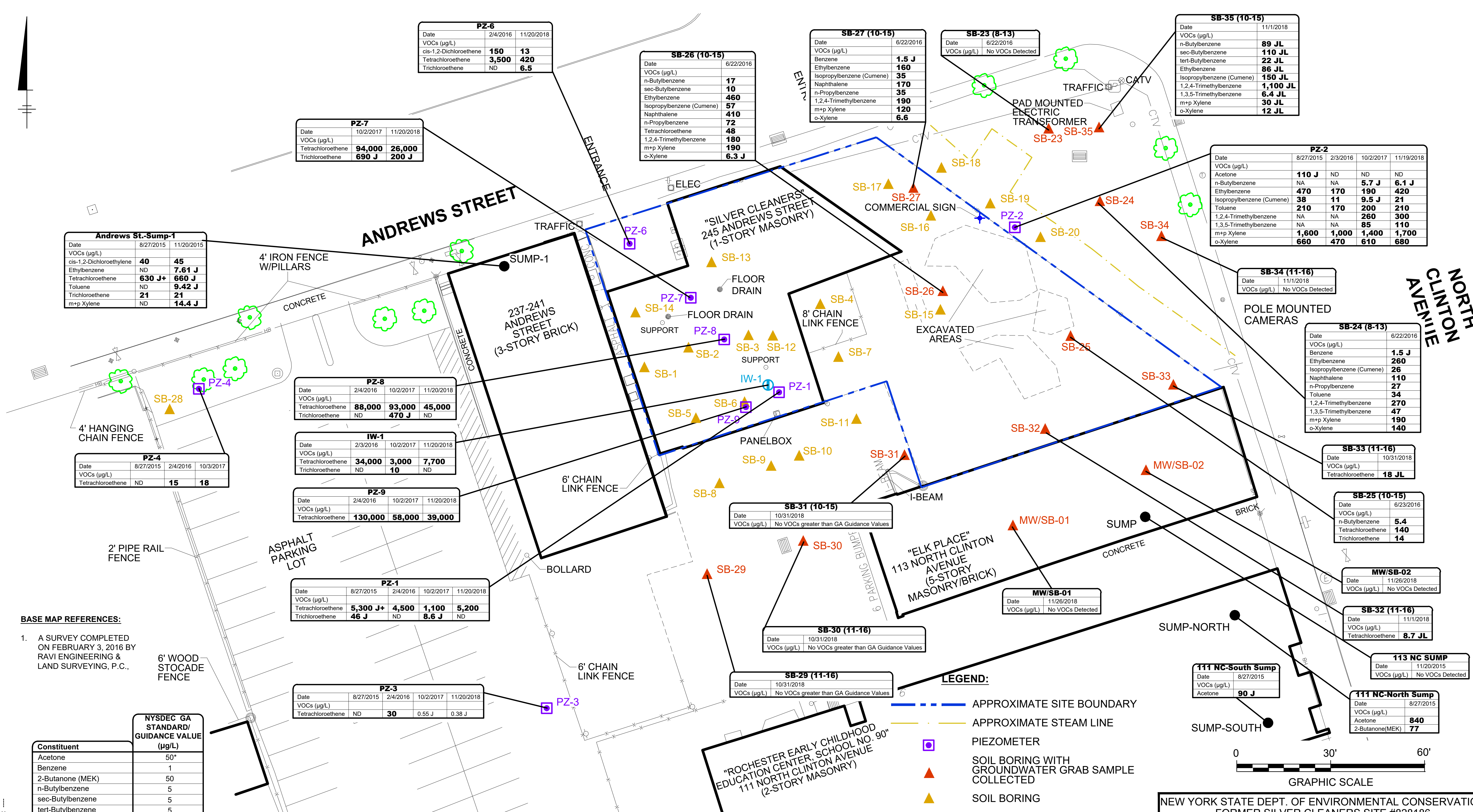
NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK

FEASIBILITY STUDY

SOIL VOC AND SVOC CONCENTRATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE **2-2**



PZ-6

Date	2/4/2016	11/20/2018
VOCs (µg/L)		
cis-1,2-Dichloroethene	**150**	**13**
Tetrachloroethene	**3,500**	**420**
Trichloroethene	ND	**6.5**

PZ-7

Date	10/2/2017	11/20/2018
VOCs (µg/L)		
Tetrachloroethene	**94,000**	**26,000**
Trichloroethene	**690 J**	**200 J**

SB-26 (10-15)

Date	6/22/2016
VOCs (µg/L)	
n-Butylbenzene	**17**
sec-Butylbenzene	**10**
Ethylbenzene	**460**
Isopropylbenzene (Cumene)	**57**
Naphthalene	**410**
n-Propylbenzene	**72**
Tetrachloroethene	**48**
1,2,4-Trimethylbenzene	**180**
m+p Xylene	**190**
o-Xylene	**6.3 J**

SB-27 (10-15)

Date	6/22/2016
VOCs (µg/L)	
Benzene	**1.5 J**
Ethylbenzene	**160**
Isopropylbenzene (Cumene)	**35**
Naphthalene	**170**
n-Propylbenzene	**35**
1,2,4-Trimethylbenzene	**190**
m+p Xylene	**120**
o-Xylene	**6.6**

SB-23 (8-13)

Date	6/22/2016
VOCs (µg/L)	No VOCs Detected

SB-35 (10-15)

Date	11/1/2018
VOCs (µg/L)	
n-Butylbenzene	**89 JL**
sec-Butylbenzene	**110 JL**
tert-Butylbenzene	**22 JL**
Ethylbenzene	**86 JL**
Isopropylbenzene (Cumene)	**150 JL**
1,2,4-Trimethylbenzene	**1,100 JL**
1,3,5-Trimethylbenzene	**6.4 JL**
m+p Xylene	**30 JL**
o-Xylene	**12 JL**

PZ-2

Date	8/27/2015	2/3/2016	10/2/2017	11/19/2018
VOCs (µg/L)				
Acetone	**110 J**	ND	ND	ND
n-Butylbenzene	NA	NA	**5.7 J**	**6.1 J**
Ethylbenzene	**470**	**170**	**190**	**420**
Isopropylbenzene (Cumene)	**38**	**11**	**9.5 J**	**21**
Toluene	**210**	**170**	**200**	**210**
1,2,4-Trimethylbenzene	NA	NA	**260**	**300**
1,3,5-Trimethylbenzene	NA	NA	**85**	**110**
m+p Xylene	**1,600**	**1,000**	**1,400**	**1,700**
o-Xylene	**660**	**470**	**610**	**680**

SB-34 (11-16)

Date	11/1/2018
VOCs (µg/L)	No VOCs Detected

Andrews St.-Sump-1

Date	8/27/2015	11/20/2015
VOCs (µg/L)		
cis-1,2-Dichloroethylene	**40**	**45**
Ethylbenzene	ND	**7.61 J**
Tetrachloroethene	**630 J+**	**660 J**
Toluene	ND	**9.42 J**
Trichloroethene	**21**	**21**
m+p Xylene	ND	**14.4 J**

SB-24 (8-13)

Date	6/22/2016
VOCs (µg/L)	
Benzene	**1.5 J**
Ethylbenzene	**260**
Isopropylbenzene (Cumene)	**26**
Naphthalene	**110**
n-Propylbenzene	**27**
Toluene	**34**
1,2,4-Trimethylbenzene	**270**
1,3,5-Trimethylbenzene	**47**
m+p Xylene	**190**
o-Xylene	**140**

PZ-8

Date	2/4/2016	10/2/2017	11/20/2018
VOCs (µg/L)			
Tetrachloroethene	**88,000**	**93,000**	**45,000**
Trichloroethene	ND	**470 J**	ND

IW-1

Date	2/3/2016	10/2/2017	11/20/2018
VOCs (µg/L)			
Tetrachloroethene	**34,000**	**3,000**	**7,700**
Trichloroethene	ND	**10**	ND

PZ-4

Date	8/27/2015	2/4/2016	10/3/2017
VOCs (µg/L)			
Tetrachloroethene	ND	**15**	**18**

SB-33 (11-16)

Date	10/31/2018
VOCs (µg/L)	
Tetrachloroethene	**18 JL**

PZ-9

Date	2/4/2016	10/2/2017	11/20/2018
VOCs (µg/L)			
Tetrachloroethene	**130,000**	**58,000**	**39,000**

SB-25 (10-15)

Date	6/23/2016
VOCs (µg/L)	
n-Butylbenzene	**5.4**
Tetrachloroethene	**140**
Trichloroethene	**14**

SB-31 (10-15)

Date	10/31/2018
VOCs (µg/L)	No VOCs greater than GA Guidance Values

MW/SB-02

Date	11/26/2018
VOCs (µg/L)	No VOCs Detected

PZ-1

Date	8/27/2015	2/4/2016	10/2/2017	11/20/2018
VOCs (µg/L)				
Tetrachloroethene	**5,300 J+**	**4,500**	**1,100**	**5,200**
Trichloroethene	**46 J**	ND	**8.6 J**	ND

MW/SB-01

Date	11/26/2018
VOCs (µg/L)	No VOCs Detected

SB-32 (11-16)

Date	11/1/2018
VOCs (µg/L)	
Tetrachloroethene	**8.7 JL**

SB-30 (11-16)

Date	10/31/2018
VOCs (µg/L)	No VOCs greater than GA Guidance Values

113 NC SUMP

Date	11/20/2015
VOCs (µg/L)	No VOCs Detected

111 NC-South Sump

Date	8/27/2015
VOCs (µg/L)	
Acetone	**90 J**

SB-29 (11-16)

Date	10/31/2018
VOCs (µg/L)	No VOCs greater than GA Guidance Values

PZ-3

Date	8/27/2015	2/4/2016	10/2/2017	11/20/2018
VOCs (µg/L)				
Tetrachloroethene	ND	**30**	0.55 J	0.38 J

111 NC-North Sump

Date	8/27/2015
VOCs (µg/L)	
Acetone	**840**
2-Butanone(MEK)	**77**

BASE MAP REFERENCES:

1. A SURVEY COMPLETED ON FEBRUARY 3, 2016 BY RAVI ENGINEERING & LAND SURVEYING, P.C.,

Constituent	NYSDEC GA STANDARD/ GUIDANCE VALUE (µg/L)
Acetone	50*
Benzene	1
2-Butanone (MEK)	50
n-Butylbenzene	5
sec-Butylbenzene	5
tert-Butylbenzene	5
cis-1,2-Dichloroethene	5
Ethylbenzene	5
Isopropylbenzene (Cumene)	5
Naphthalene	10
n-Propylbenzene	5
Tetrachloroethene	5
Toluene	5
Trichloroethene	5
1,2,4-Trimethylbenzene	5
1,3,5-Trimethylbenzene	5
m+p Xylene	5
o-Xylene	5

NOTES:

1. ALL CONCENTRATIONS ARE SHOWN IN MICROGRAMS PER LITER (µg/L).
2. BOLDED CONCENTRATIONS EXCEED THE NYSDEC GA STANDARDS OR GUIDANCE VALUE.
3. J = ESTIMATED
4. J+ = ESTIMATED BIASED HIGH
5. JL = ESTIMATED BIASED LOW
6. NA = NOT ANALYZED
7. ANALYTES DETECTED AT CONCENTRATIONS LESS THAN CLASS GA GROUNDWATER STANDARDS ARE NOT SHOWN.
8. VOC = VOLATILE ORGANIC COMPOUNDS. ND = NONE DETECTED.

LEGEND:

- APPROXIMATE SITE BOUNDARY
- APPROXIMATE STEAM LINE
- PIEZOMETER
- SOIL BORING WITH GROUNDWATER GRAB SAMPLE COLLECTED
- SOIL BORING
- INJECTION WELL
- STORM DRAIN INLET
- SUMP
- EXCAVATED AREA
- WATER VALVE
- GAS METER
- ELECTRIC METER
- TELEPHONE MANHOLE

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK
FEASIBILITY STUDY

SHALLOW OVERBURDEN GROUNDWATER VOC CONCENTRATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-3

CITY: SYRACUSE NY DIV/GROUP: ENVCAD DB: E. KRAHMER PIC: PM: TM: TR: R. CLARE LYR:(Opt)ON=*;OFF=*REF*
C:\BIM\OneDrive - ARCADIS\BIM 360 Docs\ANA - NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION\Former Silver Cleaners RIFS\2019\00266426.0000\01-DWG\RIFS_SCC_Fig11_Shallow OB-GW-VOC-Conc.dwg LAYOUT: 11 SAVED: 9/24/2019 2:51 PM ACADVER: 23.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 9/24/2019 2:55 PM BY: KRAHMER, ERIC
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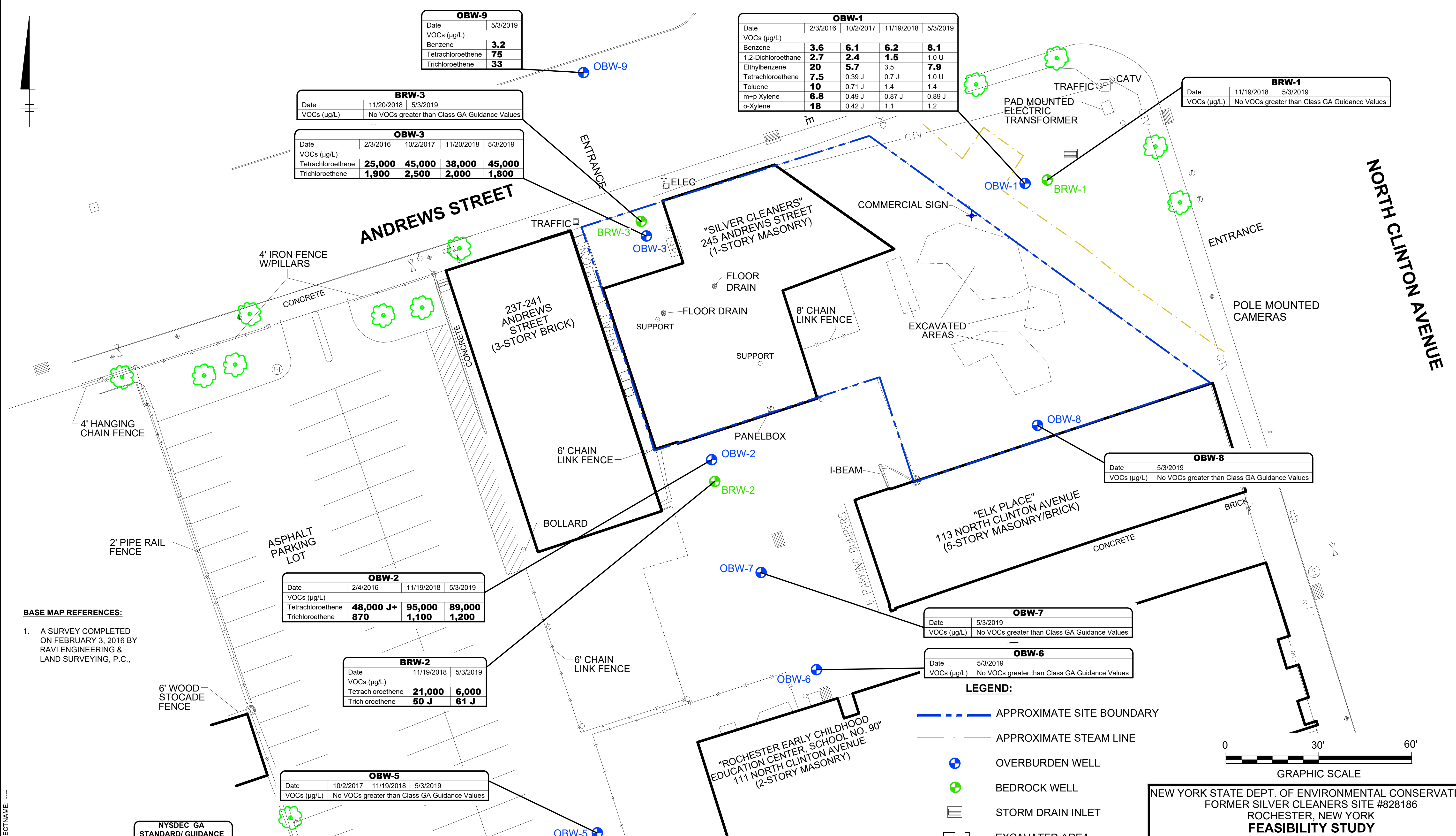


OBW-9

Date	5/3/2019
VOCs (µg/L)	
Benzene	**3.2**
Tetrachloroethene	**75**
Trichloroethene	**33**

OBW-1

Date	2/3/2016	10/2/2017	11/19/2018	5/3/2019
VOCs (µg/L)				
Benzene	**3.6**	**6.1**	**6.2**	**8.1**
1,2-Dichloroethane	**2.7**	**2.4**	**1.5**	1.0 U
Elthylbenzene	**20**	**5.7**	3.5	**7.9**
Tetrachloroethene	**7.5**	0.39 J	0.7 J	1.0 U
Toluene	**10**	0.71 J	1.4	1.4
m+p Xylene	**6.8**	0.49 J	0.87 J	0.89 J
o-Xylene	**18**	0.42 J	1.1	1.2

BRW-1

Date	11/19/2018	5/3/2019
VOCs (µg/L)	No VOCs greater than Class GA Guidance Values	

BRW-3

Date	11/20/2018	5/3/2019
VOCs (µg/L)	No VOCs greater than Class GA Guidance Values	

OBW-3

Date	2/3/2016	10/2/2017	11/20/2018	5/3/2019
VOCs (µg/L)				
Tetrachloroethene	**25,000**	**45,000**	**38,000**	**45,000**
Trichloroethene	**1,900**	**2,500**	**2,000**	**1,800**

OBW-8

Date	5/3/2019
VOCs (µg/L)	No VOCs greater than Class GA Guidance Values

OBW-2

Date	2/4/2016	11/19/2018	5/3/2019
VOCs (µg/L)			
Tetrachloroethene	**48,000 J+**	**95,000**	**89,000**
Trichloroethene	**870**	**1,100**	**1,200**

OBW-7

Date	5/3/2019
VOCs (µg/L)	No VOCs greater than Class GA Guidance Values

OBW-6

Date	5/3/2019
VOCs (µg/L)	No VOCs greater than Class GA Guidance Values

BRW-2

Date	11/19/2018	5/3/2019
VOCs (µg/L)		
Tetrachloroethene	**21,000**	**6,000**
Trichloroethene	**50 J**	**61 J**

OBW-5

Date	10/2/2017	11/19/2018	5/3/2019
VOCs (µg/L)	No VOCs greater than Class GA Guidance Values		

BASE MAP REFERENCES:

1. A SURVEY COMPLETED ON FEBRUARY 3, 2016 BY RAVI ENGINEERING & LAND SURVEYING, P.C.,

Constituent	NYSDEC GA STANDARD/ GUIDANCE VALUE (µg/L)
Acetone	50*
Benzene	1
1,2-Dicholoroethane	0.6
Ethylbenzene	5
Tetrachloroethene	5
Toluene	5
Trichloroethene	5
m+p Xylene	5
o-Xylene	5

NOTES:

1. ALL CONCENTRATIONS ARE SHOWN IN MICROGRAMS PER LITER (µg/L).
2. BOLDED CONCENTRATIONS EXCEED THE NYSDEC GA STANDARDS OR GUIDANCE VALUE.
3. J = ESTIMATED
4. J+ = ESTIMATED BIASED HIGH
5. NA = NOT ANALYZED
6. ANALYTES DETECTED AT CONCENTRATIONS LESS THAN CLASS GA GROUNDWATER STANDARDS ARE NOT SHOWN.
7. VOC = VOLATILE ORGANIC COMPOUNDS.

LEGEND:

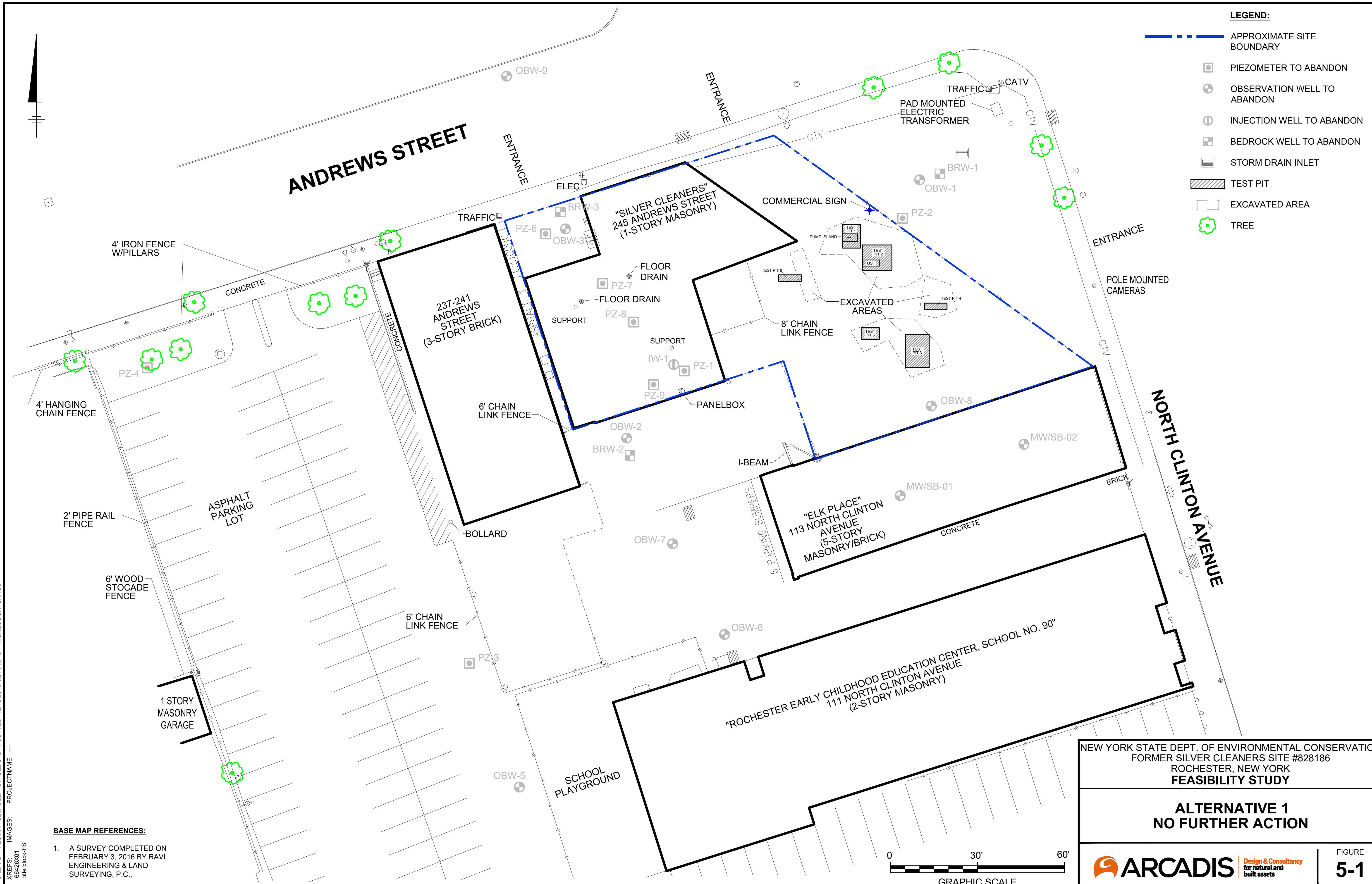
- APPROXIMATE SITE BOUNDARY
- APPROXIMATE STEAM LINE
- OVERBURDEN WELL
- BEDROCK WELL
- STORM DRAIN INLET
- EXCAVATED AREA
- WATER VALVE
- GAS METER
- ELECTRIC METER
- TELEPHONE MANHOLE

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK
FEASIBILITY STUDY

DEEP OVERBURDEN AND BEDROCK GROUNDWATER VOC CONCENTRATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-4



BASE MAP REFERENCES:

1. A SURVEY COMPLETED ON FEBRUARY 3, 2016 BY RAVI ENGINEERING & LAND SURVEYING, P.C.,

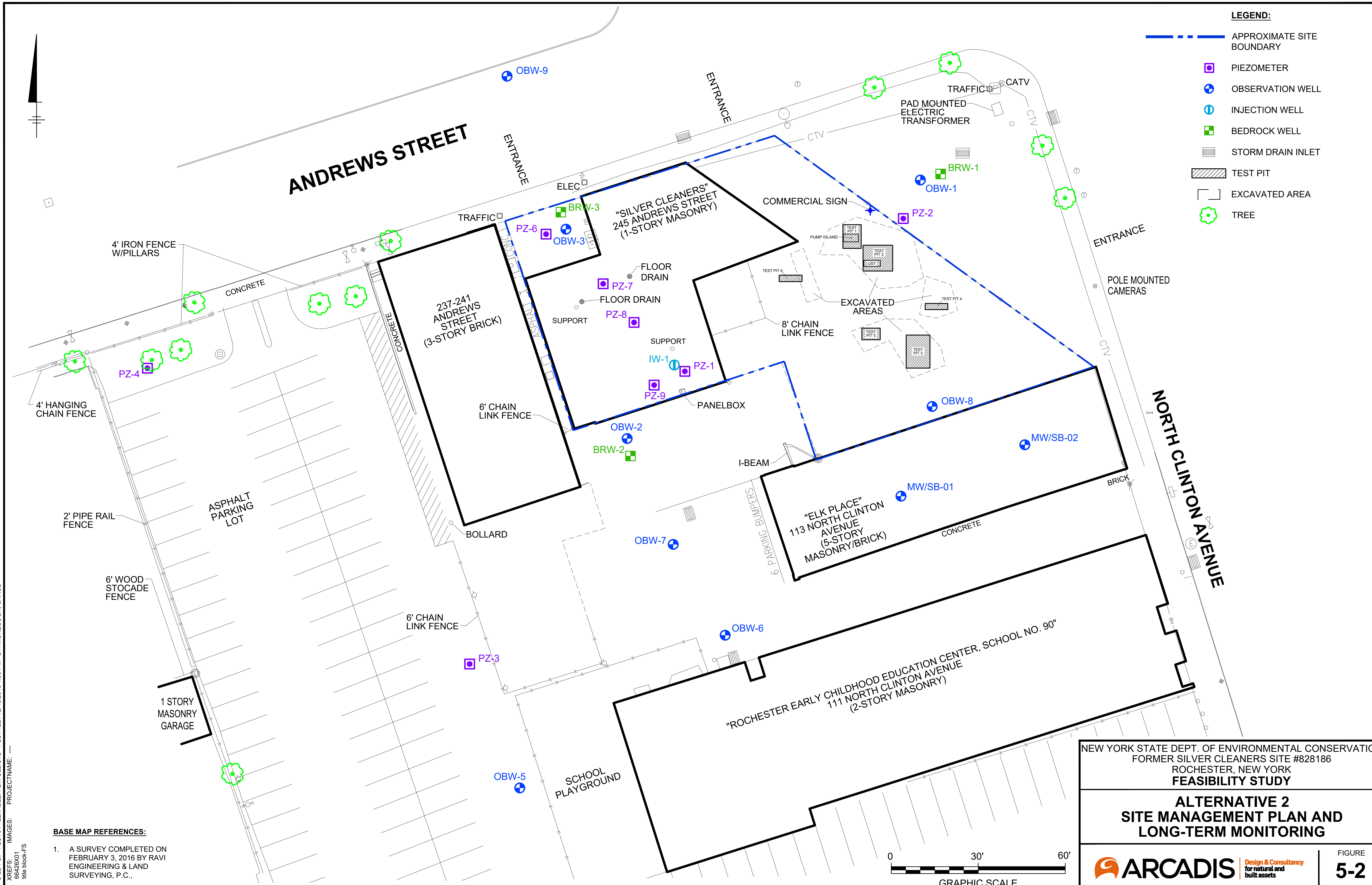
NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK

FEASIBILITY STUDY

ALTERNATIVE 1
NO FURTHER ACTION

ARCADIS Design & Consultancy for natural and built assets

FIGURE
5-1



BASE MAP REFERENCES:

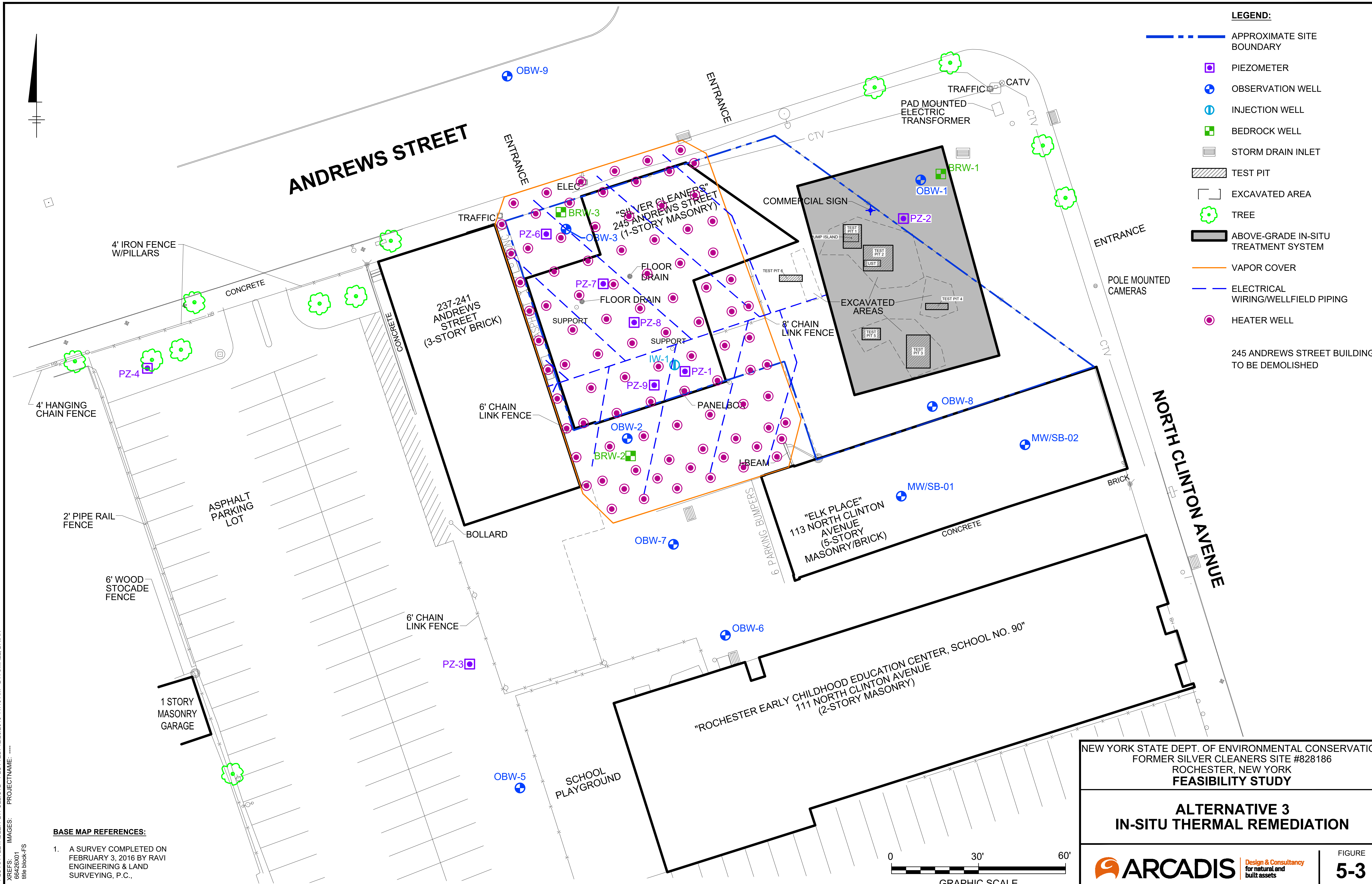
1. A SURVEY COMPLETED ON FEBRUARY 3, 2016 BY RAVI ENGINEERING & LAND SURVEYING, P.C.,

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK
FEASIBILITY STUDY

ALTERNATIVE 2
SITE MANAGEMENT PLAN AND LONG-TERM MONITORING

ARCADIS Design & Consultancy for natural and built assets

FIGURE
5-2



BASE MAP REFERENCES:

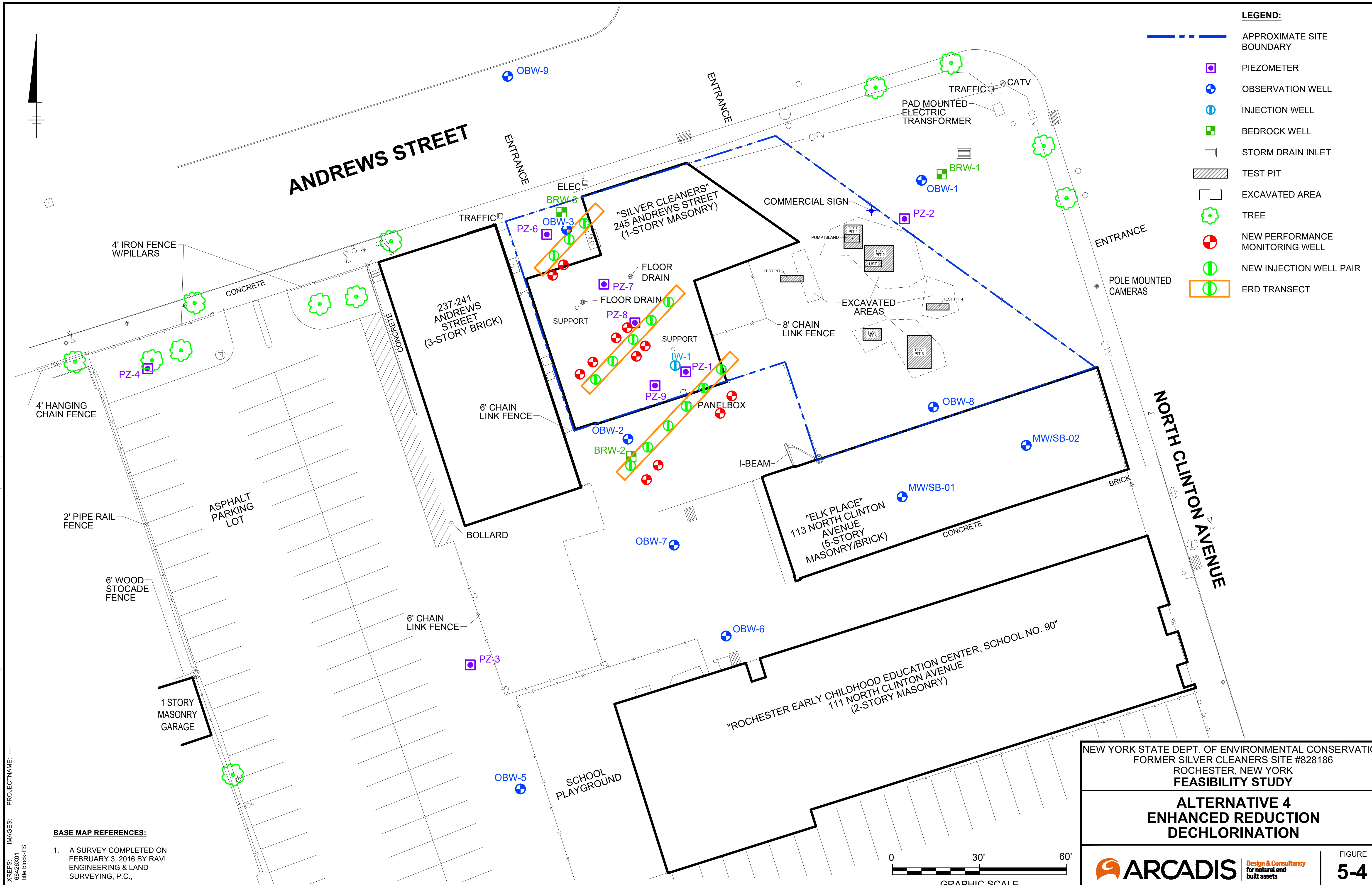
1. A SURVEY COMPLETED ON FEBRUARY 3, 2016 BY RAVI ENGINEERING & LAND SURVEYING, P.C.,

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK
FEASIBILITY STUDY

ALTERNATIVE 3
IN-SITU THERMAL REMEDIATION

ARCADIS Design & Consultancy for natural and built assets

FIGURE
5-3



BASE MAP REFERENCES:

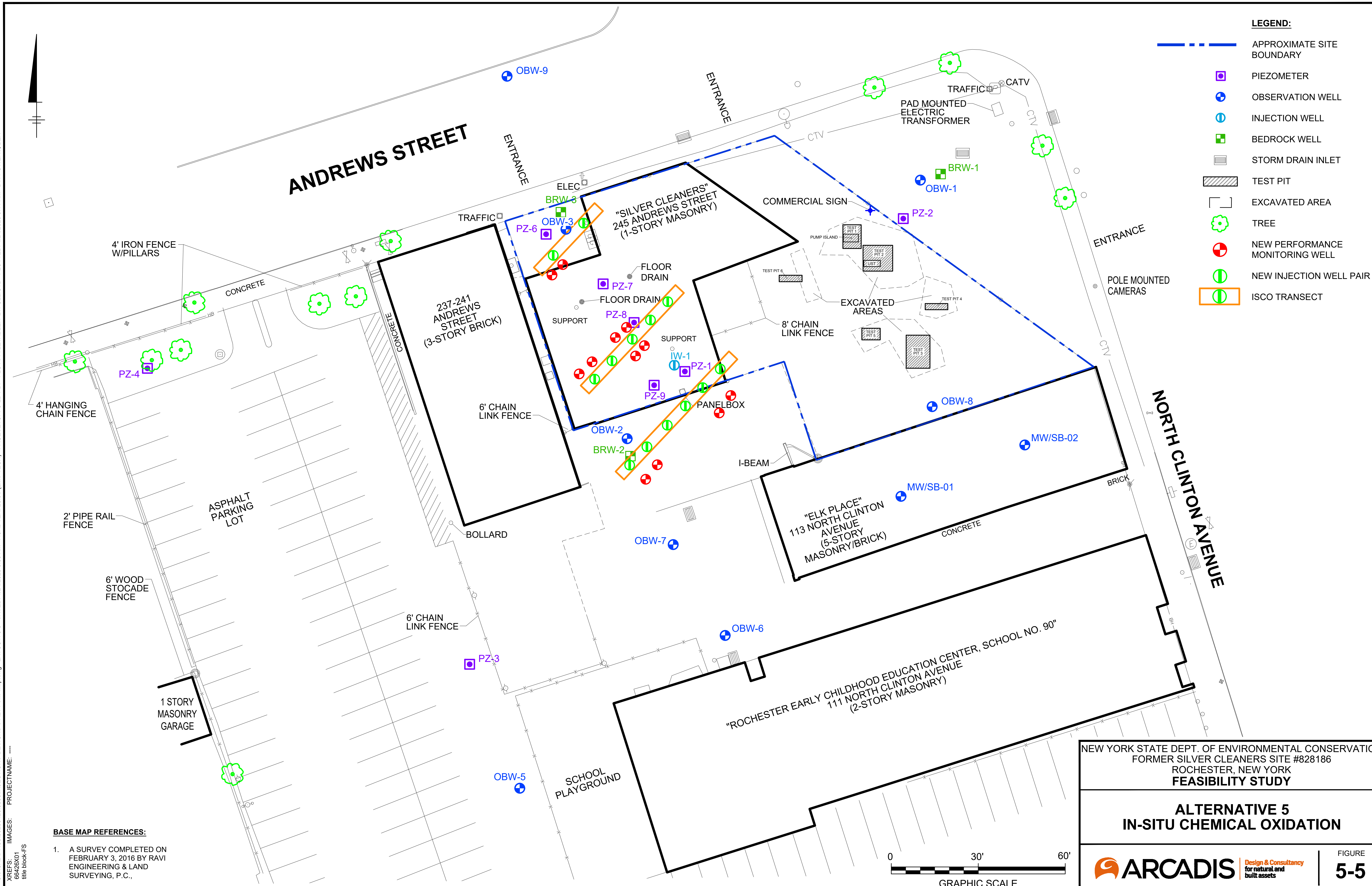
1. A SURVEY COMPLETED ON FEBRUARY 3, 2016 BY RAVI ENGINEERING & LAND SURVEYING, P.C.,

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK
FEASIBILITY STUDY

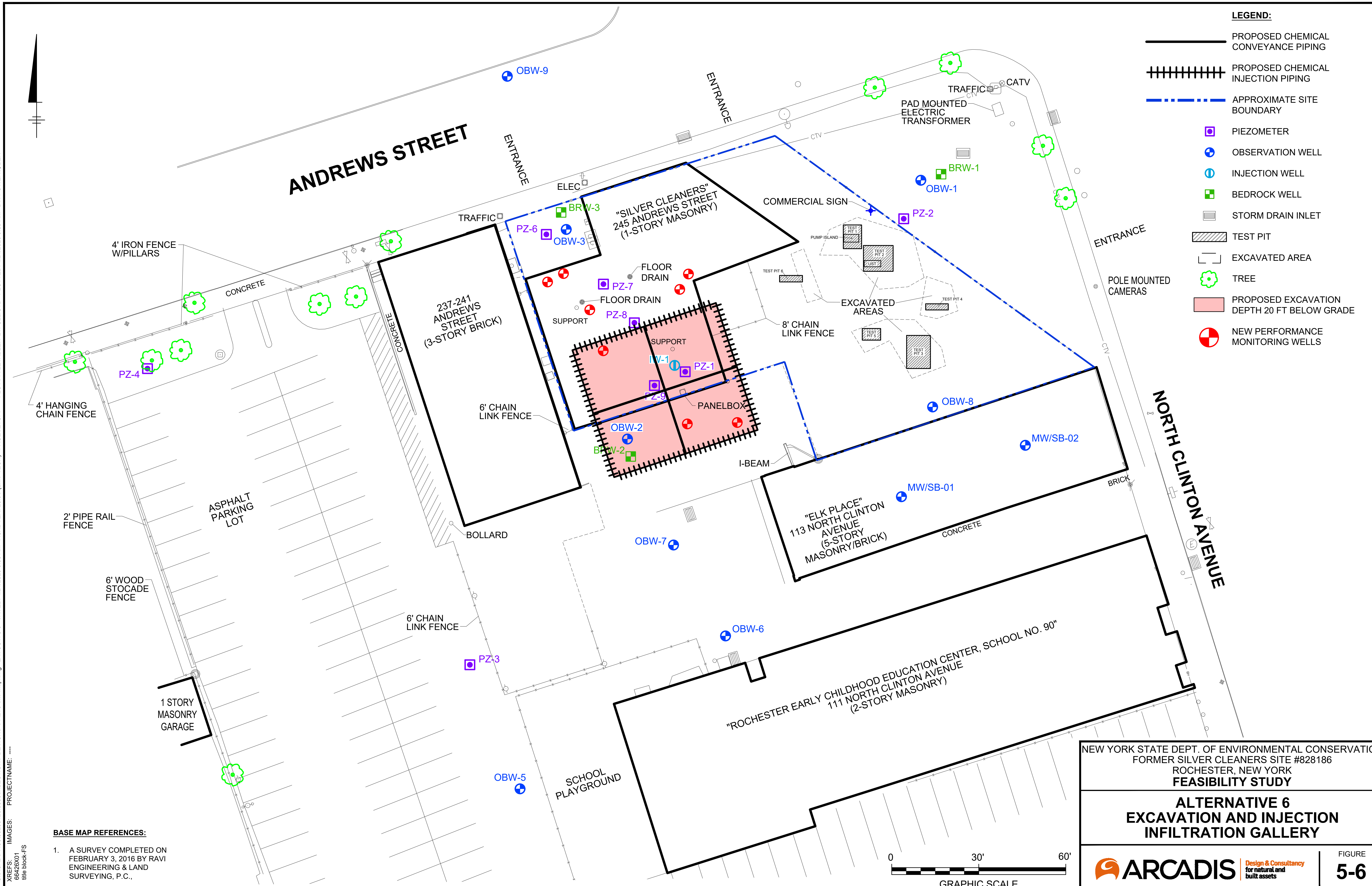
ALTERNATIVE 4
ENHANCED REDUCTION DECHLORINATION

ARCADIS Design & Consultancy for natural and built assets

FIGURE
5-4



LEGEND:
APPROXIMATE SITE BOUNDARY
PIEZOMETER
OBSERVATION WELL
INJECTION WELL
BEDROCK WELL
STORM DRAIN INLET
TEST PIT
EXCAVATED AREA
TREE
NEW PERFORMANCE MONITORING WELL
NEW INJECTION WELL PAIR
ISCO TRANSECT
ANDREWS STREET
NORTH CLINTON AVENUE
ENTRANCE
OBW-9
TRAFFIC
CATV
PAD MOUNTED ELECTRIC TRANSFORMER
CTV
BRW-1
OBW-1
PZ-2
COMMERCIAL SIGN
ELEC
BRW-3
OBW-3
PZ-6
"SILVER CLEANERS" 245 ANDREWS STREET (1-STORY MASONRY)
4' IRON FENCE W/PILLARS
CONCRETE
FLOOR DRAIN
PZ-7
SUPPORT
PZ-8
IW-1
PZ-1
PZ-9
PANELBOX
EXCAVATED AREAS
8' CHAIN LINK FENCE
POLE MOUNTED CAMERAS
OBW-8
MW/SB-02
MW/SB-01
237-241 ANDREWS STREET (3-STORY BRICK)
6' CHAIN LINK FENCE
OBW-2
BRW-2
I-BEAM
BRICK
PZ-4
4' HANGING CHAIN FENCE
ASPHALT PARKING LOT
2' PIPE RAIL FENCE
BOLLARD
OBW-7
"ELK PLACE" 113 NORTH CLINTON AVENUE (5-STORY MASONRY/BRICK)
6' WOOD STOCADE FENCE
OBW-6
PZ-3
1 STORY MASONRY GARAGE
"ROCHESTER EARLY CHILDHOOD EDUCATION CENTER, SCHOOL NO. 90" 111 NORTH CLINTON AVENUE (2-STORY MASONRY)
OBW-5
SCHOOL PLAYGROUND
BASE MAP REFERENCES:
1. A SURVEY COMPLETED ON FEBRUARY 3, 2016 BY RAVI ENGINEERING & LAND SURVEYING, P.C.,
0 30' 60'
GRAPHIC SCALE
NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK
FEASIBILITY STUDY
ALTERNATIVE 5
IN-SITU CHEMICAL OXIDATION
ARCADIS
Design & Consultancy for natural and built assets
FIGURE
5-5



BASE MAP REFERENCES:

1. A SURVEY COMPLETED ON FEBRUARY 3, 2016 BY RAVI ENGINEERING & LAND SURVEYING, P.C.,

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK

FEASIBILITY STUDY

ALTERNATIVE 6
EXCAVATION AND INJECTION INFILTRATION GALLERY

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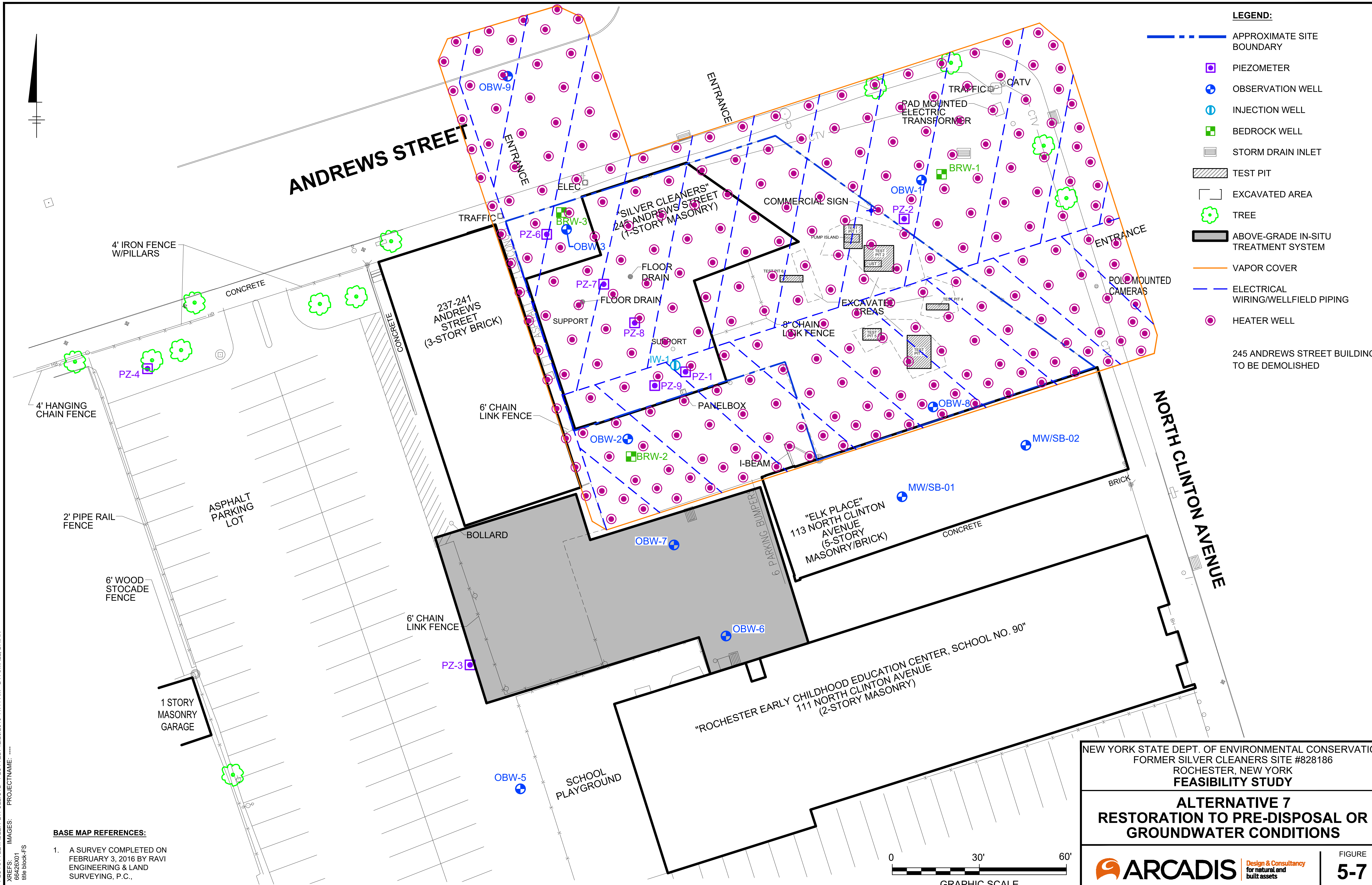
FIGURE
5-6



NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION
FORMER SILVER CLEANERS SITE #828186
ROCHESTER, NEW YORK

FEASIBILITY STUDY

ALTERNATIVE 7
RESTORATION TO PRE-DISPOSAL OR GROUNDWATER CONDITIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE **5-7**

BASE MAP REFERENCES:

1. A SURVEY COMPLETED ON FEBRUARY 3, 2016 BY RAVI ENGINEERING & LAND SURVEYING, P.C.,

CITY: SYRACUSE NY DIV/GROUP: ENVCAD DB: E. KRAHMER PIC: PM: TM: TR: R. CLARE LYR:(Opt)ON=*;OFF=*REF*
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Arcadis CE, Inc.

855 Route 146

Suite 210

Clifton Park, New York 12065

Tel 518 250 7300

Fax 518 371 2757

www.arcadis.com