KYOCERA AVX Components Corporation

Feasibility Study Report – Source Area

Operable Unit 5
Olean Well Field Superfund Site
AVX Source Area

1695 Seneca Avenue
Olean, New York

Revision 2
July 2023

689014

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Acronyms and Abbreviations

Ω·m	Ohm-meter
°C	degrees Celsius
1,1,1-TCA	1,1,1-trichloroethane
3-D	3-dimensional
amsl	above mean sea level
Arcadis	Arcadis U.S., Inc.
ARAR	applicable or relevant and appropriate requirement
AVX	AVX Corporation
AVX Property	KYOCERA AVX Components Corporation property located at 1695 Seneca Avenue in Olean, Cattaraugus County, New York; also historically referred to as the "AVX site" or "AVX Property"
BBL	Blasland, Bouck & Lee, Inc.
BBLES	BBL Environmental Services, Inc.
BFS	blast furnace slag
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	constituent of concern
COPC	constituent of potential concern
Consent Order	Administrative Order on Consent
CSM	conceptual site model
CVOC	chlorinated volatile organic compound
cy	cubic yard
DAR	Division of Air Resources
ERH	electrical resistance heating
EVS	Environmental Visualization System
Final RD	Final (100%) Remedial Design
FS	feasibility study
FS Report-Source Area	Feasibility Study Report – Source Area Operable Unit 5, Revision 1
FSIR-Source Area	Feasibility Study Investigation Report – Source Area
FSWP-Source Area	Feasibility Study Work Plan – Source Area
GAC	granular-activated carbon

Geraghty & Miller	Geraghty & Miller, Inc.
GSR	Green and Sustainable Remediation
GWMP	Groundwater Management Plan
ISS	in situ soil solidification
ISTR	in situ thermal remediation
KAVX	KYOCERA AVX Components Corporation
mg/kg	milligram per kilogram
MNA	monitored natural attenuation
MPE	multiphase extraction
NAPL	non-aqueous phase liquid
NCP	National Oil and Hazardous Substances Contingency Plan
NPL	National Priorities List
NYCRR	New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
O&M	operation and maintenance
Olean Well Field Site	Olean Well Field Superfund Site
OU-1	Operable Unit 1
OU-1 ROD	Superfund Record of Decision, Olean Well Field, New York
OU-2	Operable Unit 2
OU-2 Amended ROD	Amendment to the Operable Unit Two Record of Decision for the Olean Well Field Superfund Site
OU-2 RI/FS Order	Administrative Order on Consent, Index No. II CERCLA-10202, between the Potentially Responsible Parties and the United States Environmental Protection Agency
OU-4	Operable Unit 4
OU-5	Operable Unit 5
PCE	tetrachloroethene
PPE	personal protection equipment
PRP	Potentially Responsible Party
RAO	remedial action objective
RAWP	Remedial Action Work Plan
RDWP	Remedial Design Work Plan

RG	remediation goal
RI	remedial investigation
ROD	Record of Decision
SCO	Site Cleanup Objective
SMP	Site Management Plan
supplemental RI/FS	Administrative Order on Consent, Index No. II CERCLA-10202, between the Potentially Responsible Parties and the United States Environmental Protection Agency
SVE	soil vapor extraction
TBC	To Be Considered
TCH	thermal conduction heating
TCE	trichloroethene
U.S.C.	United States Code
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VAP	vertical aquifer profile
VOC	volatile organic compound
ZVI	zero-valent iron

1 Introduction

On behalf of KYOCERA AVX Components Corporation (KAVX), Arcadis, U.S., Inc. (Arcadis) has prepared this Feasibility Study Report – Source Area Operable Unit 5 (OU-5), Revision 1 (FS Report-Source Area) for the targeted area of source remediation of soil on the property located at 1695 Seneca Avenue in Olean, Cattaraugus County, New York (AVX Property). The AVX Property is part of the area defined by the United States Environmental Protection Agency (USEPA) as falling within the larger Olean Well Field Superfund Site (Olean Well Field Site or Site) (**Figures 1-1 and 1-2A**).

Historically, the AVX Property on which AVX had operations was referred to by the USEPA as either the “AVX site” or “AVX Property” so as not to confuse it with the larger “Olean Well Field Site” or “Site”. There may be some overlap in the use of “KAVX” and “AVX” in this revised FS Report-Source Area. Arcadis and KAVX consider the “AVX site” and the “AVX Property” or “Property” as synonymous, although the USEPA has recently requested that all such references in this FS Report-Source Area be limited to either “AVX Property” or “Property”. Therefore, Arcadis has chosen to use only the term “AVX Property” here forward, as that is the term more commonly used in both past Arcadis and USEPA documents.

A source area of constituents of concern (COCs) in soil at the AVX Property was originally depicted in the December 2011 submittal of the Feasibility Study Report (Arcadis 2011) and more recently in the September 2020 Feasibility Study Work Plan – Source Area, Revision 2 (FSWP-Source Area; Arcadis 2020b), approved by the USEPA on November 10, 2020 (USEPA 2020b). This approval was the outcome of several years of discussions and correspondences between the USEPA and KAVX regarding remedial alternatives for the AVX Property. Submission of the FSWP-Source Area was triggered by a change in the use of the building at the AVX Property, as defined by the Amendment to the Operable Unit Two Record of Decision for the Olean Well Field Superfund Site (Operable Unit 2 [OU-2] Amended ROD) related to OU-2 at the AVX Property, dated September 30, 2015 (USEPA 2015). The OU-2 Amended ROD is considered an interim remedy until such time that a remedy can be selected and implemented for the soil within the historical source areas that are located beneath and near to the former building footprint. On April 1, 2018, the plant ceased operations, which triggered preparation of the FSWP-Source Area for a final source area remedy (OU-5). A list of historical correspondences that provide more detail regarding the path that was taken ahead of preparation of the FSWP-Source Area can be found in Appendix A of the FSWP-Source Area.

The feasibility study (FS) investigation tasks described in the FSWP-Source Area (Arcadis 2020b) were performed in November and December 2020. The results are described in the Feasibility Study Investigation Report – Source Area, Revision 1 (March 2022 FSIR-Source Area; Arcadis 2022a) submitted to the USEPA in March 2022 and conditionally approved by the USEPA on June 1, 2022 (USEPA 2022a). The Feasibility Study Investigation Report – Source Area, Revision 2 (June 2022 FSIR-Source Area), which addressed the USEPA’s June 2022 comments, was submitted to the USEPA in June 2022 (Arcadis 2022b).

This FS Report-Source Area presents the results of the FS performed to support selection and implementation of a final remedy for soil within a targeted source area.

1.1 Purpose

In 2011, on behalf of KAVX, Arcadis performed a comprehensive evaluation of remedial alternatives for both soil and groundwater (Arcadis 2011). Evaluations conducted after issuance of the OU-2 ROD revealed that additional remediation of soil beneath the manufacturing building would result in significant disruption to and possible shutdown of ongoing manufacturing operations at the AVX Property. To avoid this disruption, the USEPA selected an interim remedy in an OU2 Amended ROD (USEPA 2015) to contain soil and groundwater contamination at the AVX Property until the goal of the OU-2 Amended ROD of complete source removal and restoration can be achieved. Specifically, a change in the current use of the building in the future would trigger the performance of an FS to evaluate source control and/or restoration actions, leading to the selection of a final remedy for the AVX Property, which is now referred to as OU-5 at the Site. Therefore, KAVX and Arcadis proceeded with evaluation of remedial alternatives for groundwater only, culminating with Arcadis' 2015 Feasibility Study Report (Arcadis 2015). Subsequently, the USEPA issued its OU-2 Amended ROD based on the 2015 Feasibility Study Report.

As noted previously, the selected OU-2 remedy was interim until operations at the building ceased, triggering performance of an FS to evaluate source control and/or restoration actions for soil within the historical source areas located beneath and near to the former building footprint. Building operations ceased in April 2018, and this FS Report-Source Area has been prepared to evaluate OU-5 remedial alternatives specifically for Source Area soil that are appropriately protective of human health and the environment.

1.2 Report Organization

This FS Report-Source Area follows the Guidance for Conducting Remedial Investigation and Feasibility Studies under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; EPA/540/G-89/004, Office of Solid Waste and Emergency Response Directive 9355.3-01, October 1988). This FS Report-Source Area is organized as follows:

- **Section 1 – Introduction**. Describes the purpose and report organization.
- **Section 2 – Current Conditions**. Provides some historical perspective and summarizes the physical setting, the operational and investigational history and ongoing environmental actions, and the nature and extent of constituents of concern (COCs). This section also summarizes the results of pre-design remedial characterization performed in the Source Area to support preparation of this FS Report-Source Area and describes the targeted area for source soil remediation for this FS Report-Source Area.
- **Section 3 – Basis for Remediation**. Includes descriptions of applicable or relevant and appropriate requirements (ARARs) and AVX Property-specific remedial action objectives (RAOs).
- **Section 4 – Identification and Screening of Applicable Technologies**. Identifies the potentially applicable technology types and process options for impacted soil in the defined targeted area of source remediation.
- **Section 5 – Development of Remedial Action Alternatives**. Provides an evaluation of the potential technologies for remediating soil in the targeted area of source remediation that were retained from the initial screening.
- **Section 6 – Remedial Action Alternatives Screening Process**. Describes the screening of the entire assembled alternatives based on effectiveness, implementability, and cost.
- **Section 7 – Detailed Evaluation of Remedial Action Alternatives**. Describes the detailed evaluation of the remedial action alternatives that passed the alternatives screening process described in Section 6. The detailed evaluation includes evaluation of two threshold criteria and five primary balancing criteria.

- **Section 8 – Comparative Analysis of Alternatives**. Compares each alternative against the others based on the two threshold criteria and five primary balancing criteria.
- **Section 9 – Green and Sustainable Remediation.** Summarizes impacts of four of the remedial alternatives, excluding No Action, regarding their green and sustainable implementation footprints.
- **Section 10 – References**. Lists the sources of information cited throughout this FS Report-Source Area.

2 Current Conditions

This section provides a brief description of the project background and setting. More detailed information, including the conceptual site model (CSM), is provided in the 2013 Feasibility Study Investigation Report, Revision 1 (Arcadis 2013) and the June 2022 FSIR-Source Area (Arcadis 2022b). This FSIR-Source Area provides a detailed description of additional site characterization activities and the results of those activities performed to gain additional information regarding the nature and extent of COCs in soil beneath and near to the former building and address data gaps specific to soil in a targeted area of source remediation. A summary of those results and the targeted area for source soil remediation for this FS Report-Source Area are also provided in this section.

2.1 Operable Units Background

A September 1996 Operable Unit 2 Record of Decision (1996 OU-2 ROD) identified four of the 13 locations (or properties) investigated as potentially contributing to the contamination of the City Aquifer, with the AVX Property being one of those four locations. The City Aquifer is a sand and gravel unit that is the primary groundwater resource that the well field taps to serve as the principal water supply for the City of Olean and several adjacent municipalities (Geraghty & Miller, Inc. [Geraghty & Miller] 1994). The City of Olean operates three supply wells within the well field, the nearest located approximately 2,400 feet southwest of the former KAVX manufacturing facilities (**Figure 1-1**).

The 1996 OU-2 ROD was subsequently amended by the USEPA's OU-2 Amended ROD for the Source Area (USEPA 2015). As noted previously, the selected OU-2 remedy was considered interim until an FS could be performed to evaluate source control and/or restoration actions for soil within the historical source areas located beneath and near to the former building footprint. The USEPA subsequently established OU-5 for the soil in the targeted area of source remediation.

In 2016, the USEPA initiated a remedial investigation (RI) of several properties south of the AVX Property, including the Weller property, collectively identified as Operable Unit 4 (OU-4). The RI has also included additional sampling of the southern portion of the AVX Property. On behalf of the USEPA and the United States Army Corps of Engineers, WSP USA Solutions, Inc. prepared July 2022 RI and FS Reports for OU-4 (WSP USA Solutions, Inc. 2022a, 2022b), and the USEPA published the Proposed Plan for OU-4 (USEPA 2022d). In August 2022, and on behalf of KAVX, Arcadis provided comments to the Proposed Plan, the RI Report, and FS, upon which the Proposed Plan for OU-4 was based. In September 2022, the USEPA issued a ROD for OU-4.

2.2 Ongoing Environmental Actions

Three relevant components of the AVX Property environmental program are ongoing as part of the remedy selected in the USEPA's OU-2 Amended ROD (USEPA 2015) and include:

1. Continuous pumping of production well PW-1, which provides hydraulic capture of COCs leading to groundwater restoration within the City Aquifer beneath the AVX Property and extending southward beyond the southern AVX Property boundary.
2. Installation, startup, and operation of the hydraulic containment trench in Quarters 3 and 4 of 2022 to provide a groundwater capture and treatment remedy for groundwater in the till unit.

3. Semi-annual groundwater monitoring.

These tasks are described in additional detail below.

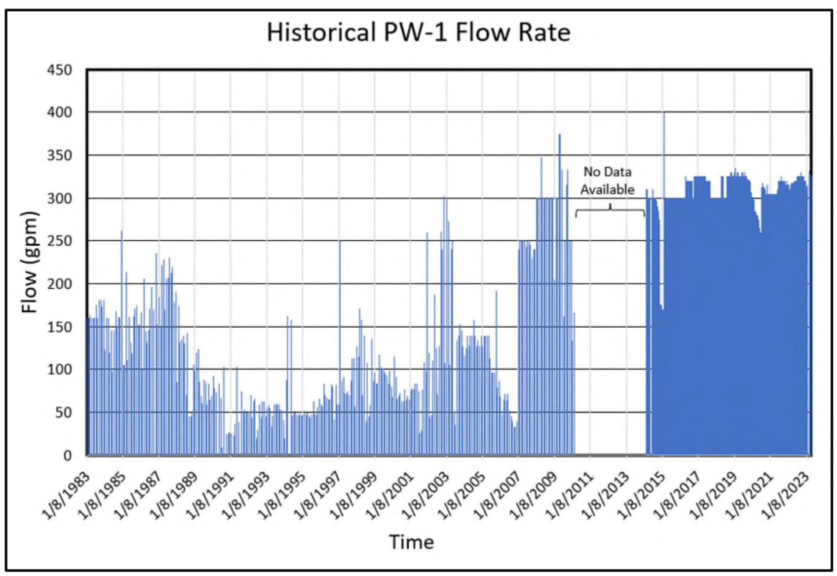
2.2.1 City Aquifer Restoration via Production Well PW-1 Groundwater Capture

KAVX production well PW-1 was historically operated continuously to supply water for former manufacturing operations and to provide groundwater capture and restoration within the City Aquifer beneath the AVX Property. The well location is shown on **Figure 1-2A**. Except for brief shutdowns for repairs, PW-1 has operated continuously since it was brought online in 1959. The groundwater capture and restoration from PW-1 currently extends southward, beyond the southern AVX Property boundary. The 2013 Feasibility Study Investigation Report, Revision 1 (Arcadis 2013) includes information regarding the extent of capture from PW-1 when operated at various flow rates. **Figure 1-2B** is a reproduction of a figure from the that report.

The current average pumping rate for production well PW-1 is 300 to 330 gallons per minute based on weekly monitoring records. The discharge water quality is monitored regularly and discharged under a State Pollutant Discharge Elimination System permit to an outfall located at the unnamed stream on the southern AVX Property boundary. The USEPA has recognized the benefit of operating the production well for the purposes of groundwater capture and restoration at least as far back as 1984, as mentioned in the Statement of Work within the 1984 Consent Order. In the Statement of Work, AVX was required to maintain operation of the production well, except for brief recovery periods during the performance of a pumping test.

AVX started maintaining pumping well PW-1 pumping records in 1983, with more frequent recording of data starting in 2014. Also, there is a period between February 2010 and February 2014 where PW-1 pumping rate data was not recorded. A graph of PW-1 pumping data since 1983 is provided on **Figure 2-1** (in text).

Figure 2-1 – Graph of Historical PW-1 Pumping Rates



2.2.2 Till Water-Bearing Unit Groundwater Restoration via Hydraulic Containment Trench

Based on the USEPA's OU-2 Amended ROD for the Source Area (USEPA 2015), KAVX performed pre-design and design activities culminating in the preparation of the 2021 Final (100%) Remedial Design (Final RD; Arcadis 2021a) and 2021 Remedial Action Work Plan (RAWP; Arcadis 2021b), which was approved by the USEPA on

January 28, 2022 (USEPA 2022b). The Final RD and RAWP describe in detail how KAVX and Arcadis will install and operate a till water-bearing unit groundwater restoration remedy. The completion of installation and system startup of the till water-bearing unit restoration remedy started in Quarter 3 of 2022 and was completed in Quarter 4 of 2022. System operation will be guided by the Site Management Plan (SMP), which is included as Appendix G of the Final RD.

2.2.3 Groundwater Monitoring Program

KAVX performs semi-annual groundwater monitoring on and downgradient of the AVX Property to evaluate water quality trends and to evaluate the groundwater potentiometric surface to understand the capture effectiveness of pumping at production well PW-1. The current monitoring program was initiated in July 2000 based on the Post-Remediation Groundwater Monitoring Plan, which was presented in the Remedial Design/Remedial Action Plan (BBL Environmental Services, Inc. [BBLES] 1999). The initial monitoring program was quarterly. In the fall of 2003, the USEPA gave verbal approval to reduce the frequency of groundwater sampling on the AVX Property from quarterly to semi-annually. KAVX currently submits groundwater monitoring reports to the USEPA twice a year.

Upon completion of construction of the till water-bearing unit hydraulic containment trench and startup of the groundwater pumping and treatment system associated with that trench, the groundwater monitoring program was modified within the SMP, which is included in Appendix G of the Final RD for the groundwater remedy (Arcadis 2021a). The SMP was prepared specifically to guide our post-groundwater startup site management (including groundwater monitoring).

2.3 Physical Setting

The Olean Well Field Site comprises approximately 800 acres in parts of three municipalities: the City of Olean and Towns of Olean and Portville in Cattaraugus County, New York (**Figure 1-1**). This region of Western New York is a deeply eroded section of the Allegheny Plateau, a terrain characterized by gently dipping sedimentary rocks shaped by glacial and fluvial processes. The Olean Well Field Site lies on a west-flowing reach of the Allegheny River in a 1- to 2-mile-wide valley between hilltops that rise approximately 700 feet above the valley floor.

The Olean Well Field Site extends along approximately 1.5 miles of the Allegheny River between two tributary creeks flowing out of the north, including Haskell Creek upriver to the east and Olean Creek downriver to the west. The two creeks drain to adjacent glacially eroded valleys separated by an irregular group of hills rising to the north. Two smaller streams flow northeast to southwest across the Olean Well Field Site from the toe of these hills, including King Brook, west of the Site, and an unnamed stream, east of the Site.

The AVX Property is located in the north-central portion of the Olean Well Field Site, within the Town of Olean, and comprises two principal areas relevant to this FS Report-Source Area. These are the operational area in the northern portion of the AVX Property and the southern undeveloped area (**Figure 1-2A**). The former operations area includes the manufacturing building, parking areas, and driveways and is accessed from Seneca Avenue to the north. The undeveloped area is largely wooded.

The AVX Property lies on south-sloping ground approximately 825 feet north of the Allegheny River. The ground surface at the building (approximately 1,440 feet above mean sea level [amsl]) is approximately 30 feet above the normal stage of the Allegheny River. In the southern undeveloped area, the ground slopes southward to a minimum elevation of approximately 1,418 feet amsl adjacent to the railroad tracks. Surface runoff from the developed portions of the AVX Property flows overland, predominantly toward the south into the southern undeveloped area where it enters the unnamed stream adjacent to the railroad tracks on the southern AVX Property boundary. The unnamed stream flows through the southern undeveloped area from the east via a ditch aligned adjacent to the railroad tracks, turning south toward the Allegheny River at a culvert beneath the railroad near AVX-19D (**Figure 1-2A**). Surface water historically pooled in the lowest elevation portions of the southern undeveloped area and in a drainage ditch extending along the railroad tracks west of the culvert. That pooling will be less following construction of the hydraulic containment trench and regrading.

The AVX Property grounds overlie approximately 25 to 35 feet of a low-permeability silt- and clay-rich till, that in turn, overlies an approximately 70-foot-thick high-permeability sand and gravel unit referred to as the City Aquifer. The till unit thickens somewhat to the north, including within the historical source areas and thins to the south when approaching the southern AVX Property boundary. The thickness of the till was confirmed during the 2020 Feasibility Study Investigation – Source Area, as four borings were advanced to the till/City Aquifer Unit contact, as reported by Arcadis in the June 2022 FSIR-Source Area (Arcadis 2022b).

Groundwater flow in the till unit is extremely slow and presumed to be biased within sporadic sandier beds found within the silt- and clay-dominated bulk of the unit. Vertical aquifer profile (VAP) investigation data further support that these beds are discontinuous: 27 of the 40 VAP borings advanced during the FS investigation were completely dry or contained insufficient water to collect even a small volume grab sample. The sand beds are not interpreted to have significant lateral continuity but will bias flow within the till to favor horizontal movement. Vertical flow downward within the till is interpreted to be extremely slow and represents a minimal component of the groundwater flux within the unit. The head differential of 10 to 30 feet between the till and the underlying City Aquifer is evidence of very poor hydraulic communication between these units, which is restricted by the low vertical hydraulic conductivity of the till, particularly in the basal portion (lower 10 feet) of the till unit.

The till and City Aquifer hydrostratigraphic units are described in detail in several documents, including the 2013 Feasibility Study Investigation Report, Revision 1 (Arcadis 2013). Select figures from the 2013 Feasibility Study Investigation Report are reproduced in **Appendix A** to help depict these key relationships that are important for the remedial alternative evaluations in this FS to establish the bounds to which the remedial alternatives are constrained.

2.4 AVX/KAVX Operational and Investigation History

In 1950, AVX Corporation (AVX; which subsequently became KAVX), a Delaware corporation, began manufacturing electrical and electronic components at the AVX Property. Manufacturing operations continued until April 1, 2018. To support the (former) manufacturing operations, AVX installed and began operation of an onsite production well (PW-1) around 1959. Except for brief shutdowns for repairs, PW-1 has operated continuously since it was installed and brought online in 1959. That operation has continued following cessation of other AVX/KAVX plant operations at the AVX Property in accordance with the OU-2 Amended ROD (USEPA 2015).

In January 1981, trichloroethene (TCE) and other chlorinated volatile organic compounds (CVOCs) were detected in the Olean municipal water supply. The source of the water supply included three production wells installed in the mid- to late 1970s in the City Aquifer. As a result, the USEPA Region 2 Field Investigation Team evaluated the Olean Well Field Site for inclusion on the National Priorities List (NPL). As a result of this evaluation, the

Olean Well Field Site was included on the National Interim Priorities List on October 23, 1981, and on the NPL list published on September 9, 1983.

According to AVX's December 10, 1982 response to a USEPA Request for Information, TCE was used in degreasing operations at the AVX Property from 1950 to 1973 and again in 1977 and 1978. Beginning in 1970, 1,1,1-trichlorethane (1,1,1-TCA) and tetrachloroethene (PCE) were also used in degreasing operations at the AVX Property.

The USEPA identified AVX as a Potential Responsible Party (PRP) for the CVOCs in groundwater in the Olean Well Field Site, following which, AVX and the USEPA entered into an Administrative Order on Consent (Consent Order) on October 1, 1984 to further investigate the AVX Property and its potential for contribution to CVOCs to the Olean Well Field Site (USEPA 1984). Under this Consent Order, AVX performed multiple phases of soil and groundwater investigations and hydraulic testing in 1984 and 1985. The results of these investigations indicated that TCE, 1,1,1-TCA, PCE, and other CVOCs were present in soil and groundwater beneath the AVX Property.

During this time, the USEPA identified several other PRPs as potential sources of CVOCs in groundwater within the Olean Well Field Site, including McGraw Edison and its parent company, Cooper Industries, and Alcas Cutlery Corporation, a corporation created by a joint venture between Alcoa Inc. and W.R. Case and Sons Cutlery Corp.

An RI and FS of the Olean Well Field Site was funded through a USEPA Cooperative Agreement and performed in 1984 through 1985 by a contractor to the New York State Department of Environmental Conservation (NYSDEC). This work was performed to characterize the extent and concentrations of CVOCs in groundwater across the Olean Well Field Site (referred to as Operable Unit 1 [OU-1]). On September 24, 1985, the USEPA issued a Superfund Record of Decision (OU-1 ROD; USEPA 1985). The selected remedy included the following:

- Installation of two air strippers at the contaminated municipal wells and the reactivation of those wells
- Extension of the City of Olean water lines into the Towns of Olean and Portville and the subsequent connection of approximately 93 private well users to the public water supply system
- Inspection of McGraw-Edison's industrial sewer and evaluation of repair and replacement options
- Post-remediation groundwater monitoring.

The OU-1 ROD (USEPA 1985) also called for a second OU-2 RI/FS to further delineate the sources of the contamination at the Site and evaluate source control remedial alternatives.

On February 7, 1986, the USEPA issued a Unilateral Administrative Order to the industrial parties identified above as PRPs, requiring them to extend the City of Olean's water line to connect private homes that had previously been on a private well potable water supply (USEPA 1986). In addition, the Unilateral Administrative Order required the recipients to remove the volatile organic compounds (VOCs) from the groundwater and install the air stripping water treatment systems on the municipal water supply.

The OU-1 ROD (USEPA 1985) also called for the performance of an OU-2 RI/FS to evaluate possible source control measures at the Site. On June 25, 1991, the USEPA issued an Administrative Order on Consent, Index No. II CERCLA-10202 (USEPA 1991) to the PRPs for the performance of the OU-2 RI/FS (OU-2 RI/FS Order). In accordance with the OU-2 RI/FS Order (also known as the supplemental RI/FS), each PRP was to undertake an investigation on their respective property (USEPA 1991), and the USEPA performed investigations on several additional properties. The results of the supplemental RI/FS were published in the October 1994 Supplemental Remedial Investigation Report (Geraghty & Miller 1994) and the June 1996 Draft-Final Supplemental Feasibility Study (Geraghty & Miller 1996). This investigation identified four areas within the Olean Well Field Site that were acting as potential sources of VOCs to groundwater. The baseline risk assessment conducted as part of this investigation concluded, based on the information available at that time, that the exposure via dermal contact with, ingestion of, or inhalation of VOCs by construction workers in the surface and subsurface soil did not pose an unacceptable risk. However, the contaminated soil serves as source material for continued groundwater contamination.

The 1996 OU-2 ROD was issued on September 30, 1996, which was designed to address VOCs at four specific sites, including the AVX Property (USEPA 1996). The selected remedy for AVX's portion of OU-2 included, among other things, excavation and offsite disposal of soil containing VOCs. This selected alternative was referred to as the "Stage 1 Remedy" and is depicted on many figures as the "Stage 1 Remedial Action Excavation Area".

A Consent Decree for implementing the site-specific OU-2-selected remedy became effective on March 17, 1998. Based on this Consent Decree, AVX prepared plans for and implemented the Stage 1 Remedy, completing it in July 2000. Soil was excavated from near the southern side of the AVX Property building. Some soil samples collected from the walls/bottom of the excavation, following completion of the Stage 1 remediation, contained VOC concentrations that were above Action Levels set forth in the 1996 OU-2 ROD. Samples that contained concentrations above the Action Levels were either from the bottom of the excavation (below the water table) or from a small number of locations on the side of the excavation closest to the building where additional excavation could not be performed due to building structural considerations. On July 20, 2000, Mr. Damien Hughes of the USEPA participated in the initial pre-final inspection of the remedial activities, and with his concurrence, the designated remedial area was then backfilled in accordance with the approved Remedial Action/Remedial Design Work Plan (BBLES 1999).

As a follow-up to completion of the Stage 1 Remedy, AVX/KAVX has been performing post-remedial action groundwater monitoring, with the focus of that monitoring performed south of the AVX Property building. Based on discussions with the USEPA during a March 26, 2003 meeting, AVX prepared and implemented the Work Plan for Well Installation, Development, Abandonment, Sampling and Reporting (BBLES 2003), which was performed to update the groundwater monitoring well network.

As a result, since that time, AVX performed multiple phases of investigation to delineate the source and extent of TCE, including investigations in:

- **2003**. On AVX Property groundwater investigation results presented in the Groundwater Sampling Event No. 13 Report (Blasland, Bouck & Lee, Inc. [BBL] 2003)
- **2004**. On AVX Property groundwater, soil, and surface-water investigation results presented in the Groundwater Investigation Report – AVX 17S Area (BBL 2005)
- **2006**. On AVX Property groundwater and soil investigation results presented in the Groundwater Investigation and Sampling Event Report No. 18 (BBL 2006)
- **2007 to 2008**. On AVX Property and off AVX Property groundwater and soil investigation results presented in the On- and Off-Site Groundwater Investigation and Sampling Event No. 22 Report (Arcadis 2008).

AVX asserts, in the December 2011 FS Report, that an off AVX Property source of VOCs, unrelated to former AVX operations, must be present south of the AVX Property. This conclusion was based on AVX's interpretation of the results of Arcadis' 2007/2008 groundwater investigation. Based on the results of Arcadis' 2007/2008 investigation, as well as previous investigations, AVX agreed to proceed with FS activities for the area north of the railroad tracks, and the USEPA proceeded with the RI for OU-4, the area south of the railroad tracks.

The 1996 OU-2 ROD was amended in 2015 by the USEPA's OU-2 Amended ROD for the AVX Source Area (USEPA 2015). The major components of the selected OU-2 remedy were:

- Maintenance of an exposure barrier in the historical source area to minimize leaching of VOCs from soil to groundwater and serve as a direct contact exposure barrier.
- Construction and operation of a hydraulic containment trench system to prevent migration of groundwater in the till unit downgradient of the AVX Property.
- Operating existing AVX production well PW-1 as an active groundwater recovery system to prevent further migration of contaminated groundwater within the City Aquifer.
- Implementation of institutional controls.
- Development of an SMP.
- Implementation of a post-remediation groundwater monitoring program as part of the SMP.

The selected OU-2 remedy was considered an interim remedy until an FS could be performed to evaluate source control and/or restoration actions for soil beneath and near to the former building footprint. Specifically, a change in the current use of the building in the future would trigger the performance of an FS to evaluate source control and/or restoration actions, leading to the selection of a final remedy.

In 2016, the USEPA initiated an RI of several properties south of the AVX Property, including the Weller property, collectively identified as OU-4. The RI also included additional sampling of the southern portion of the AVX Property; that investigation provided supplementary data useful for remedial design activities on the AVX Property.

AVX subsequently performed pre-design and design activities for the hydraulic containment trench system for the downgradient till water-bearing unit. The following has transpired as part of the remedial design process:

- Early phases of implementation of the 2018 Remedial Design Work Plan (RDWP; Arcadis 2018a) for the interim remedy selected by the OU-2 Amended ROD (USEPA 2015) and associated Pre-Design Investigation Plan were initiated. Arcadis submitted the RDWP to the USEPA on January 18, 2018, which the USEPA approved on January 26, 2018. The pre-design investigation was performed in 2018, and the Pre-Design Investigation Report was submitted to the USEPA on September 12, 2018, which the USEPA approved on May 9, 2019.
- The 30% Remedial Design was submitted to the USEPA on August 30, 2019 (Arcadis 2019), which the USEPA approved on June 2, 2020.
- The 95% Remedial Design was submitted to the USEPA on June 30, 2020 (Arcadis 2020a).
- The USEPA commented on the Pre-Final (95%) Remedial Design Report on June 14, 2021.
- On behalf of AVX, Arcadis responded to the USEPA's comments to the Pre-Final (95%) Remedial Design Report and submitted the Final RD to the USEPA on July 9, 2021 (Arcadis 2021a). The USEPA approved the Final RD in a letter dated August 27, 2021, which Arcadis received on August 30, 2021 (USEPA 2021b).
- The USEPA approved the RAWP on January 28, 2022 (USEPA 2022b).

Installation and system startup of the till water-bearing unit restoration remedy started in Quarter 3 of 2022 and was completed in Quarter 4 of 2022.

Operations in the AVX Property building ceased in April 2018. In 2019 and 2020, in advance of the investigation in and near the targeted area of source remediation, the AVX manufacturing building was demolished down to the floor slab, which was completed in October 2020. Arcadis performed the Feasibility Study Investigation – Source Area starting in late 2020 and provided a report on that work on October 4, 2021 (Arcadis 2021c). Since that time, the USEPA commented on the FSIR-Source Area and Arcadis responded on multiple occasions, including submittal of revisions to the FSIR-Source Area. These include:

- USEPA's February 1, 2022 Comments (USEPA 2022c) to Arcadis' October 4, 2021 Feasibility Study Investigation Report – Source Area
- Arcadis' March submittal of Revision 1 of the FSIR-Source Area (Arcadis 2022a)
- USEPA's June 1, 2022 conditional approval of revision 1 of the FSIR (USEPA 2022a)
- Arcadis June 30, 2022 submittal of the FSIR-Source Area (Arcadis 2022b).

All the above investigative and design history and resulting data and related actions taken by the USEPA, AVX/KAVX, and their representatives collectively provide the foundation for development of the approach for the FS for soil in the targeted area of source remediation (i.e., OU-5).

2.5 Summary of Remedial Investigation Characterization

Most recently, in 2020, characterization activities were performed within and near to the historical source areas to support completion of the FS, based on the improvement of our understanding of the following:

- Horizontal and vertical distribution of COCs, particularly within and near the targeted area of source remediation within the till unit
- Till unit/City Aquifer contact
- Presence, distribution, and relative importance of water-bearing zones within the targeted area of source remediation
- Ability of in situ soil solidification (ISS), with or without zero-valent iron (ZVI), to be a viable alternative for the remediation of soil in the targeted area of source remediation and any more permeable free water-containing stringers of soil contained therein.

Improvement of the understanding of COC distribution occurred within areas beneath the footprint of the former building, which before termination of operations on the AVX Property and demolition of the above-grade structures, was not accessible for focused and full investigation. Getting more detailed COC distribution information both within the footprint of the former building and on the perimeter of the suspected historical source areas greatly improved the understanding of the COC distribution in soil within the targeted area of source remediation. This understanding was further enhanced by incorporating the investigation data into a 3-dimensional (3-D) Environmental Visualization System (EVS) model of Site features (e.g., former building footprint, paved areas, topography/drainage, location of areas/volumes of past remediation, water table, till unit/City Aquifer contact) relative to the distribution of COCs in soil in and near to the targeted area of source remediation. This model further clarified the following:

- Likely extent of COCs at the perimeter of the investigation area and the identification of apparent gaps in the understanding of the extent. This model, which is designed to be dynamically updatable, also provides a mechanism to continue to refine the understanding of the distribution of COCs as new information is generated. The model has also been built to incorporate groundwater quality data to further the understanding of the 3-D distribution of COCs in groundwater.

- Primary locations of the highest concentrations of COCs to help better understand the likely historical release scenarios and to understand the locations where soil remediation will be most beneficial.
- COCs, which are the primary drivers for future remedial actions and whether the footprint of the distribution of the different COCs, provide additional insight into past practices and future remedial scenarios.

Additional detail regarding the pre-design investigation results and conclusions is provided in the June 2022 FSIR-Source Area (Arcadis 2022b).

2.6 Nature and Extent of Constituents of Concern

The mixture of CVOCs and non-CVOCs that make up the suite of AVX Property COCs is present at relatively high concentrations in the till unit, in an area that extends from the historical source areas of COCs in soil into groundwater. COCs have dissolved in groundwater over time and have migrated with that groundwater to the southeastern portion of the operational area southward through the southern undeveloped area to the southern AVX Property boundary. It is not unusual to observe high concentrations of these COCs in soil and groundwater within thin discontinuous sandier interbeds contained within the till. Most of the COC mass is located within the approximate footprint of the targeted area for source soil remediation (see Section 2.5). While the bulk of the COC mass is contained within the till unit, low concentrations of certain COCs are also present in groundwater at some locations within the City Aquifer.

TCE and its anaerobic biodegradation products are the most dominant chlorinated compounds in the following areas (refer to **Figure 1-2A** and **Figures 2-2 through 2-4**):

- The area of the former Machine Shop/Maintenance area, which was constructed in 1978, and built over this historical release area.
- The area beneath the former Receiving Building, and the Stage 1 remedial action excavation area. The former Receiving Building was constructed in 2000 and built over this historical release area.
- The area starting at the upslope, northern end of a shallow north-south trending drainage swale, located immediately south of the operations and fence line within the southern undeveloped area. This area extends some distance to the south and is believed to be the source for higher concentrations of TCE in groundwater from monitoring well AVX-17S, located farther downslope. This area appears to be strictly at depth and only now relevant as an impact to the saturated soil/groundwater and not the unsaturated soil.

1,1,1-TCA and PCE and their anaerobic biodegradation products are most dominant in the following areas (refer to **Figure 1-2A** and **Figures 2-2 through 2-4**):

- A former solvent underground storage tank (UST) on the southeastern corner of the building.
- A region of potential surface releases immediately south of the building, referred to as the Stage 1 remedial action excavation area.
- The area beneath the former Receiving Building, which was constructed in 2000, covering this historical release area.

- To a somewhat lesser degree, the area of the former Machine Shop/Maintenance area, which was constructed in 1978, covering this historical release area.

Because TCE is a degradation byproduct of PCE, some areas with elevated TCE concentrations may be locations of PCE releases that have undergone some anaerobic degradation to TCE. Furthermore, there appears to be comingling of solvents at each of the aforementioned areas.

Two of the aforementioned areas, the solvent storage tank and the Stage 1 remedial action excavation area, were partially remediated via excavation; however, some residual CVOCs were left in-place in soil due to physical constraints and the desire to not disrupt manufacturing operations (i.e., beneath the former Receiving Building and the former Machine Shop/Maintenance area). The impacted soil beneath the AVX Property building are the focus of this FS Report-Source Area.

Groundwater in the till unit contains dissolved CVOCs that form two primary plumes of slightly different makeup that have comingled and migrated southward in the direction of the water-table gradient. The characteristic VOC signature of the eastern plume is 1,1,1-TCA-dominant and is likely sourced from the Stage 1 remedial action excavation area and/or the former solvent UST. The western plume is composed predominantly of TCE and trends south from the head of the drainage swale at the northern extent of the southern undeveloped area, although possibly from beneath the Machine Shop/Maintenance area. The composition of both plumes reflects significant anaerobic biodegradation occurring along their flow paths, reducing the concentrations of the parent CVOCs to their daughter products as groundwater flows southward. As within soil, the concentrations of the primary solvents cannot be completely separated as they have comingled.

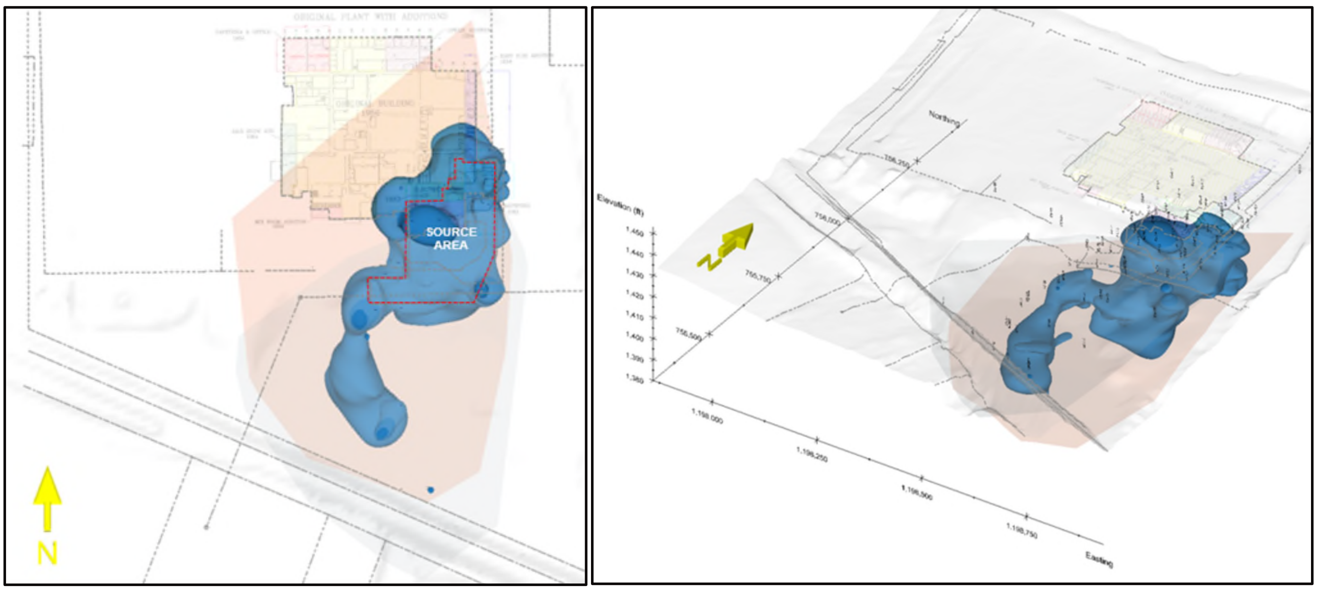
Concentrations of COCs in the City Aquifer beneath the AVX Property are orders of magnitude lower than what is detected in groundwater within the till unit and provide additional evidence that the hydraulic connection between the till unit and the City Aquifer is limited. Although the City Aquifer is used as a municipal potable water supply, continuous pumping at onsite production well PW-1 at a rate greater than 281 gallons per minute (**Figure 1-2B**) (Arcadis 2013) creates a zone of groundwater capture that extends from very close to the location of the highest COC concentrations in the targeted area of source remediation to at least as far as the southern AVX Property but has been interpreted to extend even farther. The aquifer pumping tests demonstrated that the hydraulic influence and capture of PW-1 is minor to absent in the targeted area of source remediation in the till unit (2013 Feasibility Study Investigation Report; Arcadis 2013). The hydraulic gradients within the City Aquifer beneath the AVX Property converge toward PW-1 throughout the area where groundwater is known to be impacted in the overlying till.

A detailed discussion of the CSM is also provided in the 2013 Feasibility Study Investigation Report (Arcadis 2013).

2.7 Boundary of Targeted Area of Source Remediation

A source area boundary was initially proposed in the 2011 FS Report (Arcadis 2011), which encompassed an area within which multiple individual releases of COCs had likely occurred to the ground surface and was the approximate area that may be considered for potential future remedial alternative evaluations for a targeted area of source remediation. Within that general area, migration of COCs along a complex network of stringers or zones of enhanced permeability has created irregularly shaped 3-D forms that depict the distribution of elevated concentrations of COCs observed in soil (both saturated and unsaturated). This COC distribution in soil has been modeled using the EVS software with select images of the modeled shapes provided on **Figure 2-5** (in text). It should be noted that for the modeling, historical data (collected before 2020) was incorporated into the model, with the recognition that the older data will likely overpredict concentrations and extent of the COCs outside of the area targeted for source remediation, given that some degradation of the COCs would have naturally reduced the concentrations over time. Nonetheless, it is believed that including the older data provides additional context regarding the distribution of COCs within the 2011 and later FS Report-based source area that was the target of the 2020 investigation near and within the historical source areas.

Figure 2-5. EVS 3-D Model of Extent of the Combination of Select CVOCs in Saturated and Unsaturated Soil at Concentrations Above Remediation Goals for Soil



Note: Source Area is that which is defined in the 2015 Feasibility Study.

The 3-D mass distribution of select CVOCs in soil, which are above their remediation goals (RGs) for soil, is centered on the area defined in the FSWP-Source Area (Arcadis 2020b) (**Figure 2-5**), with the highest concentrations of COCs centered on the former Machine Shop/Maintenance area and the former Receiving area. Subsequently, during several communications from February through April 2023 between Arcadis and USEPA representatives, the USEPA requested that the FS target the area/volume of the soil Source Area that includes unsaturated soil that have CVOC concentrations above the ROD-published RGs. Based on these communications, Arcadis updated the 3-D mass distribution model to recalculate areas and volumes of unsaturated zone soil (i.e., soil located above 1,430 feet amsl) that meet these criteria. **Figure 2-6** (in text) depicts the revised area for remediation that meets these criteria (red dashed line). Note that some of the area around PW-1 must be excluded to protect that critical existing element of the groundwater remedy. Furthermore, pre-remedial design investigations will be performed and subsequent discussions will take place that will refine the final footprint area to be targeted for unsaturated zone soil remediation.

During the remedial design, further evaluation would be conducted to refine the extent of COCs. Based on the entirely of the data available after the pre-design investigation, KAVX may, at its discretion, propose to perform additional saturated zone remediation to enhance the existing final groundwater remedy. KAVX would determine whether such enhancements to the groundwater remedy in the source area would improve remediation timeframes and would have a net cost benefit over the life of the groundwater remedy.

Following completion of the most recent revision of the June 2022 FSIR-Source Area (Arcadis 2022b), Arcadis refined the understanding of the COC distribution in the historical source areas. From that work, it became clearer that highest concentrations, indicative of historical releases, are centered on a few more focused areas within the broader source area presented in the 2011 and subsequent FS Reports (Arcadis 2011, 2012, 2015). These individual areas of release primarily include the former Machine Shop/Maintenance area and the former Receiving area. Two other historical source areas are also noteworthy. One includes the Drainage Swale Source Area, located near the head of the drainage swale (likely historical TCE dominant solvent release area) south of the AVX Property operational area perimeter fence. The other includes the 2000 Stage 1 excavation area (former 1,1,1-TCA-dominant solvent release area), which was located directly south of the expanded building footprint and was previously remediated via excavation and disposal of soil removal in 2000.

Figure 2-6. Area Targeted for Source Soil Remediation for Feasibility Study

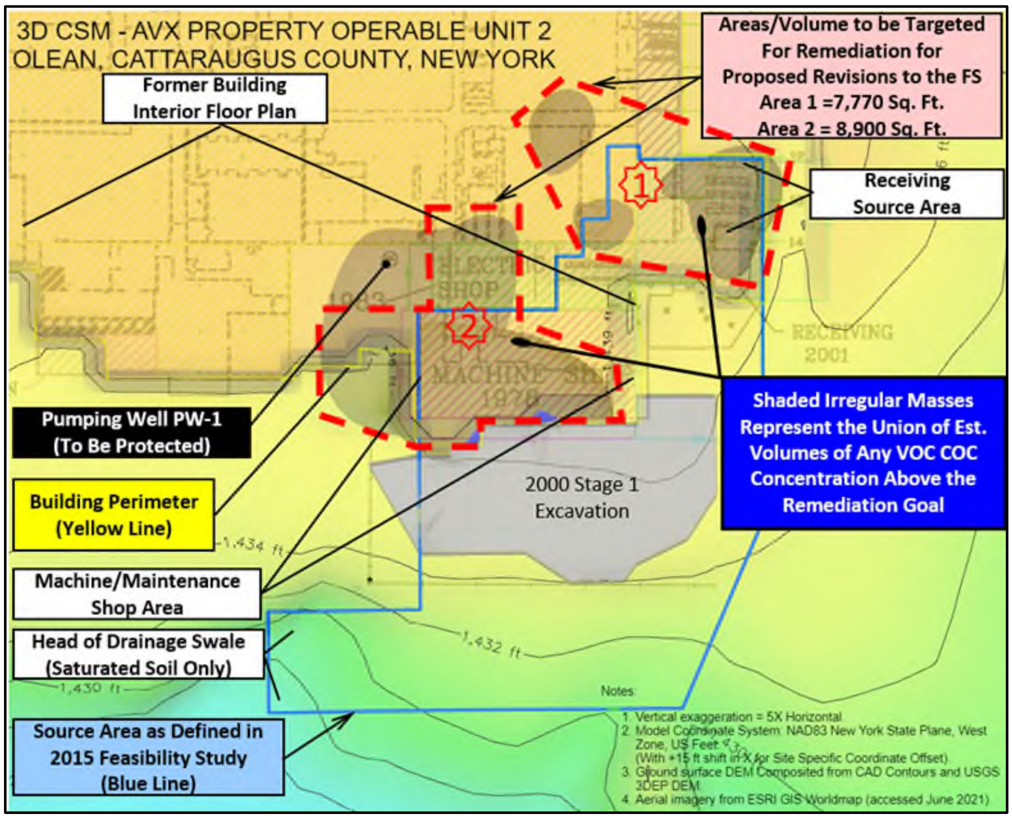


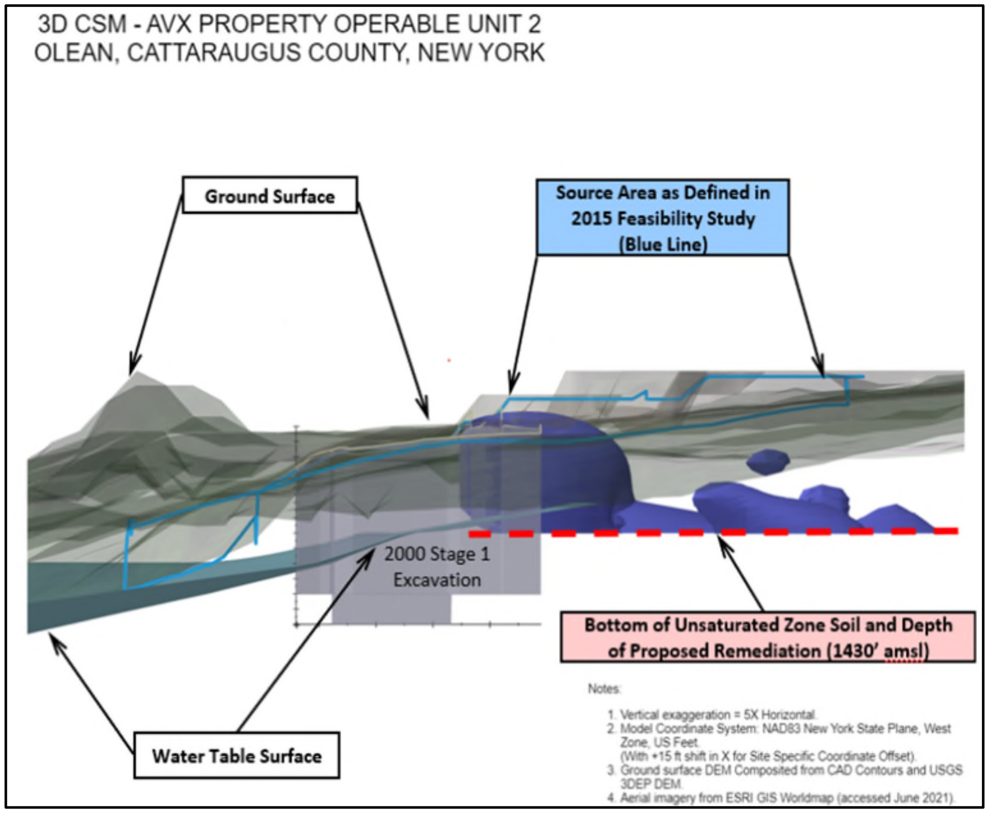
Figure 2-6 (in text) shows the various historical source area components, including the:

- Machine Shop Source Area
- Receiving Source Area
- Drainage Swale Source Area
- 2000 Stage 1 Excavation Area.

Figure 2-6 also presents the rough union of these areas, as presented in the 2015 Feasibility Study Report (Arcadis 2015), but further refined to only depict unsaturated soil areas with COC concentrations above the RGs. **Figure 2-6** also presents the refined focus area of the current FS Report-Source Area (red dashed line). **Figure 2-7** (in text) provides a cross-sectional depiction of the volume of unsaturated zone soil that will be evaluated in the FS remedial alternatives evaluation.

Further discussion of the rationale for selection of this targeted area of source soil remediation is presented in Section 3. As noted in the FSIR-Source Area (2022b), and as approved by the USEPA, the information gained during the FS Investigation-Source Area is ample to support completion of this FS Report-Source Area for remedial alternative comparisons. KAVX/Arcadis also recognize that some additional investigation may be necessary as part of the remedial design. The USEPA indicated in Comment 5 to its June 1, 2022 conditional approval of Arcadis' March 2022 FSIR-Source Area, Revision 1 that "It is recommended that data gaps are addressed during the pre-design investigation phase" of the remedy for soil within the targeted area of source remediation.

Figure 2-7. Cross-Section of Area Targeted for Unsaturated FS Report-Source Area Soil Remedial Alternatives Evaluation



Therefore, KAVX/Arcadis and the USEPA have agreed that the current available information is adequate to complete this FS for the targeted area of source remediation (i.e., OU-5).

3 Basis for Remediation

Arcadis provided a suite of remedial alternatives that were created through a sequence of submittals referenced previously herein, ultimately culminating with those alternatives identified in the 2015 Feasibility Study Report (Arcadis 2015). The 2015 Feasibility Study Report broke the AVX Property into two distinct areas:

- **Source Area (an approximate union of all historical source areas)**. Included the former solvent UST, the Stage 1 excavation area, an area beneath the southern portion of the former operations building, and the northern portion of the southern undeveloped area.
- **Perimeter (downgradient) Area**. Defined as the area along the southern AVX Property boundary next to the unnamed stream.

The remedial alternative development/screening in this FS Report-Source Area focuses on COCs in the unsaturated soil within the targeted area of source remediation and will recognize the connection that the targeted area source soil remedy will have on the groundwater remedy and groundwater quality. The final remedy for groundwater in the City Aquifer and downgradient till unit is proceeding on a separate path; therefore, no further evaluation of groundwater remedies is provided in this FS Report-Source Area.

3.1 Rationale for Selection of Targeted Area for Source Soil Remediation

In 2011, Arcadis submitted the 2011 Feasibility Study Report for the AVX Property (Arcadis 2011), which includes an evaluation of both soil and groundwater remedies in a holistic approach to site-wide remediation of all affected media. At that time, KAVX and Arcadis recognized that an aggressive soil remedy was unnecessary to establish or maintain acceptable human health exposure risks. This was particularly true given that the remedy also included a long-term solution for restoration of COCs in both the till water-bearing unit and groundwater within the underlying City Aquifer that would restore the residual COCs on the AVX Property. The groundwater restoration remedy, for both the till water-bearing unit and the City Aquifer, was first contemplated in 2011 and is a fundamentally similar remedy that is currently being implemented as the final groundwater remedy. The final groundwater restoration remedy (hydraulic containment trench) for the shallow water-bearing till zone differs little from what was originally proposed in 2011, in that a permeable reactive barrier was proposed to passively restore the aquifer, removing COCs at the same downgradient location on the AVX Property as the currently installed hydraulic containment trench. In either case, the goal was the same, which was restoration of residual COCs in shallow till water-bearing unit groundwater. The other component of the final groundwater remedy is continued operation of former production well PW-1. This was the same remedy proposed in the 2011 FS Report for the AVX Property that has been designed to remove COCs and restore the City Aquifer on the AVX Property, much as PW-1 has done since the initiation of its operation in the 1950s.

The USEPA, KAVX, and Arcadis understand that the final groundwater restoration remedy, being implemented during the second half of 2022, will necessarily operate for decades given that COCs historically released to the ground have had many decades to migrate into the unsaturated/saturated soil and groundwater and diffuse into the clayey matrix, making back-diffusion of the residual COCs in this matrix into groundwater an exceedingly slow process. Therefore, the final restoration remedy presumes decades of continued operation until achieving groundwater cleanup standards because residual COCs in saturated soil that are not readily accessible (due to the high clay content and very low-permeability of the soil) will remain after any targeted source area remedy is implemented. Therefore, those post-final remedy residual COCs will continue to back-diffuse into groundwater far into the future.

The USEPA pursued continued progress toward a final groundwater remedy while tabling evaluation/selection of a source soil final remedy, waiting until such time that manufacturing operations at the AVX Property ceased or changed in a way to allow for further assessment of COCs in soil and in the groundwater beneath/near the building. In the time since the USEPA's issuance of the OU-2 Amended ROD (USEPA 2015), the interim remedy for soil has been maintained with no known concerns for unacceptable human exposure of residual COCs in soil beneath or near the former building. Given the current conditions on the AVX Property have not changed much since the USEPA's issuance of the OU-2 Amended ROD, a final source remedy (OU-5) that includes exposure barriers remains an effective solution for prevention of unacceptable human exposures to AVX Property COCs in media in the area of targeted source remediation. This is particularly true given that the multi-component groundwater restoration final remedy is nearly implemented, and this final groundwater remedy will need to operate for decades, regardless of what target source area remediation is performed.

KAVX recognizes that there will be a balance between the degree of source remediation performed and the duration of the groundwater remedy. In addition, on the AVX Property, the targeted source area remedy must maintain the natural attribute of very low-permeability of the underlying till, which is critical for a successful holistic AVX Property-wide remedy. It is well documented that the naturally low vertical permeability portion of the till unit, with the permeability becoming lower with depth in the till unit, is the most important component of any remedy's effectiveness in protecting the highly sensitive underlying City Aquifer. The low-permeability till has provided substantial protection to the City Aquifer, as evidenced by the proximity of production well PW-1 to the highest concentration source area, and yet groundwater from that well has always exhibited extremely low COC concentrations.

In addition to the above, the costs for implementing an overly aggressive remedy within the historical source areas is also an important consideration where any costs saved now can be applied to funding a long period of operation that will be necessary regardless of the amount of remediation performed in or near the historical source areas. Again, slow back-diffusion into a low-permeability till water-bearing unit will necessitate long duration groundwater extraction and treatment for ultimate restoration.

Given the above, KAVX's proposed approach to remediating the soil with the highest COC concentrations of the source is to target the areas where releases to the ground appear to have historically occurred at areas over which additions to the original building were constructed. These include the following (also see **Figures 2-6 and 2-7** [in text]):

- The footprint of the former Machine Shop, which was an expansion to the original building in 1978.
- The footprint of the former Receiving Area at the southeastern corner of the building, which was an expansion to the original building in 2001.

During the FSIR-Source Area, the above two locations were the focus of the shallowest and highest concentrations of COCs in soil from which the other contiguous areas of elevated COC concentrations (in deeper saturated zone soil area) were derived. Additional 3-D images are presented in **Appendix B**.

After the USEPA's review of and comment (USEPA 2023) on the November 2022 FS Report-Source Area (Arcadis 2022d) and several subsequent calls and other communications between the USEPA and Arcadis representatives, the USEPA and KAVX agreed that for the purposes of this revision of the FS Report-Source

Area, KAVX and Arcadis would propose to evaluate the alternative remedies targeting areas within and near to the footprint of the former Machine Shop and receiving area down to an elevation of 1,430 feet amsl, which is a conservatively low elevation representing the top of the water table and the bottom of the unsaturated zone soil. (See email and associated attachments included in **Appendix B**.)

A recap of the rationale for selecting the proposed targeted source area/volume for remediation include the following:

- The Machine Shop and Receiving Source Area are the locations where past releases have occurred before building expansion, including directly to the unsaturated zone soil and extending into saturated zone soil.
- Similar solvent handling practices must have continued after building expansion, with evidence of post-building expansion releases within the former 2000 Stage 1 Excavation Area (**Figures 2-6 and 2-7**). This release area was remediated via excavation and offsite disposal of 5,055 tons of soil in 2000.
- Arcadis also identified the Drainage Swale Source Area (**Figure 2-6**) as being a historical location of COC releases, although investigation data provided in the June 2022 FSIR-Source Area (Arcadis 2022b) show that elevated COC concentrations in the Drainage Swale Source Area are currently limited to the saturated zone. Given the depth of the impacts at the drainage swale, Arcadis has concluded that this area is currently only a groundwater COC issue that is already being addressed by the final groundwater remedy (the hydraulic containment trench). Based on its location in the drainage swale, it would be expected that this historical and older Drainage Swale Source Area has undergone more attenuation than the other historical source areas, given that this area has been more exposed to conditions that would naturally flush and degrade the released constituents versus COCs that were in soil historically covered by the former operations building and are currently covered by the remaining building floor. Data from the June 2022 FSIR-Source Area (Arcadis 2022b) show the much lower concentrations of COCs in saturated and unsaturated soil samples collected at the head of the drainage swale versus those collected in the source areas beneath the former building (particularly the former Machine Shop). Surface water has been flowing into and through this area for decades, supplying water and nutrients to enhance natural remediation through flushing and biological degradation processes. This would include biological degradation enhanced through actions in the vegetative root zone throughout this historically heavily vegetated area. Additional discussions regarding documented historical natural degradation of source solvents are presented in the revised 2013 Feasibility Study Investigation Report (Arcadis 2013) and the 2015 Feasibility Study (Arcadis 2015).
- The June 2022 FSIR-Source Area (Arcadis 2022b) provides details regarding the distribution of COCs in saturated and unsaturated soil. Data in that report document how COC concentrations diminish significantly with depth but are nonetheless detectable, in places at or near to the till unit City Aquifer contact, and commonly within 5 feet of that contact.
- As indicated in the OU-2 Amended ROD (USEPA 2015), the USEPA states that "*the presence of elevated concentrations of VOCs in soil below the building at the AVX Property does not pose unacceptable direct-contact risks to users of the property, given the depth of contamination and presence of the building*". The USEPA goes on to state that "*the contaminated soil serves as source material for continued groundwater contamination. Therefore, it is necessary to address the soil contamination as well as the groundwater contamination."* To address this, KAVX has, therefore, implemented the groundwater remedy selected in the OU-2 Amended ROD (USEPA 2015) to address the groundwater COCs, and a soil remedy will address the unsaturated soil COCs to address the potential for future leaching to groundwater, and is also targeting some additional saturated zone soil to further benefit the groundwater remedy. Given that the USEPA also concluded that *"the ecological evaluation indicates that the AVX Property does not pose any unacceptable*

risks to aquatic or terrestrial ecological receptors" (USEPA 2015), KAVX and Arcadis have concluded that the proposed targeted area of source soil remediation presented in this FS Report-Source Area is adequate to address unacceptable residual risks.

- Subsequently, the USEPA concluded that the evaluation of the Source Area soil remedial alternatives in this FS Report-Source Area should target unsaturated zone soil containing COCs at concentrations exceeding the RG concentrations. Based on Arcadis' conservative interpretation of the elevation of the bottom of the unsaturated zone (more conservative meaning a lower elevation than if less conservative), the bottom of the Source Area soil remedy FS remedial alternative evaluation has been established at 1,430 feet amsl (information describing the rationale for the 1,430 feet amsl depth is provided in **Appendix B**).
- The soil remedy approach takes into consideration the historical Stage 1 Excavation Area remediation. At that time, the Stage 1 Excavation focused on addressing unsaturated soil; however, a portion of the soil from the saturated zone was also removed. The remedial alternatives considered as part of this FS consider active remediation to the water table (an elevation of approximately 1,430 feet amsl). A communication describing the rationale for the 1,430 feet amsl elevation of the water table is provided in **Appendix B**.

In the USEPA's conditional approval (USEPA 2022a) of Arcadis' March 2022 FSIR-Source Area (Arcadis 2022a), the USEPA agreed that some additional delineation in the area of the historical source areas should be performed during a pre-remedial design investigation within or near the final designated targeted area of source remediation. KAVX and Arcadis understand that information from that investigation could lead to modification of the targeted source area size that may be targeted for the final remedy, although KAVX and Arcadis do not anticipate that. Nonetheless, KAVX and Arcadis believe that the proposed area for targeted source remediation in unsaturated soil is a rational and logical approach that facilitates a meaningful comparison of remedial alternatives presented herein.

3.2 Applicable or Relevant and Appropriate Requirements

This section identifies ARARs for the Site, including location-, chemical-, and action-specific state and federal ARARs and "To be Considered" (TBC) non-promulgated criteria, advisories, guidance, and proposed standards issued by federal and state governments (USEPA 1989). These ARARs were developed by reviewing federal environment laws and regulations, New York State laws, and NYSDEC regulations to determine which state laws and regulations are ARARs and/or TBCs for this cleanup action.

- *Chemical-specific* requirements are usually health- or risk-based numerical values or methods that, when applied to site-specific conditions, result in the establishment of numerical values for the acceptable loading or concentration of a hazardous substance that may be found in, or discharged to, the environment.
- *Location-specific* requirements are restrictions placed on the concentrations of a hazardous substance or the conduct of activities solely because they occur in specific locations.
- *Action- (or remedy-) specific* are usually technology- or activity-based and may include limitations on actions taken with respect to hazardous constituents.

Tables 3-1 through 3-3 identify potential ARARs and TBCs, including the regulatory citation and a brief description.

3.2.1 Chemical-Specific ARARs

Chemical-specific ARARs for soil are summarized in **Table 3-1**.

3.2.2 Location-Specific ARARs

Location-specific ARARs are those that commonly restrict certain activities or limit concentrations of hazardous substances solely because of geographical or land use concerns. The primary location-specific ARARs are related to areas that may be designated as wetlands or floodplains. **Table 3-2** summarizes the location-specific ARARs.

3.2.3 Action-Specific ARARs

Action-specific ARARs are those that may place restrictions on the conduct of remediation activities or the use of certain technologies. Action-specific ARARs for the AVX Property would primarily be related to air emissions from remedial actions, waste management, and groundwater treatment or discharge. **Table 3-3** summarizes the action-specific ARARs.

3.3 Development of Remedial Action Objectives

RAOs are AVX Property-specific goals established for protecting human health and the environment. These objectives are based on available information and standards, such as ARARs and risk-based concentrations established by the risk assessment. RAOs may be qualitative (e.g., to prevent exposure to contaminated media) or quantitative (e.g., to specify the maximum contaminant concentration in a specific media). RAOs for the AVX Property were developed for two contaminated media – groundwater and soil – and provided in the OU-2 Amended ROD (USEPA 2015). Both sets of objectives are designed to restore the City Aquifer groundwater quality that is being impacted by the AVX Property to its beneficial use as a drinking water source.

The RAOs relevant to this FS Report-Source Area are those developed for soil, which are the following:

- Reduce the migration of VOC contaminants in soil to groundwater.
- Eliminate the potential for human exposure to Site contaminants via contact with contaminated soil.[1]

The risk-based assessments previously conducted and documented in the 1996 OU-2 ROD (USEPA 1996) and the OU-2 Amended ROD (USEPA 2015) indicated that VOCs in AVX Property soil do not pose an unacceptable direct contact risk. Therefore, for soil, the OU-2 Amended ROD identified New York State's 6 New York Codes, Rules, Regulations (NYCRR) Parts 375-6.4(b)(3) and 375-6.5, the Soil Cleanup Objectives (SCOs), as ARARs, TBCs, or other guidance to address contaminated soil at the AVX Property.

RGs for the targeted area of source soil remediation are summarized in **Table 3-4** below.

[1] RAOs will be achieved through meeting RGs identified in Table 3-4.

Table 3-4. Remediation Goals for Soil

COC	Soil RG (mg/kg)[a]
cis-1,2-Dichloroethene	0.25
trans-1,2-Dichloroethene	0.19
1,2-Dichloroethane	0.02
1,1,1-TCA	0.68
TCE	0.47
Toluene	0.7
PCE	1.3
Vinyl Chloride	0.02
Xylene	1.6
COC	**Soil Preliminary RG (mg/kg)[b]**
1,4-Dioxane[c]	0.1

Notes:
[a] NYSDEC SCOs [6 NYCRR Sections 375-6.4(b)(3) and 375-6.5].
[b] NYSDEC Protection of Groundwater SCOs from 6 NYCRR Part 375 - Table 375-6.8(b).
[c] Because 1,4-dioxane has physical properties that differ from CVOCs (e.g., 1,4-dioxane does not readily degrade under anaerobic conditions), additional analyses for 1,4-dioxane may be included during the pre-design phase. For the same reason, additional perfluorooctanoic acid and perfluorooctane sulfonate may also be included during the pre-design phase. Past groundwater sampling indicates that perfluorooctanoic acid and perfluorooctane sulfonate concentrations are low, if not absent.

3.4 General Response Actions

General response actions are those actions that may be taken, either individually or in combination, to achieve the RAOs for soil.

In the 2015 Feasibility Study Report (Arcadis 2015), general response actions and related technology types and process options for soil were developed through a joint process between the USEPA and KAVX/Arcadis that started first during the period between 2007 and 2010 during the initial FSWP development and later during implementation of the earlier FSWP, leading to the preparation of the 2015 FS Report. Implementable remediation options for historical source area soil located beneath and near to the former building footprint were analyzed in the 2015 Feasibility Study Report; however, implementation was determined not to be feasible at that time because it would result in significant disruption to and shutdown of ongoing manufacturing operations at the AVX Property.

A summary of these established **general response actions (bolded text)**, *technology types (italicized text)*, and <u>process options</u> (<u>underlined text</u>) are as follows:

- **No Action** (for comparison)
- **Institutional Controls –** *Access Restrictions* – <u>In the form of deed restrictions, governmental controls, and/or engineering controls and fencing</u>
- **Source Containment** – *Capping* – <u>Engineered low-permeability cover</u>
- **Source Removal** – *Excavation* with <u>offsite disposal or treatment/disposal</u>

- **In Situ Treatment**
  - *Attenuation* – Including long-term monitoring
  - *Biological Treatment* – e.g., phytoremediation
  - *Chemical/Biological Treatment* – e.g., enhanced anaerobic degradation
  - *Chemical Treatment* – e.g., chemical oxidation/reduction
  - *Physical/Chemical Treatment* –ISS with or without addition of ZVI
  - *Physical Extraction* – Including thermal heating and removal via multiphase extraction
- **Ex Situ Treatment**
  - *Physical Treatment* – Including soil washing, stabilization/soil mixing, and incineration
  - *Chemical Treatment* – e.g., chemical oxidation.

Preliminary and secondary review/screening of these technologies and process options was also performed in the FSWP-Source Area (Arcadis 2020b) and is summarized in Section 4.

4 Identification and Screening of Applicable Technologies

As noted in Section 3, preliminary and secondary review/screening of the technologies and process options identified in Section 3.3 was performed in the FSWP-Source Area (Arcadis 2020b).

An initial screening of the technical implementability of each process option and technology type was performed to reduce the number of technologies potentially applicable to a manageable number before performing a more rigorous secondary screening and evaluation process. Technical implementability refers to the ability of a remedial action or process to meet an RAO. The initial screening process eliminates those technologies or process options that are not applicable based on the COCs and AVX Property-specific characteristics. As a result, remedial technology types and process options that cannot be effectively implemented are eliminated from further consideration.

Table 4-1 provides the comprehensive list of potential alternatives, and similar to the 2015 FS, provides an initial evaluation of those alternatives and an initial screening out of some alternatives because they are either not implementable or are not expected to be effective. The initial screening was later presented in the FSWP-Source Area (Arcadis 2020b) that was approved by the USEPA in November 2020 (USEPA 2020b). Technologies and process options eliminated from further consideration are shaded in **Table 4-1** for clarity. Alternatives screened out from further consideration based on the initial screening were:

- Fencing
- In situ enhanced anaerobic degradation
- In situ chemical oxidation
- Soil washing
- Ex situ chemical oxidation.

Arcadis specifically screened out in situ injection-based remedial alternatives within **Table 4-1** based on the results of injection testing performed and reported in Appendix G of Arcadis' 2013 Feasibility Study Investigation Report (Arcadis 2013). Appendix G of that report describes the injection testing (two separate tests at two independent areas) and the conclusion that injection-based remedies are not feasible. At each pilot test area, injection wells (IW-1 and IW-2) and observation wells (OW-1A, OW-1B, and OW-1C and OW-2A, OW-2B, and OW-2C) were installed in advance of and specifically for use during implementation of the two independent tests. Those wells remain onsite as depicted on **Figure 1-2A**.

Table 4-2 provides a secondary screening of the alternatives based on the more focused analysis of the alternatives' expected effectiveness, implementability, and cost. The secondary screening is presented in Arcadis' FSWP-Source Area (Arcadis 2020b), which was approved by the USEPA in November 2020 (USEPA 2020b). Alternatives eliminated from further consideration during this secondary screening are shaded in **Table 4-2** for clarity. Alternatives screened out from further consideration based on the secondary screening were:

- Capping (Resource Conservation and Recovery Act)
- Offsite incineration/thermal desorption

- Phytoremediation
- In situ multiphase extraction (MPE)
- Ex situ onsite incineration
- Ex situ stabilization/soil mixing.

No changes to conditions have been identified since completion of FSWP-Source Area (Arcadis 2020b) screening that would affect the effectiveness, implementability, and cost of the potentially applicable technologies listed in **Table 4-2** to the extent that additional screening is warranted. As such, the potentially applicable technologies and process options listed in **Table 4-2** provide the basis for the soil remedial alternatives developed, screened, and evaluated in the following sections of this FS Report-Source Area.

5 Development of Remedial Action Alternatives

As discussed previously, this FS is focused on the targeted area of source soil remediation on the AVX Property. The historical remedy near and within the historical source areas has been an interim remedy selected in the OU-2 Amended ROD (USEPA 2015) that has relied on maintaining exposure barriers and limiting infiltration of water through unsaturated zone soil within the historical source areas. The remedial action alternatives development that follows will recognize, where appropriate, the connection that the unsaturated soil remedy within any of the historical source areas will have on the groundwater remedy and groundwater quality but will focus on COCs in soil within the targeted area of source remediation.

5.1 Remedial Action Alternative Components

Table 4-2 summarizes and compares the potentially applicable technologies and process options retained for development of remedial action alternatives. Soil technologies were compared based on relative effectiveness, implementability, and cost. Technologies that were retained after this comparison were assembled into remedial alternatives summarized in Section 5.3.

5.2 Remedial Action Alternatives

In assembling soil alternatives, the general response actions and technologies chosen to represent the various process options for soil were combined to form alternatives for soil. The following remedial action alternatives for the targeted area of source remediation have been assembled and are assessed in Sections 6 and 7:

- Alternative 1: No Action
- Alternative 2: Long-Term Monitoring
- Alternative 3: Excavation
- Alternative 4: ISS
- Alternative 5: In Situ Thermal Remediation (ISTR).

Table 5-1 below summarizes each alternative in relation to the remedial action alternative components retained.

Table 5-1. Remedial Action Alternative for Targeted Area of Source Remediation

Components	Alternative 1 No Action	Alternative 2 Long-Term Monitoring	Alternative 3 Excavation	Alternative 4 ISS	Alternative 5 ISTR
No Action	X				
Institutional Controls		X	X	X	X
Containment				X	
Removal			X		X
In Situ Treatment				X	X

6 Remedial Action Alternatives Screening Process

Remedial action alternatives were assembled in Section 5 to address soil in the targeted area of source remediation that contains COCs at concentrations exceeding their RGs for soil. This section screens these remedial action alternatives based on effectiveness, implementability, and cost. Each alternative includes a description and incorporates information regarding the different remedial components, as appropriate. The screening criteria are defined in **Table 6-1** below.

Table 6-1. Screening Criteria

Effectiveness	Implementability	Cost
Overall protectiveness of human health and the environment	Technical feasibility	Equipment/construction
Compliance with RGs	Demonstrated performance	Operation and maintenance (O&M)
Reduction of toxicity, mobility, or mass of contaminants	Availability of equipment, space, and services	
Adverse short- and long-term effects caused by implementation	Administrative feasibility	

The five remedial action alternatives for the targeted area of source remediation developed in Section 5 are:

- Alternative 1: No Action
- Alternative 2: Long-Term Monitoring
- Alternative 3: Excavation
- Alternative 4: ISS
- Alternative 5: ISTR.

These five alternatives are described and screened in Sections 6.1 through 6.5, respectively.

6.1 Alternative 1: No Action

This alternative consists of no remedial activities beyond those that have already been conducted at the AVX Property. It is the minimum proposed remedial action for soil in the targeted area of source remediation. Institutional controls for groundwater and soil addressed in the 2015 OU-2 ROD Amendment for the AVX Property would be implemented, but no additional institutional controls would be implemented. The existing semi-annual till unit groundwater monitoring program would not continue. Section 121(c) of CERCLA, 41 United States Code (U.S.C.) §9621(c), requires a review no less often than every 5 years if hazardous substances, pollutants, and contaminants remain onsite. Because hazardous substances, pollutants and contaminants will remain onsite, a review of this AVX Property will be completed at least once every 5 years (Five-Year Review).

6.2 Alternative 2: Long-Term Monitoring

Institutional controls for groundwater and soil are addressed in the 2015 OU-2 ROD Amendment for the AVX Property; additional institutional controls are not anticipated for this alternative. This alternative would document the decline in COC concentrations via natural processes. Reductions in COC concentrations occur by various naturally occurring physical mechanisms of concentration reduction, as well as destructive reactions and chemical reactions that alter the transport of constituents with a resulting concentration decrease. Monitoring would be performed to evaluate changes in COC concentrations within groundwater downgradient of the historical source areas and targeted area of source remediation that could cause or change risks to human health or the environment. The site-specific MNA evaluation has previously demonstrated that breakdown constituents (both cis-1,2-dichloroethene and vinyl chloride) are commonly present in samples from shallow till unit monitoring wells, extending from the location of the historical sources beneath and near the building downgradient to near the location of the boundary of the AVX Property (Arcadis 2015). The presence of these constituents indicates that reductive dechlorination is occurring throughout the till unit. Additionally, ethene and ethane were detected in monitoring well samples, demonstrating occurrence of the full sequence of reductive dechlorination. The MNA assessment also included analysis of electron acceptors, which showed moderate to strongly reducing conditions present throughout the area containing COCs in groundwater. The MNA screening analysis, including calculated scores and supporting tables showing point allocations, were previously submitted to the USEPA (Arcadis 2012).

Natural attenuation evaluations performed more recently as part of the AVX Property groundwater remedial design provided additional evidence of active reductive dechlorination occurring on the AVX Property, supporting MNA as a viable remedial alternative (Arcadis 2022c). The final groundwater remedy for the AVX Property has an approved SMP that took effect on the December 2022 startup of the groundwater restoration remedy. The Groundwater Management Plan (GWMP) component of the SMP includes OU-2 groundwater monitoring for MNA assessment for attenuation that will be supplemented by installation and monitoring of up to four new monitoring wells in the targeted area of source remediation.

The SMP-defined OU-2 groundwater monitoring program consists of a comprehensive monitoring network on and off the AVX Property that includes monitoring points (wells and piezometers), both previously existing and relatively new (piezometers surrounding the hydraulic containment trench), to evaluate groundwater conditions. The OU-2 groundwater monitoring is described in detail in the SMP, which is included as Appendix G of the Final RD for the groundwater remedy (Arcadis 2021a). In addition to the OU-2 groundwater monitoring, the long-term monitoring alternative will include up to four new groundwater monitoring wells installed within and downgradient of the area targeted for source soil remediation for collection of groundwater samples for CVOC and MNA parameter analysis. Monitoring would be performed semi-annually for 5 years and then every five quarters for the duration of the alternative, assumed for costing purposes to be 30 years. Because hazardous substances, pollutants, and contaminants will remain onsite for some time, a review of this AVX Property will be completed at least once every 5 years (Five-Year Review).

6.3 Alternative 3: Excavation

The major components of the soil excavation alternative are demolition and removal of the existing concrete slab floor and foundation supports, excavation of COC-contaminated soil in the targeted area of source remediation, offsite transportation and disposal of excavated material, and restoration with imported clean fill material to approximately match previously existing lines and grades.

This alternative involves excavating approximately 5,500 cubic yards (cy) of soil to depths up to approximately 9 feet below grade. The proposed excavation limits are shown on **Figure 6-1**. Excavation would be conducted using conventional construction equipment (e.g., excavators and front-end loaders). Excavation areas would be dewatered, as necessary, to facilitate soil removal. Based on the proposed extent/depth of excavation activities, excavation support systems are not likely necessary for excavation-based remedy implementation. Nonetheless, if this alternative is chosen, the remedial design phase will include an excavation plan that will provide an evaluation of the need for shoring and will include a shoring plan, if needed. While only unsaturated soil remediation alternatives are being evaluated as part of this FS Report-Source Area, a similar technology, but with modifications, could be used to address saturated soil.

Institutional controls for groundwater and soil are addressed in the 2015 OU-2 ROD Amendment for the AVX Property; additional institutional controls are not anticipated for this alternative. O&M activities associated with the institutional controls would include inspections of the clean fill cover and AVX Property fencing, and repairs as needed. Because hazardous substances, pollutants, and contaminants will remain onsite for some time, a review of this AVX Property will be completed at least once every 5 years (Five-Year Review).

6.4 Alternative 4: ISS

The major components of the ISS alternative include the demolition and removal of the existing concrete slab floor and foundation supports, excavation and removal of the asphalt paved areas to establish a level working surface for the ISS mixing equipment, construction of a swell management area adjacent to the ISS target areas for the containment of excess swell, and ISS of soil in the targeted area of source remediation.

The underlying principle behind the ISS technology for soil remediation is encapsulation of residual COCs; therefore, minimizing future flux of these COCs from soil to groundwater. Pre-determined addition rates of cementitious reagent(s) are mixed with site soil containing COCs through one of several available mixing methods, resulting in a solidified monolith of increased strength and reduced permeability relative to surrounding soil on the AVX Property. Because the bottom of the targeted area for remediation may be at times be a few feet below the water table, shallow groundwater may be diverted around the lower part of the solidified treatment zone. COCs in the treatment zone will be encapsulated through this alternative, limiting contact between upgradient groundwater and COCs in soil, thereby reducing the potential for leaching of these COCs. It is anticipated that a large-diameter auger drill rig or equivalent rotary-type mixer would be utilized for the mixing soil in situ on the AVX Property, given the soil types and target treatment depth. Because the ISS process generates additional volume of soil due to the addition of grout (swell), it may be necessary to remix swell through a process called bucket mixing if the excess soil has hardened before movement to the swell management area. This process would typically require the addition of a low amount of cementitious reagents to reactivate the solidification process and allow the swell to achieve the same strength and hydraulic conductivity properties achieved during the large-diameter auger process.

ISS of soil can be achieved through the addition of various cementitious reagents, such as Portland cement, and ground-granulated blast furnace slag (BFS), with various other pozzolanic or chemically reactive reagents available for inclusion, if dictated by site conditions. BFS is produced in a blast furnace during the reduction of iron ore to iron. It consists of non-metallic minerals, which are tapped off from the blast furnace while molten. The chemical composition, expressed as oxides, includes silica dioxide (27 to 39%), aluminum oxide (8 to 20%), calcium oxide (38 to 50%), and magnesium oxide (<10%). BFS is commonly pulverized and ground so that it can be more easily mixed with other media and is invariably considered as a leading alternative to Portland cement or as an additive to Portland cement, as an amendment for ISS projects.

An ISS treatability study, which is a laboratory bench-scale test to identify the optimal percentage of reagents, dosing requirements, and effectiveness, was performed on site soil as part of the FS investigation. This treatability study investigated the ability of Portland cement and BFS, as well as ZVI, to reduce the leaching potential and destroy site COCs. The treatability study objectives and results are detailed in the June 2022 FSIR-Source Area (Arcadis 2022b).

Important findings and conclusions drawn from the AVX Property-specific ISS treatability study were:

- ISS is a viable remedial alternative for remediating COCs in soil in the targeted area of source remediation.
- Mixing of the till unit zone soil appeared to provide significant remedial benefit by destroying any encountered higher permeability stringers that are expected to be the primary paths of COC transport from the Source Area to downgradient locations. Blending and compacting of this soil creates a monolith of uniformly low-permeability through the volume of mixed soil.
- The 2.5% Portland cement and 4.5% BFS amendment mix design recipe appeared to be the most favorable mix from a performance and cost balance, although the 1.5% Portland cement and 3.5% BFS mixture was also a technically viable alternative.
- The 2.5% Portland cement and 4.5% BFS mix design met the long-term unconfined compressive strength objective, as well as the permeability objective.
- ZVI added to the Portland cement+BFS mix did not outperform the Portland cement+BFS mix alone, and therefore, ZVI addition will not be evaluated as an ISS variant alternative in this FS Report-Source Area.

The ISS approach for the targeted area for source soil remediation is shown on **Figure 6-2**. It has been assumed that approximately up to 5,500 cy of soil in the targeted area of source remediation will be mixed with a blend of 2.5% Portland cement and 4.5% BFS, with a water-to-reagent ratio of 4.5 (grams of water to grams of reagent) to solidify the COCs in-place, creating a low-permeability monolith. It has been assumed that approximately 35% of the soil in the targeted area of source remediation mixed in-place will bulk/swell as a result of the soil mixing process and amendment addition. To accommodate the bulk soil, a dedicated swell management area will be constructed adjacent to the primary ISS treatment zone, within the former manufacturing building footprint. It has been estimated that approximately 3,755 cy of non-impacted soil will be excavated to create the swell management area and for post-ISS construction of a 3-foot-thick cover over both the ISS treatment and swell management areas. The ISS swell management materials will also include the top 3 feet of material from the ISS treatment zone, which will be removed before treatment and replaced post-treatment to provide the 3-foot-thick cover over this area. The 3-foot-thick cover has been designed to maintain the ISS-treated material below the frost line and to promote stormwater drainage away from the treatment zone. The protective cover will consist of a non-woven geotextile demarcation fabric, 2.5 to 3 feet of reused soil, and approximately 6 inches of gravel at the surface for erosion protection. The ISS swell material and the top 3 feet of treated ISS material will be re-blended and re-solidified in place following placement in the swell management area through addition of a 3% Portland cement-water slurry. While only unsaturated soil remediation alternatives are being evaluated as part of this FS Report-Source Area, a similar technology, but with modifications, could be used to address saturated soil.

The estimated duration for AVX Property mobilization, ISS pre-excavation work, concrete/asphalt removal, ISS mixing, ISS swell management containment construction, ISS swell management and re-solidification, and final cover construction work is approximately 3.5 months.

Institutional controls for groundwater and soil are addressed in the 2015 OU-2 ROD Amendment for the AVX Property. While this alternative could result in a modification to these institutional controls, additional institutional controls are not anticipated for this alternative. O&M activities associated with the institutional controls would include inspections of the surface cover and AVX Property fencing, and repairs as needed. Because hazardous substances, pollutants, and contaminants will remain onsite for some time, a review of this AVX Property will be completed at least once every 5 years (Five-Year Review).

6.5 Alternative 5: ISTR

ISTR technologies introduce heat into the subsurface to enhance the physical recovery of COCs via soil vapor extraction (SVE) and/or MPE, if water is encountered. At higher temperatures, COCs are driven into the vapor-phase via volatilization, vaporization, steam distillation, and/or steam stripping, while desorption, dissolution, and non-aqueous phase liquid (NAPL) mobility are also enhanced (e.g., Kingston et al. 2014). In finer-grained media, pneumatic fracturing associated with in situ steam generation leads to permeability enhancements and facilitates transport towards capture points. In situ chemical or biological degradation processes may also accelerate for susceptible constituents within certain temperature ranges. Conventional ex situ processes, such as liquid/vapor separation and granular-activated carbon (GAC), are used to treat the recovered vapors and fluids.

ISTR technologies are effective for source reduction of volatile and semivolatile constituents in a wide variety of soil types. They can be implemented within relatively short timeframes and are effective for treating recalcitrant mass in both the vadose and saturated zones, which may be present as NAPL trapped within fine-grained or heterogeneous media, located beneath existing buildings or infrastructure, or encountered at considerable depth. Source reduction via ISTR is often coupled with a plume management strategy, that in some cases, can leverage the gentle rises in temperature downgradient of the ISTR volume to accelerate the kinetics of in situ degradation processes (e.g., Horst et al. 2021).

The vapor pressures of chlorinated ethenes, chlorinated ethanes, and monocyclic aromatic hydrocarbons present in soil in the targeted area of source remediation are relatively high, such that an appreciable mass fraction of COCs will partition to the vapor-phase during steam distillation and/or stripping as temperatures approach 100 degrees Celsius (°C). Additionally, chlorinated ethanes, such as 1,1-TCA and 1,2-dichloroethane are amenable to degradation via heat-enhanced hydrolysis and dehydrohalogenation, which will further drive source mass reduction via accelerated dissolution. Based on these thermodynamic properties, ISTR is considered to be a viable remedial strategy for source mass in the till unit, with the objective of COC mass reduction.

The ISTR remedial alternative combines the following:

- ISTR with SVE (and possibly MPE if some water is encountered) for source mass in higher-concentration areas
- Institutional controls, in the form of deed restrictions, governmental controls, and/or engineering controls, for affected parcel(s).

Electrical resistance heating (ERH) and thermal conduction heating (TCH) were determined, based on their effectiveness for treating lower-permeability till with similar soil electrical properties, to be the most applicable ISTR technologies for source removal within the lower-permeability till unit on the AVX Property. ERH passes electric current between subsurface electrodes at low frequencies, which results in resistive heat dissipation throughout the formation. ERH is often applied in soil with electrical resistivities ranging from 1 to 500 Ohm-meter (Ω·m). The till is believed to fall within this range, based on data collected by an electrical conductivity probe during a membrane interface probe investigation as part of the 2011 FS Report (Arcadis 2011), which indicated the till has a representative soil resistivity of approximately 40 Ω·m. Because ERH requires the presence of soil moisture to pass electrical current, this technology generally has an upper temperature range equal to the boiling point of water (100°C at 1 standard atmosphere), which is sufficient to enhance recovery and in situ degradation of the COCs present at the AVX Property. In contrast, TCH utilizes downhole heating elements, operating at much higher temperatures (e.g., 400°C or higher), to transmit heat energy into the subsurface. Although not as sensitive to soil moisture, TCH often uses approximately 10 to 15% more energy than ERH (Griepke et al. 2017). For both technologies, convective cooling associated with groundwater flow velocities greater than 1 foot per day often needs to be managed with additional engineering controls (Hegele and McGee 2017); however, groundwater flow limiting controls are not expected to be needed for this alternative, based on the hydrostratigraphic data for the till unit described in the 2013 Feasibility Study Investigation Report (Arcadis 2013).

For the purposes of this evaluation, ERH was assumed for the development of the ISTR alternative(s); however, a TCH option could also be considered and would be similar in scope and effectiveness. Preliminary ERH layouts were developed using a regular 19-foot triangular grid pattern for the electrodes, with vertical MPE wells and horizontal SVE wells located at the centroids between adjacent electrodes. Distributed temperature sensor strings would be used for performance monitoring. A thermally insulating vapor cap would be constructed to provide a no-flow barrier at the surface, limit heat losses to ground surface, and minimize the potential for recondensation of vapors near ground surface. COC-laden vapors, condensed fluids, and/or groundwater extracted from the subsurface would be processed using conventional ex situ treatment equipment. Based on the COCs identified in the targeted area for soil remediation, an ex situ approach composed of cooling, phase separation, air stripping, liquid-phase GAC, and sacrificial vapor-phase GAC is envisioned. All process piping, equipment, and instrumentation would be rated for use in high temperature applications and for compatibility with the AVX Property-related COCs.

The ISTR approach for the targeted area for source soil remediation (**Figure 2-6**) is shown on **Figure 6-3**. The approximate soil volume in the targeted area for source soil remediation is 5,500 cy. To provide a degree of conservatism, conceptual ISTR locations were chosen to surround this volume. Additionally, electrodes would extend approximately 3 feet below the target treatment depths to promote complete heating of the targeted intervals. As such, the heated volume of soil will be approximately 8,200 cy. An energy density of 215 kilowatt hours per cy over this volume, plus an additional 5 to 10% for ancillary equipment, is contemplated (e.g., Griepke et al. 2017). Should ISTR be selected, further remedial design and heat transfer modeling would be undertaken to confirm these preliminary layouts. Additional soil resistivity profiling may also be completed as part of remedial design. The capacity of existing powerlines near the AVX Property would also be verified to confirm that the potential electrical demand of an ISTR alternative could be accommodated.

ISTR operations would likely last for approximately 6 months, including 3 to 4 months of heating to target temperatures, and 2 months operating at peak temperatures. O&M activities during operation may potentially include balancing the applied vacuum, water recirculation, and power delivery systems to optimize the performance; well field and process sampling; maintaining the ex situ process equipment; and pulsed operations in the later stages of treatment. Confirmation soil sampling would be conducted at the end of ISTR operations to assess remedial performance. While only unsaturated soil remediation alternatives are being evaluated as part of this FS Report-Source Area, a similar technology, but with modifications, could be used to address saturated soil.

Institutional controls for groundwater and soil are addressed in the 2015 OU-2 ROD Amendment for the AVX Property; additional institutional controls are not anticipated for this alternative. O&M activities associated with the institutional controls would include inspections of the restricted area and AVX Property fencing and repairs, as needed. Because hazardous substances, pollutants, and contaminants will remain onsite for some time, a review of the AVX Property will be completed at least once every 5 years (Five-Year Review).

7 Detailed Evaluation of Remedial Action Alternatives

The development of remedial action alternatives has followed the process below:

- Identification of RAOs and requirements for remediation (Section 3)
- Identification and screening of applicable technologies and formulation of remedial action alternatives (Sections 4 through 6).

Identification of and selection of the preferred remedial action alternative are based on consideration of the major tradeoffs among the alternatives in terms of the nine evaluation criteria. The USEPA has categorized the evaluation criteria into three groups:

- **Threshold Criteria**. The selected remedial action alternative must be protective of human health and the environment and comply with ARARs. Therefore, the USEPA has designated overall protection of human health and the environment and compliance with ARARs as the two threshold criteria. Absent an appropriate case for a waiver of some ARARs, an alternative must meet both criteria to be eligible for selection as the remedial action alternative.
- **Balancing Criteria**. The five primary balancing criteria are long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. This balancing provides a preliminary assessment of the maximum extent to which permanent solutions and treatment can be used practicably in a cost-effective manner. The alternative that is protective of human health and the environment, complies with the ARARs, and affords the most favorable balancing criteria is identified as the preferred remedial action alternative.
- **Modifying Criteria**. The USEPA will separately evaluate state and community acceptance into a final evaluation that determines which remedial action alternatives are acceptable. As stated at the beginning of Section 7, state and community acceptance will be addressed after comments to this FS Report-Source Area have been received.

This section presents a detailed analysis of each remedial action alternative developed in Section 6 based on the criteria specified in 40 Code of Federal Regulation (CFR) §300.430(e)(9) of the National Oil and Hazardous Substances Contingency Plan (NCP; USEPA 1990). These analyses are intended to aid in selection of an alternative that satisfies the RAOs; complies with the ARARs; provides a permanent solution; and reduces toxicity, mobility, and/or volume of area-specific constituents of potential concern (COPCs) for groundwater and surface water.

In accordance with CERCLA Section 121, 42 U.S.C. §9621, the NCP (USEPA 1990), and USEPA RI/FS guidance (USEPA 1988, 2000), each alternative will undergo detailed analysis based on the following nine criteria:

1. **Overall Protection of Human Health and the Environment** addresses whether or not a remedy provides adequate protection and describes how risks posed through each exposure pathway (based on a reasonable maximum exposure scenario) are eliminated; reduced; or controlled through treatment, engineering controls, or institutional controls.
2. **Compliance with ARARs** addresses whether a remedy would meet all the ARARs under federal and state environmental statutes and regulations or facility siting laws or provide grounds for invoking a waiver. Other

federal or state advisories, criteria, or guidance are TBCs. While TBCs are not required to be adhered to by the NCP, the NCP recognizes that they may be very useful in determining what is protective or how to carry out certain actions or requirements. The ARARs and TBCs identified for this action can be found in Section 3.

3. **Long-Term Effectiveness and Permanence** refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once RGs have been met. It also addresses the magnitude and effectiveness of the measures that may be required to manage the risk posed by treatment residuals and/or untreated wastes.

4. **Reduction of Mobility, Toxicity, or Volume Through Treatment** addresses the statutory preference for selecting remedial actions that include treatment technologies that permanently and significantly reduce the mobility, toxicity, and/or volume of the COPCs. Factors of this criterion to be evaluated include the treatment process employed; the amount of COPCs destroyed or treated; the degree of reduction in toxicity, mobility, and/or volume expected; the degree to which the treatment will be irreversible; and the type and quantity of residual COPCs.

5. **Short-Term Effectiveness** addresses potential human health and environmental risks of the alternative during the construction and implementation phase until remedial response objectives are met.

6. **Implementability** addresses the technical and administrative feasibility of implementing an alternative and the availability of services and materials required during implementation. Implementability is further categorized into technical feasibility, administrative feasibility, and availability criteria.

7. **Cost** addresses the capital and O&M costs and includes a present worth analysis of all costs. The capital costs consist of direct costs (construction) and indirect costs (non-construction and overhead). Direct capital costs include construction costs, equipment costs, land and development costs, relocation expenses, and disposal costs. Indirect capital costs include engineering expenses, legal fees and license or permit costs, startup costs, and contingency allowances.

   O&M costs are post-construction costs necessary to confirm the continued effectiveness of a remedial action. These costs include operating labor costs, maintenance materials and labor costs, auxiliary materials and energy, treatment residue disposal costs, purchased services, administrative cost, insurance, taxes, licensing costs, maintenance reserve and contingency funds, rehabilitation costs, and costs of periodic AVX Property reviews, if required.

   The cost estimates presented in this FS Report-Source Area were developed utilizing USEPA guidance, professional engineering judgment, and quotes from appropriate vendors. In accordance with USEPA guidance, the cost estimates in this FS Report-Source Area were prepared to provide accuracy in the range of -30 to +50% (USEPA 2000). All capital and O&M cost estimates are expressed in 2023 dollars.

   After development of the capital and O&M costs, a present-worth analysis of the overall remedial action costs associated with each alternative was completed. A present-worth analysis relates costs that occur over different time periods to present costs by discounting all future costs to the present value. This allows the cost of alternatives to be compared based on a single figure that represents the capital required in 2023 dollars to construct, operate, and maintain the alternative throughout its planned life. The present-worth calculations are based on a discount rate of 7%. Life-cycle costs are calculated for each alternative.

8. **State Acceptance** indicates whether, based on its review of the RI/FS Report, Human Health Risk Assessment (HHRA), and Proposed Plan, the state concurs with, opposes, or has no comments on the proposed remedy.

9. **Community Acceptance** refers to the public's general response to the alternatives described in the RI/FS Report, HHRA, and Proposed Plan.

The detailed analysis includes a detailed description of each remedial alternative, followed by a detailed evaluation of each remedial alternative evaluation Criteria 1 through 7. Criteria 1 and 2 are considered to be threshold criteria, Criteria 3 through 7 are considered primary balancing criteria, and Criteria 8 and 9 are considered modifying criteria. The remedial alternatives selected for detailed evaluation are summarized in **Table 7-1**. The evaluation of the remediation alternatives is presented below and summarized in **Table 7-2**. Present value cost calculations area summarized in **Table 7-3**.

In addition to the three threshold, five balancing, and two modifying criteria that are required to be analyzed in FSs, Green and Sustainable Remediation (GSR) should also be evaluated. The USEPA recognizes that the process of cleaning up a hazardous waste site uses energy, water, and other natural or processed material resources and consequently creates an environmental footprint of its own (USEPA 2022e). Green remediation is the process of examining the environmental footprint of site cleanup activities and taking steps to minimize the footprint. Green remediation strategies emphasize a whole-site approach to be used throughout the life of a cleanup project, including remedy design, remedy construction, remedy O&M, and groundwater monitoring.

A GSR evaluation becomes even more important to a remedial alternative evaluation when no one alternative stands out as a better option than the others. Therefore, remedial alternatives considered for the AVX Property have been evaluated consistent with USEPA's green remediation guidance, Technology Primer – Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites (USEPA 2008), and performed in accordance with 6 NYCRR Part 375 following DER-31 (NYSDEC 2011).

A quantitative sustainability assessment of the evaluated remedial alternatives evaluation commonly includes: (1) greenhouse gas emissions; (2) energy use (total energy use and electricity from renewable and non-renewable sources); (3) air emissions of criteria pollutants (total emissions and onsite emissions), including nitrogen oxide, sulfur oxide, and particulate matter; (4) water consumption; (5) resource consumption and waste generation (landfill space and top soil consumption); and (6) worker safety (risk of fatality, injury, and lost hours). A summary of the GSR evaluation has been included in Section 8.7.

7.1 Alternative 1: No Action

Table 7-4 presents the evaluation of the effectiveness, implementability, and cost associated with the No Action Alternative for the targeted area of source remediation. The evaluation concludes that the No Action Alternative would not be acceptable to the USEPA because this alternative would result in little or no further reduction in COC mobility, toxicity, or volume. Effectiveness, if any, would be attributed to naturally occurring processes, and no monitoring would be done to evaluate changes in risks or determine when RGs are met. However, this alternative is retained for detailed analysis as a basis of comparison, as required by the NCP, 40 CFR §300.430(3)(6) (CFR 2023), et seq. as a baseline for evaluating the remaining alternatives.

The following subsections present the detailed analysis of targeted source area remedial action Alternative 1: No Action. Groundwater monitoring would not be conducted, and no institutional controls, in addition to those for soil addressed in the 2015 OU-2 ROD Amendment for the AVX Property, would be implemented. A site review would be completed at least once every 5 years. **Table 7-2** presents a summary of this analysis. This alternative is retained for detailed analysis, as required by the NCP, as a baseline for evaluating the remaining alternatives.

7.1.1 Overall Protection of Human Health and the Environment

Although the No Action Alternative does not incorporate any activities that would present short-term exposure risks to the community, workers, or the environment, it would not be protective of human health and the environment because it would not reduce existing COC concentrations in soil in the targeted area of source remediation or provide measures to eliminate or control potential exposure pathways. Additionally, this alternative has the potential to allow COCs in soil to leach to till unit groundwater or till unit groundwater containing COCs to migrate.

Alternative 1 would not comply with chemical-specific ARARs for soil because No Action would be taken to control potential exposure pathways or address COC concentrations in soil. There are no location- or action-specific ARARs for Alternative 1.

7.1.2 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence would not be achieved through the No Action Alternative because reduction in COC concentrations in soil would not be addressed, and no institutional controls, in addition to those for soil addressed in the 2015 OU2 ROD Amendment for the AVX Property, would be implemented to eliminate or provide long-term control of potential exposure pathways. Additionally, this alternative has the potential to allow COCs in soil to leach to till unit groundwater and COCs in till unit groundwater to migrate towards potential downgradient receptors.

7.1.3 Reduction of Mobility, Toxicity, or Volume Through Treatment

Natural attenuation mechanisms may result in the reduction of COC mobility, toxicity, and volume in soil, although monitoring of these processes would not be performed with Alternative 1 to evaluate changes in mobility, toxicity, and volume.

7.1.4 Short-Term Effectiveness

The No Action Alternative does not incorporate any activities that would present exposure risks to the community, workers, or the environment.

7.1.5 Implementability

Because no technical implementation is required, the No Action Alternative is technically feasible.

7.1.6 Cost

Table 7-3 and **Appendix C** present a summary of the present value cost calculations for Alternative 1: No Action and the detailed cost backup, respectively. There are no actions to be implemented and, therefore, no capital or O&M costs are associated with Alternative 1. Total costs for this alternative are estimated to be approximately $0 in 2023 dollars.

7.2 Alternative 2: Long-Term Monitoring

Table 7-5 presents the evaluation of the effectiveness, implementability, and cost associated with the Long-Term Monitoring Alternative for the targeted area of source remediation. The evaluation assumes that long-term monitoring, in combination with the already implemented groundwater restoration remedy, and maintenance of the existing surface covers, would achieve the RAOs of mitigating COC concentrations in the targeted area of source remediation soil and minimizing the potential for human exposure to AVX Property-specific COCs; therefore, it is retained for detailed analysis.

The following subsections present the detailed analysis of targeted source area remedial action Alternative 2: Long-Term Monitoring. Under this alternative, long-term monitoring and institutional controls for soil addressed in the 2015 OU-2 ROD Amendment for the AVX Property would be implemented to address unsaturated soil, and performance would be assessed by monitoring groundwater immediately beneath and/or downgradient of the unsaturated soil source area. Targeting groundwater in contact with the base of and/or immediately downgradient of the unsaturated soil source will provide more reliable and reproducible performance monitoring data than monitoring the soil directly via multiple soil sampling/analysis events over time. Reproducibility of soil data is poor given that soil sampling is an inherently destructive process that precludes the ability to resample that particular soil location over time. Furthermore, soil concentration and permeability, particularly within a glacial till, can vary by orders of magnitude over small distances (inches), making comparison of multiple rounds of soil data even more unreliable. High variability in soil COC concentrations will mask concentration trend declines in soil, introducing further unreliability to COC concentration trend analysis via repeated sampling of the soil matrix.

This alternative would rely on long-term monitoring of the mass and concentration of COCs in the unsaturated soil. Periodic monitoring of four newly installed groundwater monitoring wells would be conducted to track attenuation of COCs immediately beneath and/or downgradient of the unsaturated soil source. In addition, existing surface covers would be maintained to control potential leaching of COCs in soil to groundwater, and institutional controls for soil addressed in the 2015 OU-2 ROD Amendment for the AVX Property would be implemented to reduce the potential for future receptor exposure in the event that the existing surface covers are removed. **Table 7-2** presents a summary of this analysis.

Long-term monitoring would be implemented through sampling the four new groundwater monitoring wells and analyzing samples for relevant MNA parameters, such as CVOCs, dissolved gases, or iron. Sampling would occur semi-annually for the first five years and then every five quarters for the remaining assumed 30-year life of the alternative. O&M activities for long-term MNA monitoring include the groundwater sampling events, waste disposal, and monitoring well maintenance.

The surface covers are already in place. O&M activities involved in maintaining the surface cover may potentially include inspection of the asphalt and vegetative covers; repair of major cracks within the asphalt cover or replacement of portions of that cover, as needed; clearing of invasive vegetation; and seeding the vegetative cover as needed.

O&M activities associated with the institutional controls may potentially include inspections of the restricted area and the fencing and repairs to the fence, as needed.

7.2.1 Overall Protection of Human Health and the Environment

Implementation of this alternative is not expected to result in exposure risks to the community, workers, or environment. Long-term groundwater monitoring of new monitoring wells would supplement ongoing OU-2 ROD-Amendment remedy-related groundwater monitoring of a comprehensive monitoring network on and off the AVX Property and would be used to supplement the long-term monitoring performed in the four new wells to document the decline/reduction of COCs via natural processes. Institutional controls for soil addressed in the 2015 OU-2 ROD Amendment for the AVX Property and the AVX Property groundwater restoration remedy implemented downgradient of the area of targeted source remediation would protect against human exposure to COCs in groundwater while concentrations attenuate in the soil in the targeted area of source remediation. Groundwater monitoring would be used to assess achievement of RAOs. This alternative would protect against both current and future human exposure to groundwater with constituents above the numeric chemical-specific ARARs and would be protective of human health and the environment.

7.2.2 Compliance with Applicable or Relevant and Appropriate Requirements

This alternative would comply with chemical-specific ARARs by limiting the potential completion of an exposure pathway for COCs in soil in the targeted area of source remediation by institutional controls for soil addressed in the 2015 OU-2 ROD Amendment for the AVX Property and documenting the decline of COC concentrations in exceedance of chemical-specific ARARs in downgradient groundwater in combination with the AVX Property groundwater restoration remedy. Alternative 2 would comply with location- and action-specific ARARs. For cost estimating purposes, the timeframe for Alternative 2 to achieve RAOs is estimated to be 30 years, although it is unclear whether RAOs would be reached within this timeframe.

7.2.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence would be achieved through institutional controls for soil addressed in the 2015 OU-2 ROD Amendment for the AVX Property and groundwater monitoring in conjunction with the AVX Property groundwater restoration remedy implemented downgradient of the targeted area of source remediation. Institutional controls would prevent potential exposure to COCs at levels in exceedance of chemical-specific ARARs in soil in the targeted area of source remediation. Long-term groundwater monitoring will allow for determination of when RGs are met.

7.2.4 Reduction of Mobility, Toxicity, or Volume

Alternative 2 would reduce COC mobility and further reduce migration of COCs in downgradient groundwater through natural attenuation mechanisms. Long-term monitoring of COC concentrations and natural attenuation parameters in downgradient groundwater will allow for assessment of changes in risk and determination of when RGs are met.

7.2.5 Short-Term Effectiveness

Implementation of this alternative would result in minimal exposure risks to the community, workers, and the environment. Institutional controls for soil addressed in the 2015 OU-2 ROD Amendment for the AVX Property would prevent exposure to COCs in soil within the targeted area of source remediation.

7.2.6 Implementability

Implementation of this alternative is technically feasible because the technology is conventional and administratively feasible because potential exposure to COCs in soil in the targeted area of source remediation would be further restricted through institutional controls for soil addressed in the 2015 OU-2 ROD Amendment for the AVX Property and collection and treatment of downgradient groundwater. This alternative would not limit or interfere with the ability to perform future remedial actions. The 2015 OU-2 ROD Amendment-based remedy already has groundwater monitoring integral to the remedy, which will provide data that supplements that from additional groundwater monitoring at the four new long-term monitoring wells incorporated in to Alternative 2. Institutional controls would be readily implementable.

7.2.7 Cost

Table 7-3 and **Appendix C** present a summary of the present value cost calculations for Alternative 2: Long-Term Monitoring. The total costs for Alternative 2 are estimated to be approximately $291,000 in 2023 dollars.

7.3 Alternative 3: Excavation

Table 7-6 presents the evaluation of the effectiveness, implementability, and cost associated with the Excavation Alternative for the targeted area of source remediation. The evaluation concludes that excavation would achieve the RAOs of mitigating COC concentrations in soil in the targeted area of source remediation and minimizing the potential for human exposure to AVX Property-specific COCs; therefore, it is retained for detailed analysis.

The following subsections present the detailed analysis of the targeted source area remedial action Alternative 3: Excavation. The major components of the soil excavation alternative are demolition and removal of the existing concrete slab floor and foundation supports, excavation of impacted soil in the targeted area of source remediation, offsite transportation and disposal of excavated material, and restoration with imported clean fill material to match previously existing lines and grades. **Table 7-2** presents a summary of this analysis.

Excavation areas would be restored with imported clean fill material to match the previously existing lines and grades. Imported clean fill material would need to meet the allowable constituent levels for imported fill or soil for commercial or industrial use as per the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation. Surface restoration details would be developed as part of the remedial design for this alternative.

For developing and costing this alternative, it was assumed that all excavated material (approximately 5,500 cy) would be transported offsite for disposal as non-hazardous waste at a solid waste landfill. Rainwater/surface water that accumulates in, and is then removed from, any excavation areas would be temporarily containerized onsite (e.g., in 21,000-gallon frac tanks). It is anticipated that any water that accumulates and is removed from an excavation will be treated by the onsite groundwater treatment system that will be operational at the time of the source soil remediation activities. This system discharges to the publicly owned treatment works.

7.3.1 Overall Protection of Human Health and the Environment

COCs in soil in the targeted area of source remediation and the potential for human exposure to COCs in this targeted area via contact with soil and/or inhalation of vapors would be significantly reduced under this alternative. This alternative is protective of human health and the environment because exposure to COCs in soil in the targeted area of source remediation is reduced due to the removal of soil containing COCs followed by construction of a clean stone fill cover system. The stone cover system will be designed to promote stormwater drainage away from the targeted area of source remediation.

7.3.2 Compliance with Applicable or Relevant and Appropriate Requirements

Chemical-specific ARARs and TBCs will be met by removing impacted soil from the Source Area and minimizing further migration of COCs from the targeted area of source remediation to downgradient groundwater. The timeframe for Alternative 3 to achieve RAOs is anticipated to be the same as its implementation timeframe – approximately 4 months.

7.3.3 Long-Term Effectiveness and Performance

Removal and offsite disposal of targeted soil would remove some quantity of COCs and reduce overall leaching of COCs into groundwater downgradient of the targeted area of source remediation. This alternative is effective for all COCs in the targeted area of source remediation because impacted material would be excavated and transported offsite for disposal. Removal of impacted material would reduce the potential for exposure to media containing COCs in the targeted area of source remediation. If subsurface activities (e.g., installation of new utilities) were to be conducted in this area after remediation, activities would likely be conducted in areas restored with imported clean fill. The potential for exposure to impacted media would be significantly reduced under this alternative.

7.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment

This alternative involves excavating and offsite transportation and disposal of approximately 5,500 cy of material at a solid waste landfill to address accessible COCs in soil in the targeted area of source remediation. The removal of accessible COCs in soil would reduce the flux of COCs from source material to groundwater, which would substantially reduce the mobility and volume of groundwater impacts, though not through treatment.

7.3.5 Short-Term Effectiveness

Implementation of this alternative could result in short-term exposure of the surrounding community and site workers to AVX Property-related COCs as a result of excavation, material handling, and offsite transportation and disposal activities during subsurface intrusive activities. The anticipated duration of these activities is approximately 4 months. Potential exposure mechanisms would include ingestion and dermal contact with impacted soil and/or groundwater and inhalation of vapors or dust containing COCs during remedial construction. However, work activities, including handling potentially impacted material, would be conducted in accordance with the procedures described in an SMP to minimize the potential for exposures to COCs in media within the targeted area of source remediation. Best management practices can be employed to reduce and control dust. Potential exposure of remedial workers would be minimized using appropriately trained field personnel and personal protection equipment (PPE), as specified in an AVX Property-specific Health and Safety Plan that would be developed as part of the remedial design.

Additional worker safety concerns include working with and around large construction equipment, noise generated from operating construction equipment, and increased vehicle traffic associated with transportation of excavated material from the site and delivery of fill materials. These concerns would be minimized by using engineering controls and appropriate health and safety practices, such as use of two-way radios for communication between operators/drivers and workers, signage and barricades to control vehicular movement, high-visibility clothing for all workers, and appropriate hearing protection for workers in close proximity to operating equipment. On and offsite transportation activities would be managed under a traffic control plan to minimize risks to AVX Property workers and the community.

The current zoning for the AVX Property is listed as manufacturing, and areas immediately surrounding the AVX Property are zoned for industrial, commercial, and residential uses. The AVX Property is currently vacant. Based on the current and anticipated future land use of the AVX Property, the potential for exposure to subsurface soil and groundwater containing site-related COCs is minimal. Most of the AVX Property is covered with asphalt, concrete, former building concrete slabs, or vegetated soil. As noted above, an SMP has been prepared for the AVX Property groundwater remedy and will be updated to address any additional management considerations following the implementation of the targeted source area remediation. The SMP would detail any required institutional and engineering controls required for the targeted area of source remediation, such as any future soil and/or groundwater management.

This alternative would not affect the current or anticipated future land use at the AVX Property. Accessible impacted material would be removed from the AVX Property. Community access to the excavation area would be restricted by temporary security fencing and signage around the work area.

7.3.6 Implementability

This alternative would be both technically and administratively implementable for targeted areas. Some limitations to excavation depths exist due to shallow groundwater and excavation and backfill could increase vertical permeability and COC flux compared with the naturally low vertical permeability and low flux in the till. This alternative is readily implementable using conventional construction equipment (e.g., excavators and front-end loaders). From a technical implementability aspect, remedial contractors capable of performing the excavation activities are readily available; however, conducting excavation activities in an urban setting would present numerous logistical issues. Transportation planning would be conducted before the remedial activities. Additionally, soil removal activities would have to be conducted in a manner as to not jeopardize the health and safety of or cause a nuisance to the surrounding community.

7.3.7 Cost

Table 7-3 and **Appendix C** present a summary of the present value cost calculations for Alternative 3: Excavation and the detailed cost backup, respectively. Cost components of this alternative include demolition, excavation, and offsite transportation and disposal of material; dewatering of the excavation area and containerization and treatment of that water; and restoration with imported clean fill material to match previously existing lines and grades. The total costs for Alternative 3 are estimated to be approximately $2,414,000 in 2023 dollars.

7.4 Alternative 4: ISS

Table 7-7 presents the evaluation of the effectiveness, implementability, and cost associated with the ISS Alternative for the targeted area of source remediation. The evaluation concludes that ISS would achieve the RAOs of mitigating COC concentrations in soil in the targeted area of source remediation and minimizing the potential for human exposure to AVX Property-specific COCs; therefore, it is retained for detailed analysis.

The following subsections present the detailed analysis of the targeted source area remedial action Alternative 4: ISS. The ISS work will include the demolition and removal of the existing concrete slab floor and foundation supports, and the excavation and removal of the asphalt paved areas in preparation for establishing a level working surface for the ISS mixing equipment. It is anticipated that a large-diameter auger drill rig will be utilized at this AVX Property, given the soil types and target treatment depth. **Table 7-2** presents a summary of this analysis.

7.4.1 Overall Protection of Human Health and the Environment

This alternative is protective of human health and the environment because exposure to COCs in the soil in the targeted area of source remediation is reduced due to the solidification of soil and COCs followed by construction of a clean stone cover system. The stone cover system will be designed to promote stormwater drainage away from the solidified monolith and will eliminate the potential exposure pathways and prevent COCs from mobilizing from the soil to groundwater.

7.4.2 Compliance with Applicable or Relevant and Appropriate Requirements

Chemical-specific ARARs and TBCs will be met by removing the potential receptor pathways to concentrations exceeding the threshold criteria and by significantly reducing, if not eliminating, vertical infiltration and the potential for impact to groundwater associated with solidified materials remaining underneath the clean stone cover system. Location- and action-specific ARARs will be met through this alternative. The timeframe for Alternative 4 to achieve RAOs is anticipated to be the same as its implementation timeframe – approximately 3.5 months.

7.4.3 Long-Term Effectiveness and Permanence

The solidification of soil containing COCs in the targeted area of source remediation through implementation of this proven technology is highly effective because the methods employed reduce the human and ecological exposure pathways to COCs and reduce or eliminate the mobility of the COCs in the area targeted for source remediation. Bench-scale treatability testing already performed has demonstrated that permeability and soil strength are achieved by the amendment mix design. The use of institutional controls for soil addressed in the 2015 OU-2 ROD Amendment for the AVX Property to protect the solidified mass, a stone cover system and long-term inspection, monitoring, maintenance, and reporting will be incorporated to verify long-term effectiveness and permanence. Furthermore, the groundwater monitoring called for by the 2015 OU-2 ROD Amendment (described in the GWMP for the AVX Property groundwater restoration remedy) will provide data that will indirectly reflect upon the success of the ISS unsaturated soil source area remedy.

7.4.4 Reduction of Mobility, Toxicity, or Volume

This alternative provides substantial reduction of the mobility of COCs. The volume of COCs is not reduced by this alternative because all COCs are solidified within the monolith.

7.4.5 Short-Term Effectiveness

This alternative has the potential to pose short-term impacts to workers, community members, and the environment during the solidification and construction phase, which has an anticipated duration of approximately 3.5 months. Workers, community members, and the environment could be impacted by odors generated during the mixing of ISS amendment with COC-containing soil in the targeted area of source remediation. Workers also have increased potential to come into direct contact with COCs during the mixing phase. In addition, the mixing process and associated machinery may pose physical hazards and potential safety concerns for workers. Best management practices can be employed to reduce and control dust and odor generation, and workers can use PPE and health and safety planning techniques to minimize potential for exposure to COCs and risks associated with the solidification process.

7.4.6 Implementability

ISS is a demonstrated technology for treating site-specific contaminants in-place and can be successfully implemented at the AVX Property. The AVX Property is relatively flat in the targeted area of source remediation, with plenty of adjacent work areas to support equipment and management of the ISS swell material. These site conditions make ISS an ideal alternative. Additionally, the site will allow for the management of ISS swell material onsite, eliminating the need for transportation and disposal offsite, and importing supplemental clean backfill material. A detailed treatability study has been performed, providing assurances that the performance criteria for permeability and unconfined compressive strength of the solidified soil will be achieved, and leach testing data results confirmed a non-detection for COCs.

7.4.7 Cost

Table 7-3 and **Appendix C** present a summary of the present value cost calculations for Alternative 4: ISS and the detailed cost backup, respectively. The total costs for Alternative 4 are estimated to be approximately $2,901,000 in 2023 dollars. This cost reflects a 10 percent contingency to account for current unknowns and risks associated with meeting target ISS remedial objectives.

7.5 Alternative 5: ISTR

Table 7-8 presents the evaluation of the effectiveness, implementability, and cost associated with the ISTR Alternative for the targeted area of source remediation. The evaluation concludes that ISTR would achieve the RAOs of mitigating COC concentrations in soil in the targeted area of source remediation and minimizing the potential for human exposure to AVX Property-specific COCs; therefore, it is retained for detailed analysis.

The following subsections present the detailed analysis of targeted source area remedial action Alternative 5: ISTR. The ISTR remedial alternative includes post-ISTR institutional controls for soil addressed in the 2015 OU-2 ROD Amendment for the AVX Property. **Table 7-2** presents a summary of this analysis.

7.5.1 Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment by physically removing COC mass from the subsurface, thereby minimizing the amount of COC mass available for long-term partitioning to downgradient groundwater. COC concentrations in the till unit soil and groundwater would be permanently reduced via ISTR. In the interim, institutional controls for soil addressed in the 2015 OU-2 ROD Amendment for the AVX Property would reduce the potential for future receptor exposure.

7.5.2 Compliance with Applicable or Relevant and Appropriate Requirements

Chemical-specific ARARs and TBCs will be met by physically removing COC mass in soil and till unit groundwater, thereby minimizing COC partitioning to downgradient groundwater. Location- and action-specific ARARs will also be met through this alternative. The timeframe for Alternative 5 to achieve RAOs is anticipated to be the same as its implementation timeframe – approximately 6 months of operations.

7.5.3 Long-Term Effectiveness and Permanence

ISTR would be effective for treating COCs present in the till unit and is anticipated to reduce concentrations within the ISTR targeted volumes to below the soil cleanup standards in a timely fashion (i.e., approximately 6 months of operations). COCs amendable to heat-enhanced hydrolysis (e.g., 1,1,1-TCA) may also experience concentration reductions in soil and groundwater adjacent to and/or downgradient of the ISTR volumes. Given the vertical offset between the ISTR volumes and the deeper till unit contact, groundwater flow in the underlying aquifer is not expected to result in cooling effects; this would be confirmed as part of the remedial design. Given the presence of degradation byproducts from past sampling on the AVX Property, and assuming that source mass is significantly reduced after ISTR operations are completed, MNA is anticipated to be effective for polishing within lower-concentration areas. Institutional controls for soil addressed in the 2015 OU-2 ROD Amendment for the AVX Property would be effective for minimizing the potential for receptor(s) to come into contact with COCs before achieving remediation objectives.

7.5.4 Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative would greatly reduce the volume and toxicity of COCs in soil, soil vapor, and groundwater (if present) within the perimeter of the subsurface heaters or electrodes. By maintaining pneumatic and hydraulic control, the volume and mobility of COCs in groundwater and soil vapor would be reduced during active operations through physical recovery/extraction. After heating, concentration gradients driving partitioning to soil vapor and groundwater would decrease considerably and further reduce the mobility of any remaining constituents that may be partitioning towards the downgradient hydraulic containment trench (e.g., Heron et al. 2016). More moderate temperature increases adjacent to and/or downgradient of the ISTR volume may also cause hydrolysis or biodegradation rates to accelerate and further reduce the toxicity and mobility of peripheral constituents above soil cleanup standards; however, this may occur in the months to years following active ISTR treatment in the targeted area of source remediation.

7.5.5 Short-Term Effectiveness

Implementation of this alternative may potentially result in short-term exposure risks to workers, the community, or the environment when performing drilling activities, energizing electrical equipment, maintaining the ex situ treatment equipment, and/or decontaminating and demobilizing remedial components. Potential risks to workers and the community would be managed through effective design, engineering controls, health and safety protocols, and training. Testing would be performed during system startup to confirm that any potential electrical hazards are controlled. Drill cuttings or groundwater recovered during well installation activities, as well as wastes recovered from within the ex situ treatment equipment, would be managed using approved methods.

7.5.6 Implementability

ISTR equipment and technical personnel are readily available. Because most of the existing infrastructure (e.g., buildings, utilities) at the AVX Property have been removed, and existing paved surfaces can be utilized as part of a vapor cap design, ISTR may be readily implementable. Locations and capacity of the existing powerlines nearby to feed an ISTR system should be confirmed with the utility. Drilling, construction, operations, and site restoration would require unrestricted AVX Property access for 12 to 24 months; during that time, only foot traffic would be possible within the ISTR footprint. Any existing monitoring wells and buried utilities within the ISTR footprint would be evaluated and decommissioned, temporarily rerouted, or thermally protected. ISTR has fewer concerns with truck traffic, noise, or nuisance odors than the excavation or ISS alternatives. In terms of approvals from other offices and agencies, ISTR would require an electrical power drop from New York State Electric and Gas and discharge permit equivalents from the NYSDEC Division of Air Resources (DAR) and City of Olean Department of Public Works. A DAR-1 analysis may be required for air emissions.

ISTR is a mature technology that has a demonstrated a track record of performance with more than 641 implementations since the late 1980s identified during a recent study (Horst et al. 2021). More than half of these projects were for the source reduction of CVOCs. It has been implemented previously in New York at sites managed under federal and state frameworks. Institutional controls for soil addressed in the 2015 OU-2 ROD Amendment for the AVX Property are also accepted approaches for risk management of less impacted areas. Regulatory and community acceptance of this alternative is anticipated.

7.5.7 Cost

Table 7-3 and **Appendix C** present a summary of the present value cost calculations for Alternative 5: ISTR with SVE (MPE, as necessary) and the detailed cost backup, respectively.

For the purposes of this evaluation, ERH was selected for FS-level cost estimation; however, costs for a TCH option would be similar, based on recent project experience. Capital costs for ISTR would include equipment procurement, drilling, construction, and demobilization associated with the ISTR system components. O&M costs include ISTR operations in Year 0.

The estimated total costs for ISTR of approximately 8,200 cy of soil, to surround the targeted area for source soil remediation, are estimated to be approximately $3,581,000 in 2023 dollars.

8 Comparative Analysis of Alternatives

A comparative analysis of the targeted area of source remedial action alternatives using the threshold and balancing criteria is presented in Sections 8.1 through 8.8. These sections also provide a comparative analysis of the expected performance of each alternative relative to the other alternatives to identify their respective advantages and disadvantages.

8.1 Overall Protection of Human Health and the Environment

As indicated in **Table 7-2**, Alternative 1 would not achieve RAOs and would, therefore, not be protective of human health and the environment. For cost estimating purposes, the timeframe for Alternative 2 to achieve RAOs is estimated to be 30 years, although it is unclear whether RAOs would be reached within this timeframe. It is estimated that Alternatives 3 through 5 would achieve soil RAOs within 6 months of operation or less. Alternatives 3 through 5 achieve the RAOs identified for soil in the targeted area source remediation and offer a similar level of protection of human health and the environment.

8.2 Compliance with Applicable or Relevant and Appropriate Requirements

Alternative 1 would not comply with chemical-specific ARARs. There are no action- or location-specific ARARs for Alternative 1. Alternatives 2 through 5 would comply with ARARs. Alternatives 3 through 5 would attain ARARs more quickly than Alternative 2. For Alternative 2, long-term groundwater monitoring, through the installation of an estimated four additional groundwater monitoring wells near the footprint of the former manufacturing building, would be used to monitor COCs in groundwater directly beneath and/or downgradient of the remediated unsaturated source of COCs to assess the effectiveness of that alternative. Groundwater monitoring, performed as part of the groundwater remedy called for by the 2015 OU-2 ROD Amendment, will provide supplementary indirect evidence of the success of the unsaturated zone soil source remedial Alternatives 3 through 5.

8.3 Long-Term Effectiveness and Permanence

Alternative 1 would provide the least long-term effectiveness because there would be no controls to limit exposure to COCs in soil in the targeted area of source remediation. Alternative 2 would be more effective than Alternative 1 because surface covers currently in place (building foundation and pavement) will be maintained. Institutional controls for soil addressed in the 2015 OU-2 ROD Amendment for the AVX Property would also be implemented under Alternative 2 to further reduce the potential for receptor exposure. Migration of COCs above the chemical-specific ARARs would continue to occur under both of these alternatives; however, this would be controlled by the groundwater restoration remedial action recently implemented downgradient near the southern AVX Property boundary. Alternatives 3 through 5 are all effective alternatives in the long-term because they would remove COCs from soil (Alternatives 3 and 5) or immobilize COCs in soil (Alternative 4) in the targeted area of source remediation:

- Alternative 3 would use physical methods to remove COCs from soil
- Alternative 4 would use solidification to render COCs in soil inaccessible
- Alternative 5 would use SVE wells to remove COCs volatized by thermal treatment from the subsurface.

All alternatives would permanently reduce accessible COC concentrations over time. Alternatives 3, 4, and 5 would have similar permanence.

8.4 Reduction of Mobility, Toxicity, or Volume Through Treatment

Alternative 1 would not reduce mobility, toxicity, or volume because no action would be taken. Alternatives 2 through 5 all reduce toxicity and volume of COCs in soil in the targeted area of source remediation. The maintenance of the surface covers that will be conducted in Alternative 2 would reduce leaching of COCs in soil to groundwater. Alternative 3 would reduce the toxicity and volume of COCs in soil in the targeted area of source remediation through removal and would be the most effective alternative at reducing mobility, toxicity, and volume of COCs because it removes COCs from the treatment area. Alternatives 4 and 5 provide active in situ treatment of COCs in soil that would aggressively reduce the mobility, volume, and toxicity of these COCs. Alternative 5 would be more effective than Alternative 4 in reducing mobility, toxicity, and volume of COCs because it destroys COCs rather than solidifying them in-place.

8.5 Short-Term Effectiveness

Alternative 1 would have no short-term impacts because no action would be taken. Alternative 2 would require limited activities (surface cover maintenance, groundwater monitoring) that would result in short-term exposure risks to workers, the public, or the environment, although these activities would be managed through engineering controls, and worker training. For cost estimating purposes, Alternative 2 has an estimated implementation timeframe of 1 month to install groundwater monitoring wells, although it is unclear whether RAOs would be reached within 30 years.

Under Alternative 3, the potential risks to workers, the public, or the environment would increase due to substantial soil disturbance and offsite transportation of soil, although these activities would be managed through engineering controls, health and safety procedures, and worker training. The implementation timeframe for Alternative 3 is estimated to be approximately 4 months.

Under Alternative 4, the potential risks to workers, the public, or the environment would increase due to implementation of ISS although these activities would be managed through engineering controls, health and safety procedures, and worker training. The implementation timeframe for Alternative 4 is estimated to be approximately 3.5 months.

Installation of the electrodes and associated SVE and MPE wells for Alternative 5 may result in short-term exposure risks to workers, the public, or the environment, but these potential risks are likely lower than those from Alternatives 3 and 4 because there will be less physical disturbance and movement of soil. These potential risks would be managed through engineering controls, vapor monitoring and mitigation, health and safety procedures, and worker training. The implementation timeframe for Alternative 5 is estimated to be approximately 6 months.

8.6 Implementability

All soil alternative remedial technologies described in this FS Report-Source Area are well-established technologies that, if selected, could be implemented with commercially available equipment.

There is nothing to implement for Alternative 1. Alternative 2 is simple to implement. The excavation planned for Alternative 3 and the ISS planned for Alternative 4 would both be more difficult to implement than Alternative 2, but both would use conventional equipment, which is readily available. Alternative 5 would require the most specialized equipment to implement with the installation of electrodes, SVE wells, and MPE wells (as necessary), temperature monitoring points, and a power delivery system and waste stream controls, but the equipment is also conventional and readily available.

8.7 Cost

Alternative 1 , with an estimated $0 cost, is the most economical options. Alternative 2 is the second least costly alternative with a present-worth cost estimate of $291,000. Alternative 5 is the costliest alternative with a present-worth cost estimate of $3,581,000. Alternative 3 is the least costly active remediation alternative with a present-worth cost estimate of $2,414,000.

8.8 State and Community Acceptance

The USEPA will evaluate the state and community acceptance criteria separately.

9 Green and Sustainable Remediation

The environmental benefits of the USEPA's preferred alternative may be enhanced by employing design technologies and practices that are sustainable in accordance with the USEPA Region 2's Clean and Green Energy Policy and the NYSDEC's Green Remediation Policy.

A summary of the GSR analysis is presented as a series of five bar charts presented below (**Figures 9-1 through 9-5**). These five charts highlight the impacts of four of the remedial alternatives, excluding No Action, regarding their green and sustainable implementation footprints. The results of the analysis are a relative comparison of the potential remedial alternatives developed for the AVX Property to promote consideration of GSR principles as part of the remedy selection process in consideration of DER-31. Beyond the standard feasibility criteria, the quantified sustainability assessment adds dimension in the evaluation and selection of a final remedy that incorporates the commonly accepted principles of GSR. In all instances, the analysis was performed with the fundamental assumption that the remedy must achieve the RGs identified for the AVX Property to be retained and qualify for further consideration.

The environmental impacts associated with the alternatives are directly affected by the impacts generated during implementation, the energy requirements for operation of the remedy, and the remedy lifetime. The comparative GSR analysis identifies Alternative 2 as the most sustainable of the alternatives considered. Alternative 2 presents the lowest energy, air emission, waste generation, and accident risk because it entails less energy requirements to implement than the other alternatives and uses existing infrastructure. For the remaining higher-footprint alternatives, Alternative 4 provides the more sustainable approach compared to Alternatives 3 and 5. Alternative 4 diverts waste through the reuse of slag as a soil solidification agent and has lower energy use, air emissions, and accident risk than Alternatives 3 and 5.

Incorporation of green best practices into the design and operation of a remedial activity can help achieve cleanup objectives by ensuring protectiveness while decreasing the environmental footprint of the cleanup activity itself. Consistent with the USEPA Principles for Greener Cleanups and DER-31, a qualitative analysis of the sustainable best management practices for the preferred remedy will be performed during the remedial design.

Additional detail on the GSR analysis is provided in **Appendix D**.

Figure 9-1. Total Estimated Green House Gas Emissions

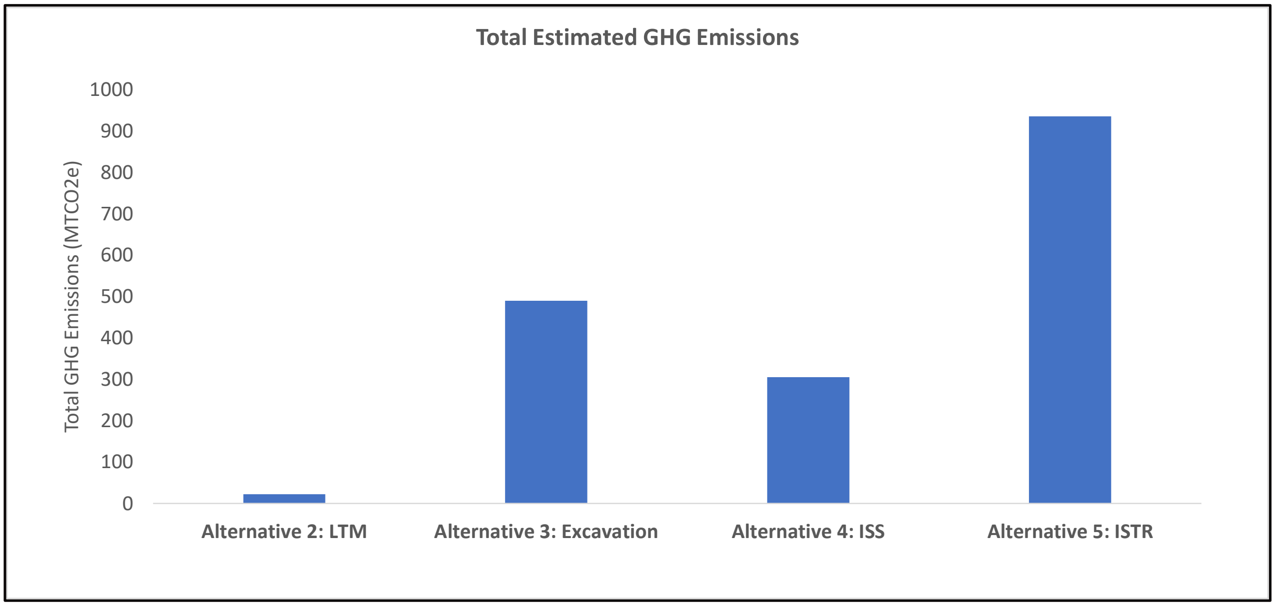


Figure 9-2. Total Estimated Energy and Electricity Usage

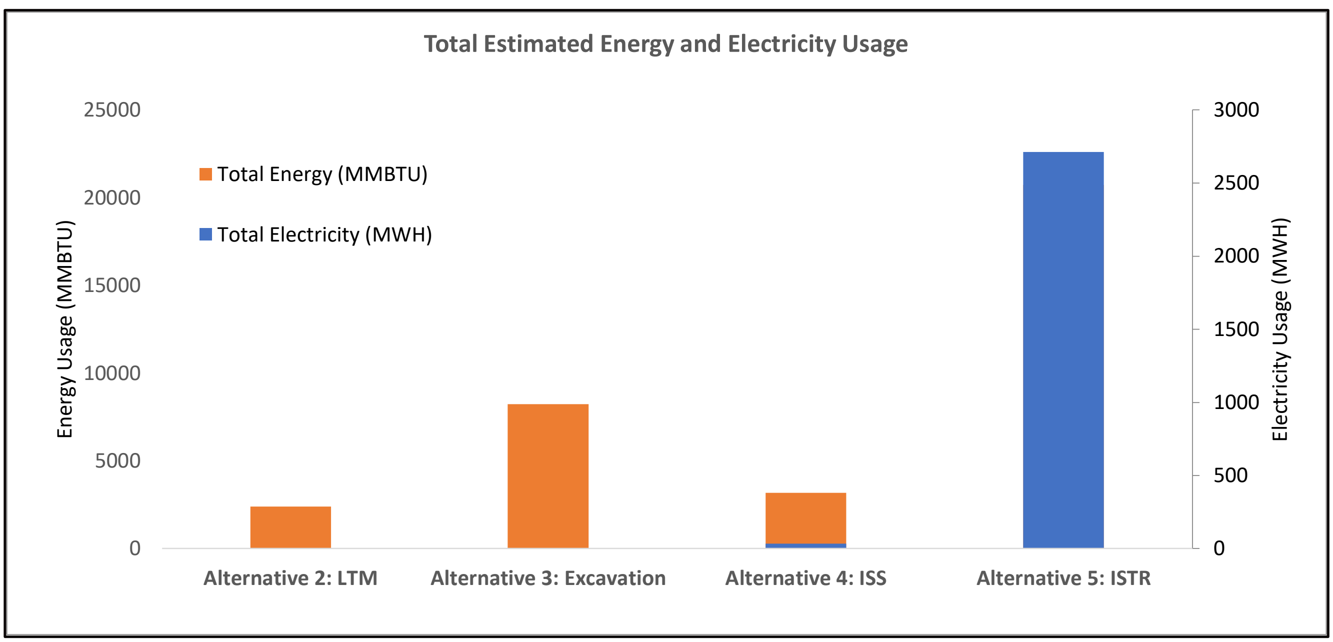


Figure 9-3. Total Estimated NOx, SOx, and PM_{10} Emissions

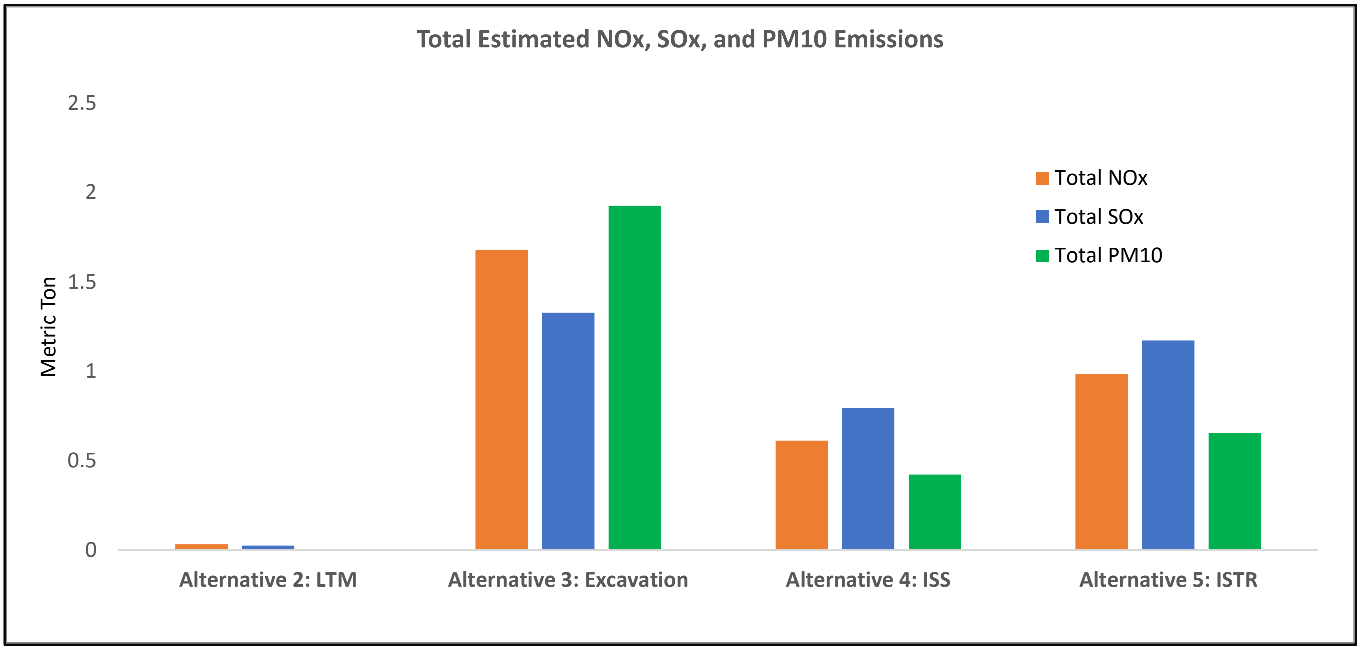


Figure 9-4. Total Estimated Water Usage

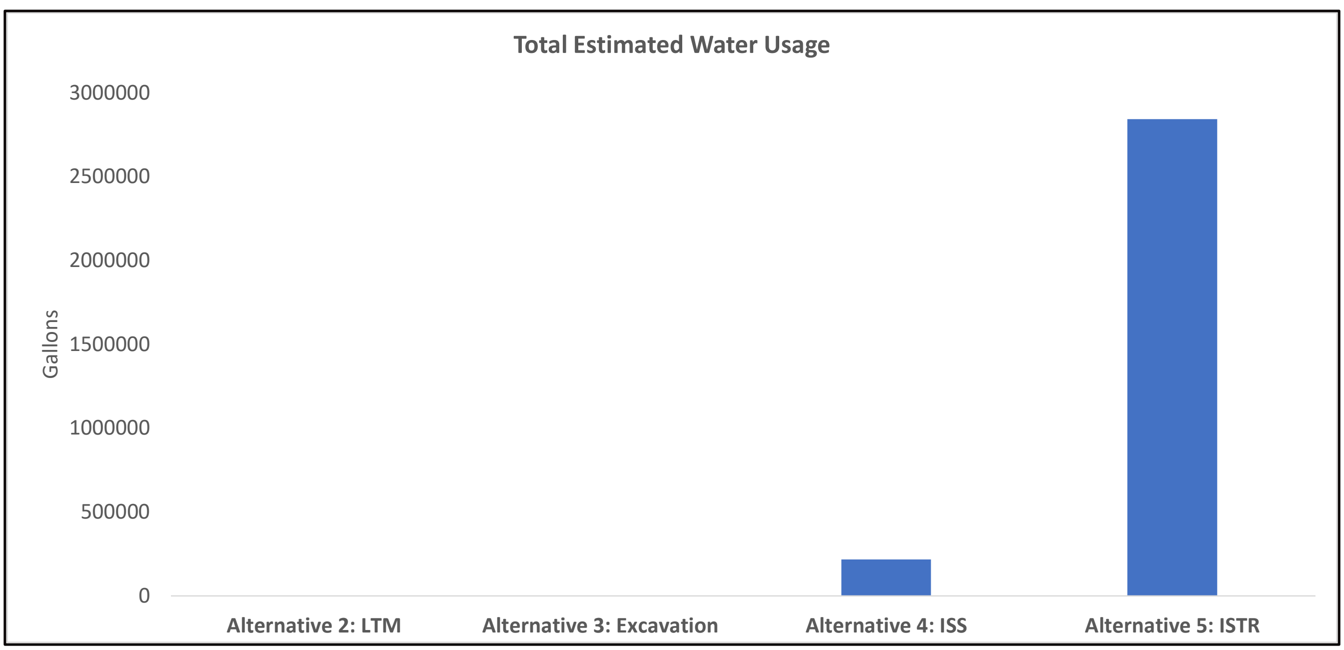
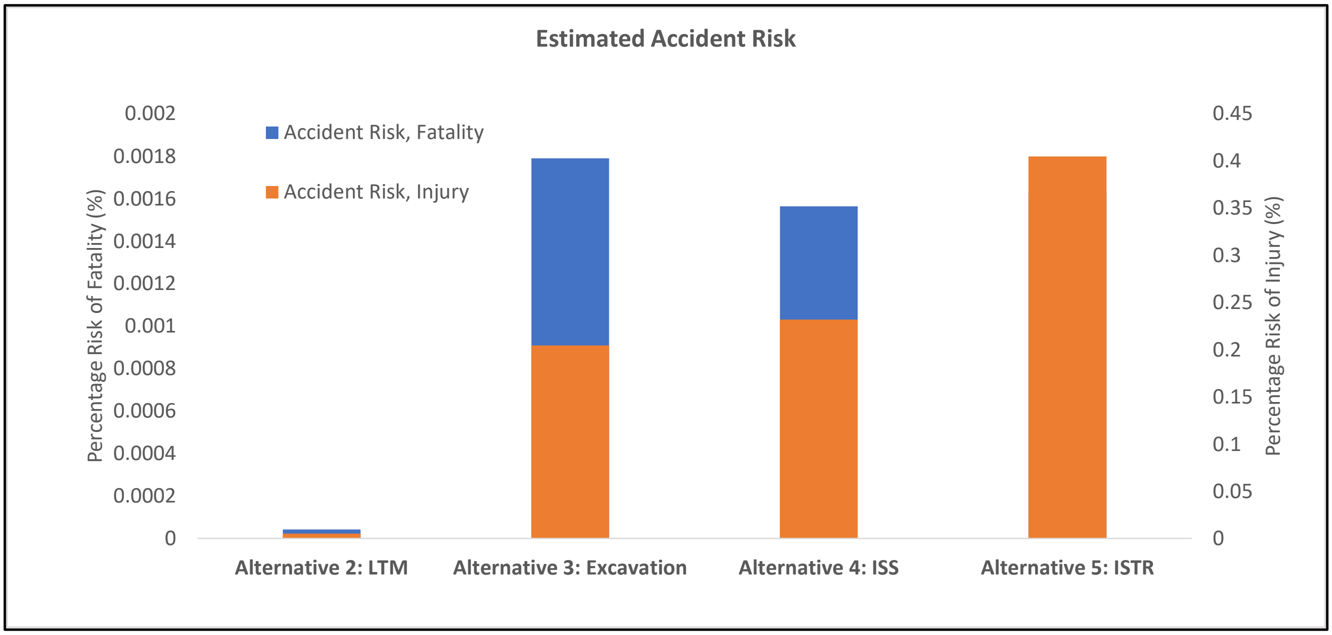


Figure 9-5. Estimated Accident Risk



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Tables

Table 3-1
Chemical-Specific ARARs, TBCs, and Other Guidelines Screening Table
Olean Well Field OU5 Superfund Site
KYOCERA AVX Components Corporation
Olean, New York

Media/Authority	Requirement	Requirement Synopsis	Consideration in the Feasibility Study
State Criteria, Advisories, and Guidance	New York Remedial Program Soil Cleanup Objectives (6 NYCRR Subpart 375-6.4 and 6.5), pursuant to the New York Environmental Conservation Law	Applies to the development and implementation of remedial programs for soil. Establishes numeric soil cleanup objectives both for unrestricted use and for restricted use for the protection of human health, the protection of ecological resources, and the protection of groundwater.	Provides soil cleanup objectives for constituents in soil for unrestricted and restricted use for the protection of human health and groundwater.
	NYSDEC Commissioner Policy - Soil Cleanup Guidance (CP-51), October 2010	This policy provides the framework and procedures for the selection of soil cleanup levels appropriate for each of the remedial programs in the NYSDEC Division of Environmental Remediation.	Provides a method for selecting appropriate soil cleanup levels.
	Sampling, Analysis, and Assessment of Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs, April 2023	This document summarizes currently accepted procedures and updates previous NYSDEC Division of Environmental Remediation technical guidance pertaining to PFAS to ensure consistency in sampling, analysis, reporting, and assessment of PFAS.	Provides Protection of Groundwater Soil Cleanup Guidance values for PFOA (0.8 ppb) and PFOS (1.0 ppb).
Federal Criteria, Advisories, and Guidance	USEPA RSLs for Chemical Contaminants at Superfund Sites (USEPA May 2023 and periodic updates)	Provides non-enforceable, generic, risk-based contaminant concentrations to be used for site "screening."	Provides screening levels for constituents in soil based on risk or potential migration to groundwater.

Notes:
ARAR = applicable or relevant and appropriate requirement
NYCRR = New York Codes, Rules, and Regulations
NYSDEC = New York State Department of Environmental Conservation
PFAS = per- and polyfluoroalkyl Substances
PFOA = perfluorooctanoic acid
PFOS = perfluorooctanesulfonic acid
ppb = parts per billion
RSL= Regional Screening Level
TBC = To Be Considered
USEPA = United States Environmental Protection Agency

Table 3-2
Location-Specific ARARs, TBCs, and Other Guidelines Screening Table
Olean Well Field OU5 Superfund Site
KYOCERA AVX Components Corporation
Olean, New York

Site Feature/Authority	Requirement	Requirement Synopsis	Consideration in the Feasibility Study
Wetlands and Floodplains			
State Criteria, Advisories, and Guidance	New York Regulations concerning Freshwater Wetlands (6 NYCRR Parts 663 and 665), pursuant to the New York Environmental Conservation Law	Regulations to ensure the preservation of New York regulated freshwater wetlands. Regulates activities that may adversely affect wetlands.	Remedial measures will be designed to mitigate adverse impacts on protected functions and achieve no net loss.
Federal Regulatory Requirements	Section 404(b)(1) of the Clean Water Act, 33 U.S.C. §1344 (Permits for Dredged or Fill Material); Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR Part 230); and Section 404(c) Procedures (40 CFR Part 231)	Under these requirements, no activity that adversely affects a CWA Section 404 wetland shall be permitted if a practicable alternative with lesser effects is available. Controls discharges of dredged or fill material to protect aquatic ecosystems.	Remedial measures will be designed to mitigate adverse impacts on protected wetlands and achieve no net loss.
	40 CFR Part 6, Appendix A - Statement of Procedures on Floodplain Management and Wetlands Protection (44 FR 64177, Nov. 6, 1976, as amended at 50 FR 26323, June 25, 1985)	Action to avoid, whenever possible, the long- and short-term impacts on wetlands and to preserve and enhance wetlands. Plans for action in federal wetlands must be submitted for public review.	All practicable means will be used to minimize harm to the wetlands. Wetlands disturbed by remedial activities will be mitigated in accordance with requirements.
		Action to avoid, whenever possible, the long- and short-term impacts associated with the occupancy and modifications of floodplains development, wherever there is a practical alternative. Promotes the preservation and restoration of floodplains so that their natural and beneficial value can be realized.	Federally regulated floodplains disturbed during remediation activities will be restored to their original or an improved condition and function.
	Fish and Wildlife Coordination Act (16 U.S.C. 661-668ee)	Any modification of a body of water that triggers a federal approval requires consultation with the U.S. Fish and Wildlife Service and the appropriate state wildlife agency to develop measures to prevent, mitigate, or compensate for losses of fish and wildlife. This requirement is addressed under CWA Section 404 requirements.	Impact on fish and wildlife will be incorporated into the planning and decision-making regarding remedial alternatives.

Table 3-2
Location-Specific ARARs, TBCs, and Other Guidelines Screening Table
Olean Well Field OU5 Superfund Site
KYOCERA AVX Components Corporation
Olean, New York

Site Feature/Authority	Requirement	Requirement Synopsis	Consideration in the Feasibility Study
Endangered Species			
Federal Regulatory Requirements	Endangered Species Act (16 U.S.C. 1531-1532, 1536, and 1538-1540; 50 CFR Part 402)	Requires actions to ensure the continued existence of any endangered or threatened species. Also requires that their habitats will not be jeopardized by a site action.	No endangered species have been identified at the site. However, before onsite habitat disturbance, consultation with federal agencies is recommended to ensure that remedial actions do not jeopardize the continued existence of any endangered or threatened species, or adversely modify or destroy critical habitat.
State Criteria, Advisories, and Guidance	6 NYCRR Parts 182.1-182.2, 182.5, 182.8-182.13, and 182.15-182.16 - Endangered and Threatened Species of Fish and Wildlife; Species of Special Concern: Incidental Take Permits, pursuant to the New York Environmental Conservation Law	Requires actions to ensure the continued existence of endangered or threatened species.	No endangered species have been identified at the site. However, before onsite habitat disturbance, determination as to whether the proposed activity is likely to result in the take or taking of any species listed as endangered or threatened may be requested to ensure that remedial actions do not jeopardize the continued existence of any endangered or threatened species, or adversely modify or destroy critical habitat.

Notes:
CFR = Code of Federal Regulations
CWA = Clean Water Act
FR = Federal Register
NYCRR = New York Codes, Rules, and Regulations
TBC = To Be Considered
U.S.C. = United States Code

Table 3-3
Action-Specific ARARs, TBCs, and Other Guidelines Screening Table
Olean Well Field OU5 Superfund Site
KYOCERA AVX Components Corporation
Olean, New York

Media/Authority	Requirement	Requirement Synopsis	Consideration in the Feasibility Study
Air			
Federal Regulatory Requirements	Clean Air Act - National Primary and Secondary Ambient Air Quality Standards (40 CFR Parts 50.1-50.3 and 50.6) and National Emission Standards for Hazardous Air Pollutants (40 CFR Parts 61.01 - 61.19)	Establishes air emissions limits for hazardous air pollutants.	Air emissions from remedial actions will meet the regulatory limits.
State Criteria, Advisories, and Guidance	New York Air Pollution Control Regulations: 6 NYCRR Part 200 (General Provisions); 6 NYCRR Part 201 (Permits and Registrations); 6 NYCRR Part 202 (Emissions Verification); 6 NYCRR Part 211 (General Prohibitions); 6 NYCRR Part 256 (Air Quality Classifications System); 6 NYCRR Part 257 (Air Quality Standards); 6 NYCRR Part 263 (Air Quality Regulations for Cattaraugus County); all pursuant to the New York Environmental Conservation Law	Prohibits emissions of any contaminant that may become injurious to human, plant, or animal life. Provides emission standards. Describes applicable permits.	Air emissions from remedial actions will meet the regulatory limits.
	NYSDEC DAR-1 (formerly Air Guide 1) - Guidelines for the Evaluation and Control of Ambient Air Contaminants Under 6 NYCRR Part 212 (NYSDEC DAR, February 2021) and 6 NYCRR Part 212 - Process Operations	This policy outlines the procedures for evaluating the emissions of criteria and non-criteria air contaminants from process operations in New York State. Process emission sources refer to the equipment at manufacturing facilities that result in the release of air contaminants during operation.	Air emissions from remedial actions will meet the levels in these guidelines.
	NYSDOH - Generic Community Air Monitoring Plan (DER-10, Appendix 1A)	Provides a generic plan for monitoring of air quality during remedial construction.	Any remedial alternatives that involve soil intrusive activities will comply with these guidelines.
Surface Water			
Federal Regulatory Requirements	Federal National Pollutant Discharge Elimination System Regulations (40 CFR Part 122 and 125)	Federal water quality standards/pollutant effluent discharge standards.	Treated water discharged to surface water during remedial activities will meet the substantive requirements of these regulations.
State Criteria, Advisories, and Guidance	State Pollutant Discharge Elimination System Regulations (6 NYCRR Part 750), pursuant to Article 17 of the New York Environmental Conservation Law (Consolidated Laws of New York, Chapter 43-B, Article 17), New York State Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations (6 NYCRR Part 703), and New York State Division of Water Technical and Operational Guidance Series (TOGS) Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (TOGS 1.1.1)	Establishes state water quality standards/pollutant effluent discharge standards.	Treated water discharged to surface water or groundwater during remedial activities will meet the substantive requirements of these regulations.
Waste			

Table 3-3
Action-Specific ARARs, TBCs, and Other Guidelines Screening Table
Olean Well Field OU5 Superfund Site
KYOCERA AVX Components Corporation
Olean, New York

Media/Authority	Requirement	Requirement Synopsis	Consideration in the Feasibility Study
Federal Regulatory Requirements	RCRA 40 CFR Part 261.30-261.31 and 261.170-261.179 (Identification and Listing of Hazardous Waste), 40 CFR Part 262.11, 262.13, 262.18, 262.40, 262.44 and subparts B, C, and H (Standards Applicable to Generators of Hazardous Waste); and 40 CFR Part 263.10-263.12, 263.20-263.22 and 263.25 Standards Applicable to Transporters of Hazardous Waste	Defines waste that are subject to regulation as hazardous waste under 40 CFR Parts 262-264. Defines regulations applicable to generators and transporters of hazardous waste.	If remedial alternatives require excavation of waste, management approaches for listed and characteristic waste, if encountered, will be met. If hazardous waste will be generated, stored, or transported, these standards will apply.
	USDOT Rules for Transportation of Hazardous Materials (49 CFR Parts 107, 171, 172, 177, 179)	Outlines procedures for the packaging, labeling, manifesting, and transporting of hazardous materials.	If remedial alternatives require excavation of waste and the hazardous waste will be transported, these rules will apply.
State Criteria, Advisories, and Guidance	New York Solid Waste Management Regulations (6 NYCRR Part 360)	Establishes standards and criteria for solid waste management operations. Regulations apply to land disposal of non-hazardous wastes.	Management and treatment of onsite remediation-derived waste will comply with these regulations.
	New York Hazardous Waste Management Regulations (6 NYCRR Parts 370-376)	Establishes criteria for identifying and handling hazardous waste. Regulations apply to owners and operators of facilities that treat, store, or dispose hazardous wastes.	Management and treatment of onsite remediation-derived waste will comply with these regulations.
	New York State Waste Transporter Regulations (6 NYCRR Part 364)	Establishes permit requirements for transportation of regulated waste.	If remedial alternatives require excavation of regulated waste and the waste will be transported, these regulations will apply.
	New York State Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities (6 NYCRR Part 372)	Establishes record keeping requirements and standards related to the manifest system for hazardous wastes.	If remedial alternatives require excavation of regulated waste and the waste will be transported, these regulations will apply.
General			
Federal Regulatory Requirements	Federal Underground Injection Control Regulations (40 CFR Parts 144 -148)	These regulations set forth the federal requirements for controlling underground injections.	All underground injection actions will comply with the regulations.
Federal Criteria, Advisories, and Guidance	USEPA Region 2 Clean and Green Policy	Establishes preferences for sustainable technologies and practices for federal cleanup programs.	To be considered in the selection of remedial alternatives.
	Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites (OSWER Directive 9200.4-17P) (1999)	Provides guidance on how the USEPA will implement national policy on the use of monitored natural attenuation.	Decisions on use and efficacy of monitored natural attenuation will be consistent with guidance.
State Criteria, Advisories, and Guidance	NYSDEC DER Green Remediation (DER-31, January 2011)	Defines "green remediation" and identifies the NYSDEC's approach to implementing green remediation.	To be considered in the selection of remedial alternatives.
	NYSDEC Groundwater Monitoring Well Decommissioning Policy (CP-43, November 2009)	Provides the procedures for decommissioning groundwater monitoring wells.	Any monitoring wells to be decommissioned will be abandoned pursuant to this policy.

Notes:
CFR = Code of Federal Regulations
DAR - Division of Air
DER = Division of Environmental Remediation
NYCRR = New York Codes, Rules, and Regulations
NYSDEC = New York State Department of Environmental Conservation
OSWER = Office of Solid Waste and Emergency Response
RCRA = Resource Conservation and Recovery Act
RSL = Regional Screening Level
TOGS = Technical and Operational Guidance Series
TBC = To Be Considered
USEPA = United States Environmental Protection Agency
WQC = Water Quality Criteria

Table 4-1
Initial Screening of Potentially Applicable Technologies and Process Options for Soil
Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

General Response Action	Technology Type	Process Option	Description	Retained? (Yes/No)	Initial Screening
No Action	None	None	Not Applicable	Yes	Retain: Required by National Contingency Plan and the United States Environmental Protection Agency guidance as a baseline for comparison to other process options.
Institutional Controls	Access Restrictions	Deed Restrictions	Deed restrictions issued for property in potentially contaminated areas to control land use.	Yes	Potentially implementable. Institutional controls are usually used in conjunction with other technology types.
		Fencing	Fencing will minimize access to impacted soils.	No	Minimal additional benefit because of already acceptable risk due to limited direct contact exposure above that which will result from implementation of deed restrictions or an environmental covenant.
Containment	Surface Cover	Asphalt/Concrete Paving/Clean Soil	Exposure barrier reduces the likelihood of direct contact exposure to COCs	Yes	Potentially implementable: Currently part of the interim soil remedy.
	Capping/Cover	Low-Permeability (i.e., Resource Conservation and Recovery Act) cover	Low-permeable cap placed over impacted areas.	Yes	Potentially implementable. Would reduce contaminant migration to groundwater.
Removal	Excavation	Offsite Landfill Disposal	Physical removal of impacted soil with offsite disposal.	Yes	Potentially implementable for targeted areas. Some limitations to excavation depths due to shallow groundwater. Excavation/backfill remedy could increase vertical permeability and COC flux compared with the naturally low vertical permeability and low flux in the till.
		Offsite Incineration/Thermal Desorption	Physical removal of impacted soil with offsite thermal treatment and disposal.	Yes	Potentially implementable for targeted areas. Some areas may have limited to difficult excavation accessibility due to water, although engineering measures could be implemented to excavate below the water table. Some dewatering may be required. Could be some enhanced downward migration of COCs during excavation.
In Situ Treatment	Natural Attenuation	Long-Term Monitoring	Natural processes, such as volatilization, biodegradation, and chemical reactions are allowed to reduce contaminant concentrations to acceptable levels.	Yes	Potentially implementable. Long-term monitoring is usually used in conjunction with other technology types for remedial actions.
	Biological Treatment	Phytoremediation	Uses plants to potentially remove, transfer, stabilize, and destroy COCs in soil.	Yes	Potentially implementable.
	Chemical/Biological Treatment	Enhanced Anaerobic Degradation	The injection of a substrate to stimulate microorganisms to degrade COCs.	No	Not technically implementable due to the low-permeability of the till unit as indicated by previous injection testing and concern with increasing hydraulic conductivity of source zone for direct- push injection techniques. In addition, if higher pressure injection and hydraulic fracturing was performed to distribute chemical/biological solid substrates, permeability may be enhanced, increasing the chance of downward migration of COCs. This initial screening is the same as presented in the 2020 Feasibility Study Work Plan (Arcadis 2020b).

Table 4-1
Initial Screening of Potentially Applicable Technologies and Process Options for Soil
Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

General Response Action	Technology Type	Process Option	Description	Retained? (Yes/No)	Initial Screening
In Situ Treatment (cont.)	Chemical Treatment	Chemical Oxidation/Reduction	Use of chemical oxidant (e.g., ozone, hydrogen peroxide, persulfate, and permanganate) or reductant (e.g., ZVI) to oxidize or reduce COCs in situ.	No	Not technically implementable due to the low-permeability of the till unit as indicated by previous injection testing, and concern with increasing hydraulic conductivity of source zone for direct- push injection techniques. In addition, if higher pressure injection and hydraulic fracturing was performed to distribute chemical agents, permeability may be enhanced, increasing the chance of downward migration of COCs.
	Physical/Chemical Treatment	In Situ Stabilization with Portland Cement or Bentonite + ZVI	The mixing of a reactive media (ZVI) and stabilizing agents (bentonite and/or cement) to soils using conventional soil mixing equipment to decrease concentrations of contaminants and reduce the hydraulic conductivity of the treated zone.	Yes	Potentially implementable for targeted areas, although hydraulic conductivity already low. ISS would reduce hydraulic conductivity of any sandy stringers, if encountered within the otherwise low-permeability till.
	Physical Extraction	Conductive or Electrical Resistivity Heating with Soil Vapor Extraction	The use of in situ electrodes or heater wells to desorb and volatilize contaminants in situ for removal with soil vapor extraction.	Yes	Potentially implementable. Retained as an aggressive technology for source removal.
		Multiphase Extraction	Utilizes vacuum extraction to physically remove and capture from the subsurface.	Yes	Potentially implementable for targeted saturated areas with higher soil permeability.
Ex Situ Treatment	Physical Treatment	Soil Washing	Contaminants are removed from the soil by washing and the soil can be reused.	No	Not implementable due to low-permeability of soils.
		Stabilization/Soil Mixing	Contaminants are immobilized by aboveground mixing with cement or fly ash or other stabilizing agents and the mixture can be returned to an open excavation or used in concrete or asphalt construction.	Yes	Potentially implementable for targeted areas. Some areas may have limited to difficult excavation accessibility due to shallow depth to water.
		Onsite Incineration	Soils incinerated at high temperatures.	Yes	Potentially implementable for targeted areas. Some areas may have limited to difficult excavation accessibility due to shallow depth to water. Retained as an aggressive technology for complete source removal/treatment.
	Chemical Treatment	Chemical Oxidation	Use of chemical oxidant (ozone, hydrogen peroxide, persulfate, and permanganate) to oxidize COCs.	No	Not implementable due to low-permeability soils.

Notes:
Shading indicates that the process option was eliminated during the initial screening stage.
COC = constituent of concern
ISS = in situ soil solidification/stabilization
ZVI = zero-valent iron

Table 4-2
Secondary Screening of Potentially Applicable Technologies and Process Options for Soil
Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

General Response Action	Technology Type	Process Option	Effectiveness	Implementability	Cost	Comments
No Action	None	None	Not Applicable	High	Not Applicable	Retain: Required by National Contingency Plan and the United States Environmental Protection Agency guidance as a baseline for comparison to other process options.
Institutional Controls	Access Restrictions	Deed Notification/ Restrictions	Moderate. Effective for protection of potential receptors by reducing potential for exposure in the event of building or surface cover removal, but does not reduce COPC concentrations or migration.	High	Low	Retain. To be considered in conjunction with other technologies.
Containment	Surface Cover	Asphalt/Concrete Paving	Moderate: Does not reduce contaminant mass or volume, but does reduce contaminant migration to groundwater and reduces potential for receptor exposure.	High: Maintains the surface cover that is already in place.	Low: Low O&M costs	Retain: Conventional technology to be considered in conjunction with other technologies.
	Capping	Low-Permeability (i.e., Resource Conservation and Recovery Act) Cap	Low: Does not reduce contaminant mass or volume and would likely only marginally reduce the contaminant migration to groundwater given the already low till soil permeability. In addition, much of the Source Area soil is saturated. A cap would reduce the potential for receptor exposure, although direct contact exposure is already minimal.	Moderate: Much of the Source Area soil is saturated. May restrict future site uses for areas that are accessible.	Moderate: Moderate capital costs; low O&M costs.	Do not retain: The relatively effectiveness is too low to consider with significant potential impact to property reuse.
Removal	Excavation	Offsite Landfill Disposal	High: Permanently removes source mass and contaminated soil. Would prevent receptor contact and prevent leaching of contaminants from source areas.	Moderate to Low: Most of the soil Source Area will be accessible for excavation following building demolition. A portion of the concrete slab, which otherwise is to remain, will have to be removed to allow excavation. Implementability may be impacted at depths greater than 20 feet due to COCs in the saturated zone. May also enhance downward migration of COCs during excavation activities.	Moderate to high with cost affected by amount of water handling required and depth of COCs/excavation.	Retained given that the building has been demolished so that targeted soil removal could be performed, at least above the water table and possibly below the water table if water entering excavation is minimal, although engineering measures could be implemented to excavate below the water table. Investigation in the Source Area has provided some insight on the amount of water that may be encountered during excavation.
		Offsite Incineration/Thermal Desorption	High: Permanently removes source mass and contaminated soil. Would prevent receptor contact and prevent leaching of contaminants from source areas.	Moderate to Low: Most of the soil Source Area will be accessible for excavation following building demolition. A portion of the concrete slab, which otherwise is to remain, will have to be removed to allow excavation. Implementability may be impacted at depths greater than 20 feet due to COCs in the saturated zone.	High: Higher than for just landfill disposal and cost also affected by amount of water handling required and on depth of COCs/excavation.	Do not retain: More expensive primary alternative to excavation and landfilling and with no improvement on implementability or effectiveness. Landfill disposal restrictions may require some incineration to meet landfill permit conditions.

Table 4-2
Secondary Screening of Potentially Applicable Technologies and Process Options for Soil
Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

ARCADIS

General Response Action	Technology Type	Process Option	Effectiveness	Implementability	Cost	Comments
In Situ Treatment	Natural Attenuation	Long-Term Monitoring	Low to moderate: Will not prevent receptor exposure or leaching to groundwater, but will have gradual reductions in contaminant volume and toxicity.	High	Low	Retain: Conventional technology to be considered in conjunction with other technologies.
	Biological Treatment	Phytoremediation	Low: Reduces contaminant volume and potential for leaching to groundwater but has limited effect on soil at greater depths. Not a good primary technology but may be a natural process fostered in the currently vegetated southern portion of the Source Area.	Low: Much of the soil source is currently under cover that would likely need to be maintained	Low: Low capital costs and low O&M costs.	Do not retain: Not expected to be effective as a primary technology to address more deeply impacted Source Area soil.
	Physical/Chemical Treatment	In Situ Stabilization with Bentonite and ZVI or with Portland Cement	Moderate: Effective for remediation of VOCs in source soils, ZVI will decrease the concentrations of contaminants while the bentonite will reduce the potential for contaminants leaching to groundwater.	Moderate: May require permit for ZVI inclusion. May be challenging to implement on steeper slopes on the southern portion of the Source Area.	Moderate: Low costs if applied directly in open excavation, moderate to high costs if injected from surface.	Retain: Will evaluate via bench-scale studies to assess effectiveness.
In Situ Treatment	Physical Extraction	Conductive or Electrical Resistivity Heating with Soil Vapor Extraction	Moderate to high: Would increase volatilization of COPCs in source soil. Low-permeability soil layers present at the site would be suited to ERH.	Moderate: Proven technology for removal of VOCs. Vapor capture of the volatilized compounds is required, the limited vadose zone and high water table may create challenges with short-circuiting.	Moderate to High: Moderate capital costs and low O&M costs (less than 6 months of O&M).	Retain: An aggressive technology for complete source removal.
		Multiphase Extraction	Moderate: Effective for removal of contaminant mass from high mass flux zones, but back diffusion from low-permeability matrix may necessitate a long treatment timeframe.	Moderate: Will include the installation of wells and trenching, and a continuously operating system.	Moderate: Moderate capital costs; moderate O&M costs.	Do Not Retain: Not expected to be effective as a primary technology for Source Area soil. However, vapor extraction is likely to be a key component of the thermal alternative.
Ex Situ Treatment	Physical Treatment	Onsite Incineration	High: Permanently removes source mass and contaminated soil. Would prevent receptor contact and prevent leaching of contaminants from source areas.	Moderate to Low: Most of the soil Source Area will be accessible for excavation following building demolition. A portion of the concrete slab, which otherwise is to remain, will have to be removed to allow excavation. Implementability may be impacted at depths greater than 20 feet due to COCs in the saturated zone.	High: Higher than for just landfill disposal and cost also affected by amount of water handling required and on depth of COCs/excavation.	Do not retain: More expensive primary alternative to excavation and landfilling and with no improvement on implementability or effectiveness. Landfill disposal restrictions may require some incineration to meet landfill permit conditions.
		Stabilization/Soil Mixing	Moderate: Hydraulic conductivity is already low, but would further reduce the potential for leaching to groundwater. Does not permanently remove source mass.	Moderate to Low: Most of the soil Source Area will be accessible for excavation following building demolition. A portion of the concrete slab, which otherwise is to remain, will have to be removed to allow excavation. Implementability may be impacted at depths greater than 20 feet due to COCs in the saturated zone.	High: Higher than for just landfill disposal and cost also affected by amount of water handling required and on depth of COCs/excavation.	Do not retain: More expensive primary alternative to excavation and landfilling and with no improvement on implementability or effectiveness.

Notes:
Shading indicates that the process option was eliminated during the screening stage.
COC = constituent of concern
COPC = constituent of potential concern
ERH = electrical resistance heating
KAVX = KYOCERA AVX Components Corporation
O&M = operation and maintenance
VOC = volatile organic compound
ZVI = zero-valent iron

Table 7-1
Summary of Remedial Alternatives Selected for Detailed Evaluation
Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Remedial Alternative	Description	Media	COCs
Remedial Alternative 1	No Action	Targeted Source Area Soil	VOCs
Remedial Alternative 2	Long-Term Monitoring with Institutional Controls and Surface Cover Maintenance	Targeted Source Area Soil	VOCs
Remedial Alternative 3	Excavation with Institutional Controls and Surface Cover Maintenance	Targeted Source Area Soil	VOCs
Remedial Alternative 4	ISS with Institutional Controls and Surface Cover Maintenance	Targeted Source Area Soil	VOCs
Remedial Alternative 5	ISTR with Institutional Controls and Surface Cover Maintenance	Targeted Source Area Soil	VOCs

Notes:
COC = constituent of concern
ISS = in situ solidification
ISTR = in situ thermal remediation
VOC = volatile organic compound

Table 7-2
Summary of Detailed and Comparative Analysis of Source Area Remedial Alternatives
Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

ARCADIS

Evaluation Criteria		Alternative 1 No Action	Rating	Alternative 2 Long-Term Monitoring	Rating	Alternative 3 Excavation	Rating	Alternative 4 ISS	Rating	Alternative 5 ISTR	Rating
Threshold Criteria											
1)	Overall protection of human health and the environment	Does not further minimize, reduce, or control COCs in targeted area of soil remediation or provide measures to control potential leaching or migration. Soil RAOs may be met by natural processes but specific monitoring to document the achievement of RAOs would not be performed.	0	Protective of human health and the environment by documenting removal of COCs by natural processes. Controls some potential leaching of COCs from targeted area of soil remediation to groundwater by maintaining the existing surface cover. Soil RAOs would be met by natural processes.	2	Protective of human health and the environment by eliminating potential exposure to COCs in the targeted area of soil remediation through complete removal. Prevents future COC migration and reduces COC concentrations in soil. Soil RAOs would be met.	4	Protective of human health and the environment by controlling potential exposure to COCs in the targeted area of soil remediation. Provides substantial reduction of the mobility of COCs and controls potential leaching of COCs in soil solidified within the monolith to groundwater. Soil RAOs would be met.	3	Protective of human health and the environment by reducing potential exposure to COCs in the targeted area of soil remediation. Prevents future COC migration and reduces COC concentrations in soil. Soil RAOs would be met. Would likely leave small residual concentrations of COCs in soil following completion of ISTR implementation.	3
2)	Compliance with ARARs	Does not control potential exposure pathways or address existing COC concentrations. No action- or location-specific ARARs.	0	Controls some potential leaching of COCs from soil to groundwater.	2	Complies with ARARs.	5	Complies with ARARs.	5	Complies with ARARs.	5
Balancing Criteria											
3)	Long-term effectiveness and permanence	Not effective or permanent. Potential exposure risks associated with COCs in soil would remain with no controls or long-term management plan.	0	Groundwater monitoring indicates that significant reductive dechlorination of COCs is occurring naturally on the KAVX Property.	2	Effective and permanent removal of COCs from soil. Decline in COCs in downgradient groundwater would be documented. Clean fill may become recontaminated by groundwater re-entering the lower portion of the excavation area.	5	Effective and permanent stabilization of treated soil would minimize further potential leaching of COCs from soil. Decline in COCs in downgradient groundwater would be documented. No data available to document very long term integrity of the solidified mass (i.e., many decades in the future).	3	Effective and permanent for removal of COCs from soil. Decline in COCs in downgradient groundwater would be documented.	4
4)	Reduction of mobility, toxicity, or volume	COCs in soil would continue to leach to groundwater and migrate.	0	Does not provide an active treatment component; maintaining the existing surface structures will control potential leaching of COCs in soil to groundwater but those same surface structures will also limit the reduction of residual COCs concentrations that may be a benefit from increased flushing.	3	Aggressively and permanently reduces volume of COCs in targeted area of soil remediation through removal although that mass and volume would be transferred to a managed landfill. The most aggressive remedy.	5	Reduces mobility of COCs in solidified soils but COCs remain in the solidified mass.	4	Aggressively and permanently reduces volume of COCs in targeted area of soil remediation. COCs will be destroyed through thermal treatment and collected liquids and vapors discharged under permits.	4
5)	Short-term effectiveness	No activities would be implemented that would present potential short-term exposure risks to human health or the environment.	5	Limited activities (groundwater monitoring) result in minimal short-term exposure risks that would be managed through engineering controls and safe working procedures by qualified personnel. Downgradient groundwater is being contained by the hydraulic extraction trench, preventing migration to downgradient areas that may impact workers, adjacent populations, or the environment.	5	Short duration of construction activities (excavation) results in short-term exposure risks and impacts to workers, adjacent populations (through increased truck traffic), or the environment that would be managed through engineering controls and worker training. Additionally, excavation results in relocation of contamination rather than remediation on site.	3	Short duration of construction activities (soil mixing) results in limited short-term exposure risks and impacts to workers, adjacent populations, or the environment that would be managed through engineering controls and worker training.	3	Construction and treatment activities result in limited short-term exposure risks and impacts to workers, adjacent populations, or the environment that would be managed through engineering controls and worker training. Additional electric and thermal working hazards would also be managed through engineering controls and worker training.	4
6)	Implementability	Technically feasible because no technical components are necessary. However, likely not administratively feasible as there would be no controls on exposure to COCs in the targeted area of soil remediation.	2	Long-term monitoring and maintenance of existing surface structures are highly implementable. Long-term groundwater monitoring is already implemented as a component of the KAVX OU-2 groundwater containment remedy. Administrative feasibility is high because downgradient groundwater is being contained and treated.	5	Technically and administratively feasible. Long-term groundwater monitoring is already implemented as a component of the KAVX OU-2 groundwater containment remedy.	4	Technically and administratively feasible. Long-term groundwater monitoring is already implemented as a component of the KAVX OU-2 groundwater containment remedy.	4	Technically and administratively feasible. Long-term groundwater monitoring is already implemented as a component of the KAVX OU-2 groundwater containment remedy.	4
7)	Cost	Capital Costs: $0 Annual Maintenance (30 years): $0 Total O&M Costs:$0 Total Present Value Cost: $0	5	Capital Costs: $44,000 Annual Maintenance (30 years): $450,000 Total O&M Costs: $117,000 Total Present Value Cost: $291,000	4	Capital Costs: $2,228,000 Annual Maintenance (30 years): $450,000 Total O&M Costs: $0 Total Present Value Cost: $2,414,000	3	Capital Costs: $2,715,000 Annual Maintenance (30 years): $450,000 Total O&M Costs: $0 Total Present Value Cost: $2,901,000	2	Capital Costs: $3,395,000 Annual Maintenance (30 years): $450,000 Total O&M Costs: $0 Total Present Value Cost: $3,581,000	1
Other Criteria											
	Green and Sustainable Remediation	No action by its nature will have no GHG and other emissions, will require no energy or water use and will carry no risk for accidents.	5	Outside of No Action, Long-Term Monitoring has the lowest potential for GHG emissions and other emissions (NOx, SOx and PM10), relatively low energy and water use and a low potential to contribute to accidents.	4	The excavation remedial alternative has the largest potential NOx/SOx/PM10 emissions of all the alternative and relatively high estimated GHG emissions, energy usage, and risk for accidents (particularly fatalities). Excavation does have a low water usage impact although water usage in the northeast US is far less of a concern than in other parts of the country.	2	Of the more active remedial alternatives, ISS has the lowest expected GHG and NOx/SOx/PM10 emission, energy usage and accident risk but has a modestly small expected water usage.	3	ISTR has the highest GHG emissions, water usage, and power usage of all the alternatives and a relatively high accident risk. ISTR has the highest energy requirement during implementation due to the high electrical power demand. Again, water usage impact within areas of the northeast US is far less of a concern than in other parts of the country.	2
Screening Score Summary											
			17		**27**		**31**		**27**		**27**

Notes:
All costs are estimated to an accuracy of +50% to -30% (USEPA 2000). Cost estimates were prepared in 2023 and are expressed in 2023 dollars.
ARAR = applicable or relevant and appropriate requirement
COC = constituent of concern
KAVX = KYOCERA AVX Components Corporation
O&M = operation and monitoring
OU-2 = Operable Unit 2
RAO = remedial action objective
USEPA = United States Environmental Protection Agency
GHG = Green House Gas
SOx = Sulfur Oxides
NOx = Nitrogen Oxides

Rating categories for Threshold and Balancing and Other Criteria (Excluding Cost):
(0) None
(1) Low
(2) Low to moderate
(3) Moderate
(4) Moderate to high
(5) High

Table 7-3
Summary of Comparative Analysis of Source Area Remedial Alternative Costs
Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Remedial Alternative	Description	Present Value 30-Year Life Cycle ($)
Remedial Alternative 1	No Action	$0
Remedial Alternative 2	Long-Term Monitoring with Institutional Controls and Surface Cover Maintenance	$291,000
Remedial Alternative 3	Excavation with Institutional Controls and Surface Cover Maintenance	$2,414,000
Remedial Alternative 4	ISS with Institutional Controls and Surface Cover Maintenance	$2,901,000
Remedial Alternative 5	ISTR with Institutional Controls and Surface Cover Maintenance	$3,581,000

Notes:
Assumes a project life of 30 years. A 7% discount rate was applied per A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002 OSWER 9355.0-75; July 2000.
All costs are rounded to the nearest $1,000.
All costs are based on an accuracy of +50/-30% (USEPA 2000).

Table 7-4
Screening of Source Area Remedial Alternative 1: No Action
Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Synopsis: Under this alternative, no further action would be taken to address constituents of concern (COCs) within the area targeted for source soil remediation.

Effectiveness	Implementability	Cost
Advantages		
Natural attenuation processes would continue to slowly reduce concentrations of COCs in soil (through leaching and diffusion).	Easily implemented.	No capital or operation and maintenance (O&M) costs would be required.
Disadvantages		
Little or no further reduction in COC mobility, toxicity, or volume in the short term. COCs in soil would continue to leach to till unit groundwater. The underlying City Aquifer is used as a public water supply. May limit future land use. Not further protective of human receptors. No monitoring would be done to evaluate changes in risks or determine when remedial goals are met.	May require future remedial action.	May defer and increase eventual future capital and O&M expenditures if future remediation is required.

Conclusion: The No Action Alternative would not achieve the remedial action objectives. It is retained as a baseline for comparison to the remaining alternatives as is required by the National Contingency Plan.

Table 7-5
Screening of Source Area Remedial Alternative 2: Long-Term Monitoring
Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Synopsis: Under this alternative, long-term monitoring would be used to document the natural decline of constituents of concern (COCs) via natural processes. Maintenance of the existing surface covers (concrete slab floor, pavement, and vegetative cover) would be conducted to reduce potential leaching of COCs already in soil to till unit groundwater. Deed notifications/restrictions would be implemented to reduce the potential for future receptor access in the event of surface cover removal.

Effectiveness	Implementability	Cost
Advantages		
Natural attenuation processes already historically demonstrated to be reducing COC concentrations over time in KAVX Property groundwater. Maintaining surface covers will reduce water infiltration and control potential leaching of COCs in soil to groundwater. Would reduce the potential for future receptor access through deed notification/restrictions.	Groundwater monitoring for monitored natural attenuation (MNA) assessment is already being implemented as a component of the KAVX Property, Operable Unit 2, groundwater containment remedy. Conventional technology to install and sample new groundwater monitoring wells.	Low. Provides for long-term planning of predictable monitoring and maintenance costs.
Disadvantages		
The time to achieve remediation goals will be longer than for active remediation alternatives.		Long-term groundwater sampling and analysis, cover maintenance, and inspection monitoring costs.

Conclusion: In combination with the already implemented groundwater containment remedy, this alternative would achieve the remedial action objectives of mitigating COC concentrations within the historical source areas. This alternative is retained for detailed analysis.

Table 7-6
Screening of Source Area Remedial Alternative 3: Excavation
Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Synopsis: Under this alternative, excavation of unsaturated targeted Source Area soils would be implemented to remove constituents of concern (COCs) and reduce further leaching of COCs to groundwater beneath and downgradient of the area targeted for source soil remediation.

Effectiveness	Implementability	Cost
Advantages		
Would remove COCs in soil within the targeted area of source soil remediation over a short timeframe and reduce leaching of COCs to underlying and downgradient groundwater. Provides long-term protection.	Conventional proven technology. Services and materials are readily available.	Low to no operation and monitoring costs.
Disadvantages		
Relies solely on removal to mitigate potential exposures to impacted media. Does not destroy COCs.	Potential short-term risks to remedial workers and the public from exposure to impacted soil and groundwater during soil excavation, offsite transportation and disposal of excavated material, and backfilling. Potential short-term risks from construction equipment operation and generation of noise and dust. Any fill used will likely have significantly higher permeability than the existing native silts and clays that will be removed, and therefore, there is the potential for increased infiltration and the vertical component of groundwater flow.	High capital costs associated with excavation and offsite disposal. Offsite disposal of excavated material and import of backfill would be required.

Conclusion: This alternative would achieve the remedial action objectives of mitigating COC concentrations in the targeted area for source soil remediation and minimizing further migration of the COCs to underlying and downgradient groundwater. This alternative is retained for detailed analysis.

Table 7-7
Screening of Source Area Remedial Alternative 4: ISS
Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Synopsis: Under this alternative, in situ soil solidification (ISS) of targeted Source Area soils would be implemented to reduce constituent of concern (COC) concentrations and minimize further leaching of COCs to groundwater beneath and downgradient of the area targeted for source soil remediation.

Effectiveness	Implementability	Cost
Advantages		
Would minimize further leaching of COCs to groundwater through the reduction in bulk permeability. That is, it will be particularly effective to reducing migration through currently existing higher-permeability stringers and zones within the targeted area. Provides long-term protection. An ISS treatability study was performed and concluded optimal percentage of reagents with specific dosing requirements would be effective and achieve remedial performance objectives.	Conventional technology that is proven with site-related COCs through a laboratory bench-scale study. Services and materials are readily available. Minimal to no transportation and disposal of Source Area soils. A more sustainable solution when compared to the excavation alternative. Minimal impact to the community by minimizing truck traffic. Stabilized soil will have the strength to support future construction.	Moderate capital costs associated with the soil mixing, solidification process. Provides for long-term planning of predictable monitoring costs. Onsite bulk/swell management of ISS soils eliminates transportation and disposal, saving significant costs.
Disadvantages		
	Life cycle duration requires long-term maintenance. Any areas with steeper slopes area will require subgrade preparation before implementation. Lower-permeability soil may require additional mixing and handling for sufficient stabilization. Requires the completed solidified monolith surface to be below the seasonal frost level. Need area to handle expanded volumes of post-stabilized soil due to bulking.	Long-term operation and maintenance costs. Capital costs could be higher if additional soil mixing or more aggressive mixing techniques are needed for sufficient stabilization. Will require additional costs associated with a swell management area and larger final protective cap.

Conclusion: This alternative would achieve the remedial action objectives of mitigating COC concentrations in the targeted area for source soil remediation and minimizing further migration of the COCs to underlying and downgradient groundwater. This alternative is retained for detailed analysis.

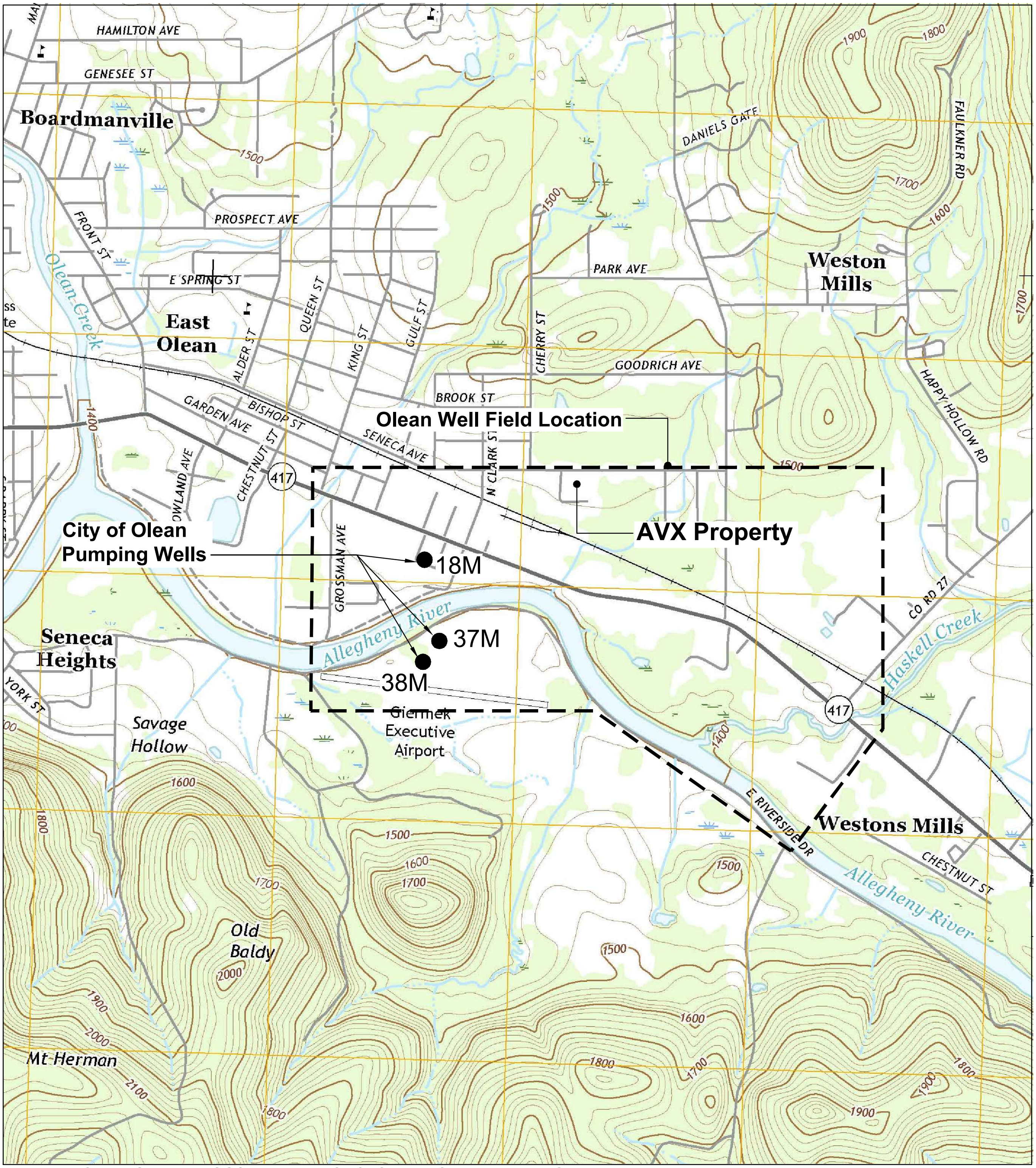
Table 7-8
Screening of Source Area Remedial Alternative 5: ISTR
Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Synopsis: Under this alternative, in situ thermal remediation (ISTR) would be implemented to remediate volatile constituents of concern (COCs) in soil. Electrodes or heater wells would be placed throughout the targeted remediation area with vapor extraction wells to capture and remove volatilized COCs.

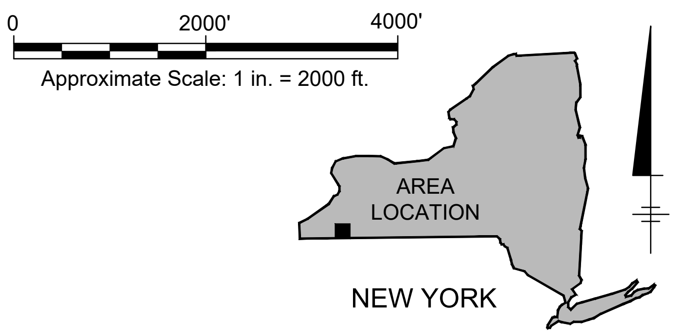
Effectiveness	Implementability	Cost
Advantages		
Would aggressively reduce COC mass and toxicity in the targeted area of remediation over a short timeframe. Provides long-term protection. Longer-term dissipation of temperatures following active treatment may enhance degradation of chlorinated ethanes and ethenes in the periphery of the targeted heating.	Proven technology for the removal of volatile organic compounds. Compatible with site geology and elevated source area concentrations. COC mass is physically removed from the subsurface, allowing soils to remain in place. Razed building, with pad left in place, simplifies component installation and vapor cover. Minimal impact to community by minimizing intrusiveness, odors, and truck traffic.	Moderate capital costs associated with system installation and demobilization. Relatively short timeframe of 6 months over which ISTR operation and maintenance (O&M) costs are incurred. Provides for long-term planning of predictable monitoring costs.
Disadvantages		
Continued monitoring may be required to confirm longer-term reduction of COC concentrations in underlying groundwater.	Power drop availability and cost were assumed based on experience and would need to be verified with the local power company if this alternative was selected. Capture of volatilized vapors within the relatively thin vadose zone may require additional management (e.g., horizontal extraction wells).	Raw materials and energy costs can increase or decrease depending on commodity markets cost for large power demands is substantial. O&M costs may increase if site conditions differ from those anticipated and/or volatilized vapors are not effectively captured.

Conclusion: This alternative would achieve the remedial action objective of mitigating COC concentrations in the targeted area for source soil remediation. The COC mass and toxicity in Source Area soil would be reduced by active remediation. The timeframe to achieve remediation goals will be decreased. This alternative is retained for detailed evaluation.

Figures



REFERENCE: BASE MAP USGS 7.5. MIN. TOPO. QUAD., OLEAN, NEW YORK, 2016.



KYOCERA AVX COMPONENTS CORPORATION
OLEAN WELL FIELD SUPERFUND SITE
OLEAN, NEW YORK

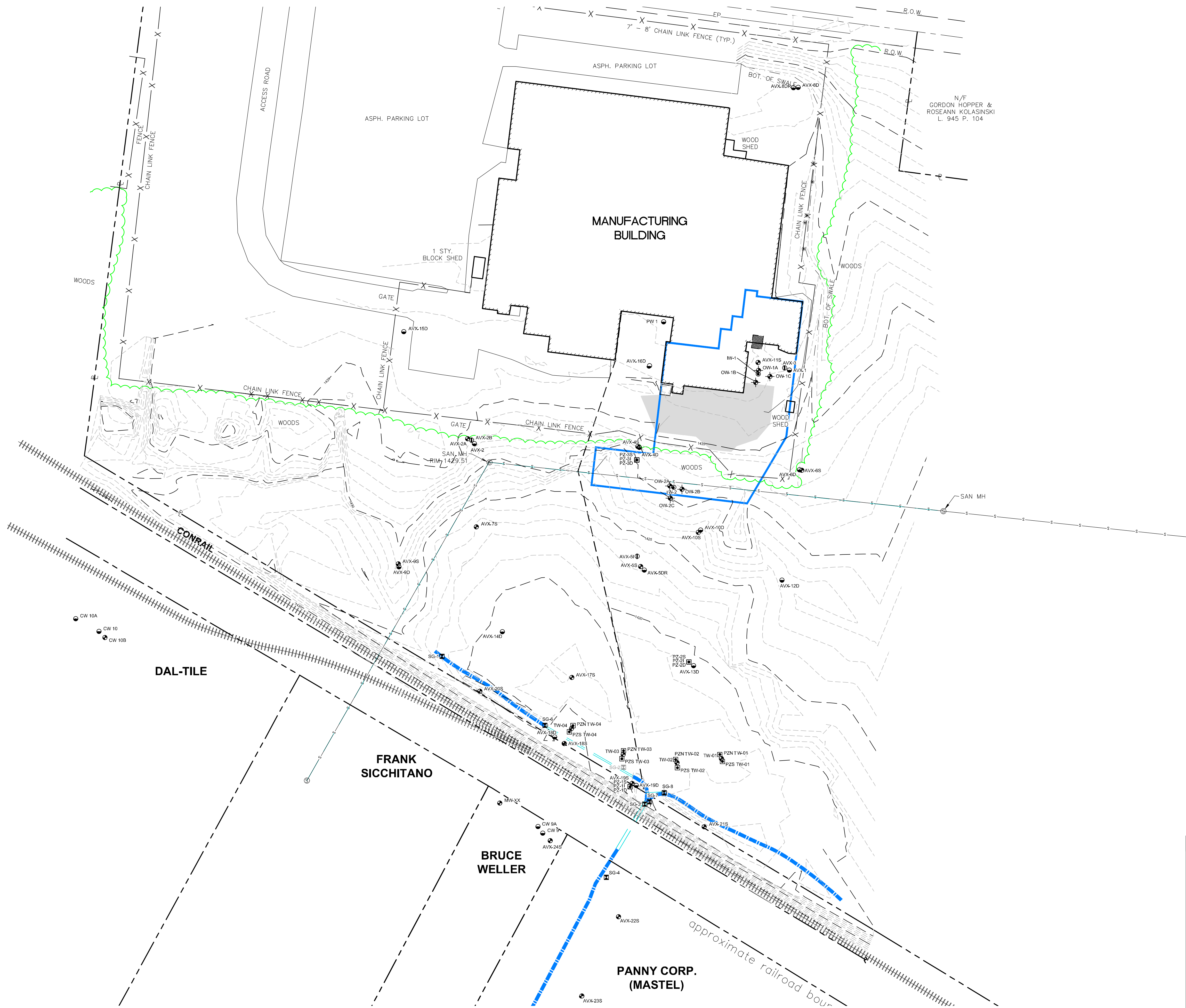
FEASIBILITY STUDY REPORT - SOURCE AREA

KAVX PROPERTY AND OLEAN WELL FIELD LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-1

CITY:(Reqd) DIV/GROUP:(Reqd) DB:(Reqd) LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
C:\Users\aschilling\OneDrive - ARCADIS\BIM 360 Docs\AVX CORP\Olean - Remedial Design Work Plan\2018\B0007393.0000\01-DWG\FS Fig1-1-SITE LOC.dwg LAYOUT: 1-1 SAVED: 10/11/2018 10:32 AM ACADVER: 21.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 10/11/2018 10:33 AM BY: SCHILLING, ADAM
XREFS: IMAGES: NY_Olean_20160826_TM_geo.jpg PROJECTNAME: ----



LEGEND:

AVX-3	SHALLOW MONITORING WELL LOCATION
AVX-2B	INTERMEDIATE MONITORING WELL LOCATION
AVX-1	DEEP MONITORING WELL LOCATION
PZ-3D	PIEZOMETER LOCATION
IW-1	INJECTION WELL LOCATION
OW-1	OBSERVATION WELL LOCATION
TW-01	TEMPORARY MONITORING WELL
SG-1	STAFF GAUGE
SG-2	STAFF GUAGE (REMOVED)
	UTILITY POLE
	BENCHMARK
	INVERT OF CULVERT PASSING BENEATH RAILROAD TRACKS
	PROPERTY BOUNDARY
	SANITARY SEWER LINE
	SPDES DISCHARGE PIPE
	UNNAMED STREAM
	STREAM WITHIN CULVERT
	APPROXIMATE LOCATION OF FORMER UNDERGROUND STORAGE TANK EXCAVATION
	SOURCE AREA AS DEFINED BY 2015 FEASIBILITY STUDY
	STAGE 1 REMEDIAL ACTION EXCAVATION AREA
	EDGE OF VEGETATION

NOTES:

1. PROPERTY LINE (JANUARY 13, 1981), SANITARY SEWER LINE (OCTOBER 2003), TOPOGRAPHIC CONTOURS (SOUTH OF FACILITY FENCE) (OCTOBER 2004), AND SPDES DISCHARGE PIPE (FEBRUARY 2, 2005) LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES. TOPOGRAPHIC CONTOURS AND SPDES DISCHARGE PIPE LOCATIONS UPDATED FROM SURVEY PERFORMED BY FISHER ASSOCIATES ON JUNE 29, 2019.
2. AVX–18S LOCATION (FEBRUARY 2, 2005), AVX–19S, AVX–20S, AVX–18D AND AVX–19D LOCATIONS (JUNE 5, 2006), AVX–21S, AVX–22S, AVX–23S, AVX–24S, AND MW–XX LOCATIONS (MAY 5, 2008) OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES.
3. PIEZOMETER (PZ), INJECTION WELL (IW) AND OBSERVATION WELL (OW) LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON APRIL 28, 2011.
4. STAFF GAUGE (SG) LOCATIONS SG–1 THROUGH SG–4 OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON OCTOBER 14, 2011.
5. STAFF GAUGE SG–2 REMOVED DURING PRE DESIGN INVESTIGATION PREPARATORY CONSTRUCTION ACTIVITIES.
6. STAFF GAUGE LOCATIONS SG–6, 7 AND 8 ARE APPROXIMATE AND HAVE NOT BEEN SURVEYED.
7. PRE–DESIGN INVESTIGATION TEST WELLS AND PIEZOMETERS NEAR THE SOUTHERN PROPERTY BOUNDARY SURVEYED BY FISHER ASSOCIATES ON JUNE 29, 2018.

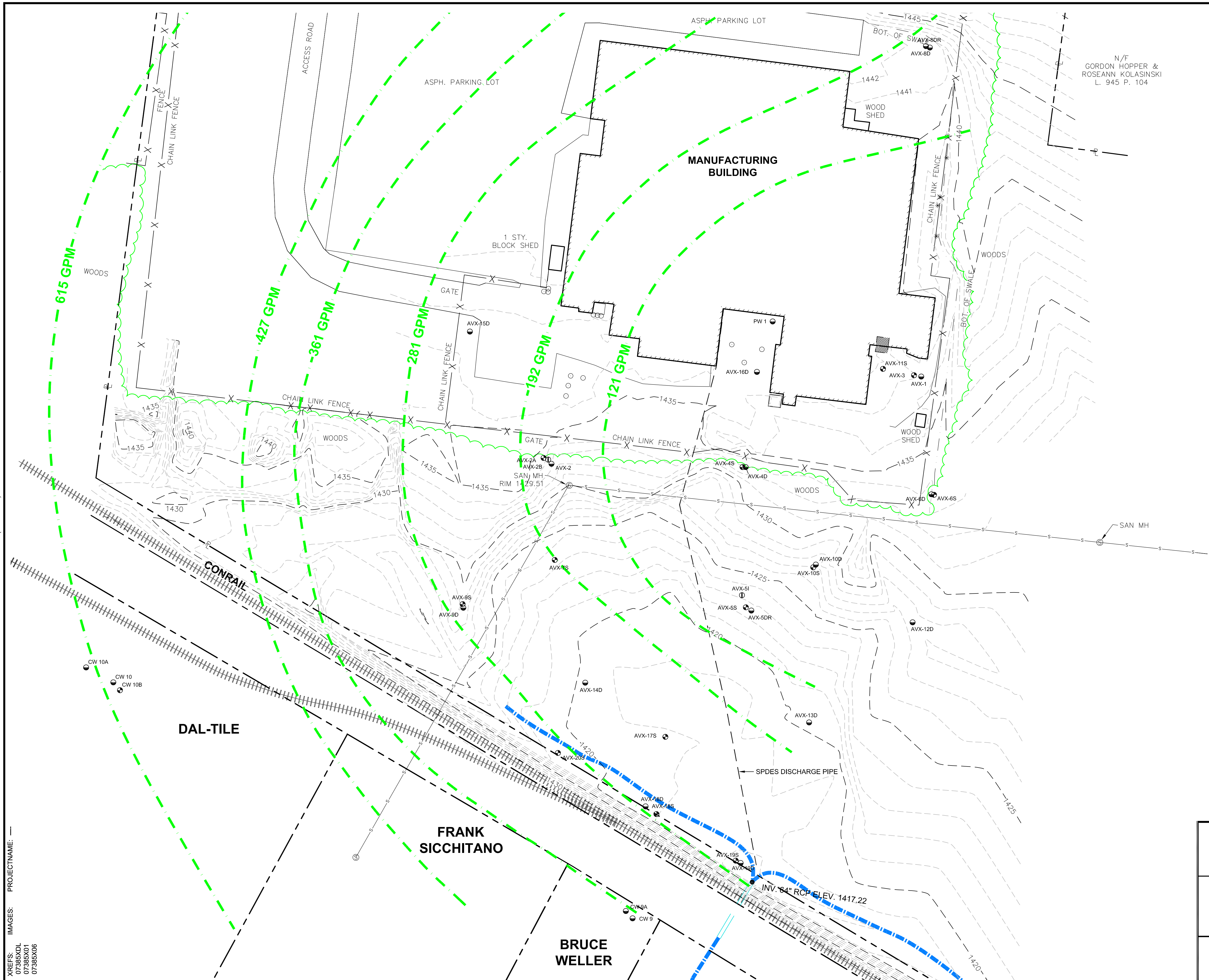
0 60' 120'
GRAPHIC SCALE

KYOCERA AVX COMPONENTS CORPORATION
OLEAN, NEW YORK
OU-5 FEASIBILITY STUDY REPORT - SOURCE AREA

SITE MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-2A



LEGEND:

- AVX-3 — SHALLOW MONITORING WELL LOCATION
- AVX-2B — INTERMEDIATE MONITORING WELL LOCATION
- AVX-1 — DEEP MONITORING WELL LOCATION
- UTILITY POLE
- BENCHMARK
- INVERT OF CULVERT PASSING BENEATH RAILROAD TRACKS
- PROPERTY BOUNDARY
- SANITARY SEWER LINE
- SPDES DISCHARGE PIPE
- UN-NAMED CREEK
- APPROXIMATE LOCATION OF FORMER UNDERGROUND STORAGE TANK EXCAVATION
- APPROXIMATE BOUND OF PW-1 CAPTURE ZONE AT GIVEN FLOW RATE (Q) IN GPM

NOTES:

1. PROPERTY LINE (JANUARY 13, 1981), SANITARY SEWER LINE (OCTOBER 2003), TOPOGRAPHIC CONTOURS (SOUTH OF FACILITY FENCE) (OCTOBER 2004), AND SPDES DISCHARGE PIPE (FEBRUARY 2, 2005) LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES.

2. AVX-18S LOCATION (FEBRUARY 2, 2005) AND AVX-19S, AVX-20S, AVX-18D AND AVX-19D LOCATIONS (JUNE 5, 2006) OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES.

0 50' 100'
GRAPHIC SCALE

AVX CORPORATION
OLEAN, NEW YORK

OU-5 FEASIBILITY STUDY REPORT - SOURCE AREA

ESTIMATED CAPTURE ZONE OF PW-1 AT SIX PUMPING RATES

ARCADIS

FIGURE
1-2B

CITY: Syracuse DIV/GROUP: EnvCAD DB: A.Schilling P. LISTER, A.Schilling PIC: W. POPHAM PM/TM: M. HANISH LYR: ON=*;OFF=REF, (FRZ) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 9/5/2012 11:42 AM BY: SCHILLING, ADAM
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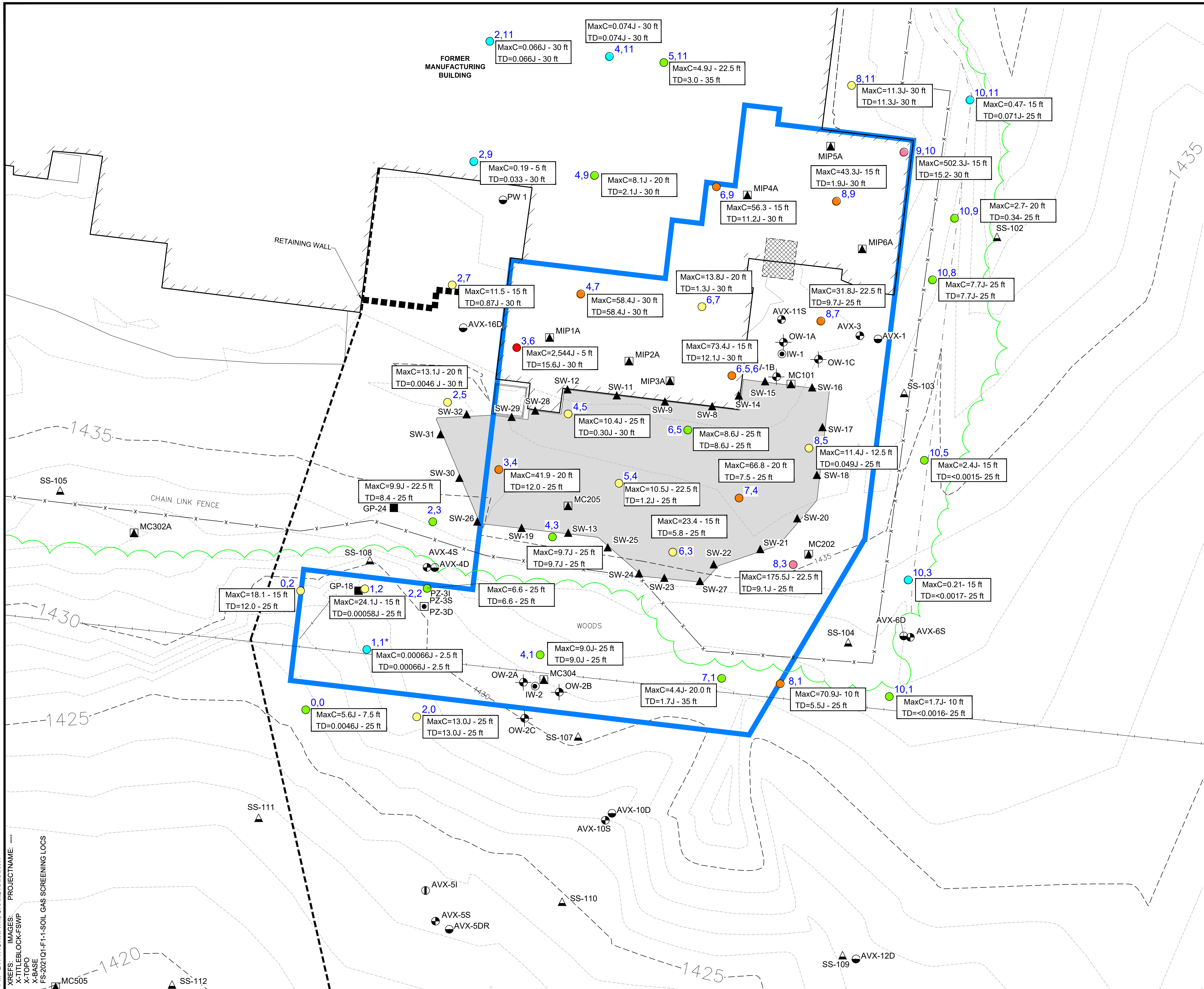

LEGEND:

AVX-3	SHALLOW MONITORING WELL LOCATION
AVX-2B	INTERMEDIATE MONITORING WELL LOCATION
AVX-1	DEEP MONITORING WELL LOCATION
PZ-1S	PIEZOMETER LOCATION
IW-1	INJECTION WELL LOCATION
OW-1	OBSERVATION WELL LOCATION
MIP1A/MC700	MEMBRANE INTERFACE PROBE CONFIGURATION SOIL SAMPLING 2011
SS-110	SURFACE SOIL SAMPLING LOCATION (2011)
SW-11	POST-EXCAVATION SIDEWALL SOIL SAMPLING LOCATION (2000)
GP-24	GEOPROBE BORING SOIL SAMPLING LOCATION (2004)
	UTILITY POLE
	BENCHMARK
	PROPERTY BOUNDARY
	SANITARY SEWER LINE
	SPDES DISCHARGE PIPE
	APPROXIMATE LOCATION OF FORMER UNDERGROUND STORAGE TANK EXCAVATION
	APPROXIMATE EDGE OF VEGETATION
	SOURCE AREA AS DEFINED BY 2015 FEASIBILITY STUDY
	STAGE 1 REMEDIAL ACTION EXCAVATION AREA (2000)
10,3	WHOLE CORE SOIL SAMPLING LOCATION (2020)

MAXIMUM LAB- DETERMINED TOTAL SELECT CVOC CONCENTRATIONS (mg/kg):

- ND-1
- >1-10
- >10-25
- >25-100
- >100-1000
- >1000

MaxC=18.1 - 15 ft — MAXIMUM CONCENTRATION (MAXC) OF TOTAL SELECT CVOCS (mg/kg) AND DEPTH OF THAT MAXIMUM CONCENTRATION

TD=12.1 - 25 ft — CONCENTRATION OF TOTAL SELECT CVOCS (mg/kg) AT THE BASE OF BORING AND TOTAL DEPTH OF THE BORING (TD)

NOTES:

1. PROPERTY LINE (JANUARY 13, 1981) AND SANITARY SEWER LINE (OCTOBER 2003) LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES.
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4. TOPOGRAPHIC CONTOURS AND SPDES DISCHARGE PIPE LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY FISHER ASSOCIATES ON JUNE 29, 2018.
5. WHOLE CORE SOIL SAMPLING LOCATIONS SURVEYED BY OR MEASURED FROM LOCATIONS SURVEYED BY FISHER ASSOCIATES ON NOVEMBER 17, 2020.
6. SELECT CVOCS ARE THOSE FOR WHICH THERE ARE PROJECT–DEFINED SOIL RAOS LISTED IN THE 2017 AMENDED REMEDIAL DESIGN/REMEDIAL ACTION CONSENT DECREE.
7. * WHOLE CORE SOIL SAMPLING LOCATION SS–1,1 HAS ONLY ONE SAMPLE WHICH WAS COLLECTED FROM A DEPTH OF 2.5 FEET BGS. A DECISION WAS MADE TO SHIFT THE LOCATION FOR DEEPER SAMPLES TO SS–1,2, WHICH IS COLLOCATED WITH HISTORICAL BORING GP–18.

0 20' 40'
GRAPHIC SCALE

KYOCERA AVX COMPONENTS CORPORATION
OLEAN, NEW YORK
OU-5 FEASIBILITY STUDY REPORT - SOURCE AREA

DISTRIBUTION OF TOTAL SELECT CVOC CONCENTRATIONS IN SOIL

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-2

CITY: SYRACUSE, NY DIV/GROUP: ENV/IM-DV DB: R. BASSETT, W. JONES, P. LISTER LD: A. SCHILLING PM/TM: M. HANISH LYR: ON=*;OFF=REF, (FRZ) PM BY: THORWATH CHANDRAKANTH PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 8/30/2021 2:13 PAGESETUP: ---- ACADVER: 24.0S (LMS TECH) SAVED: 8/30/2021 2:12 PM LAYOUT: 2
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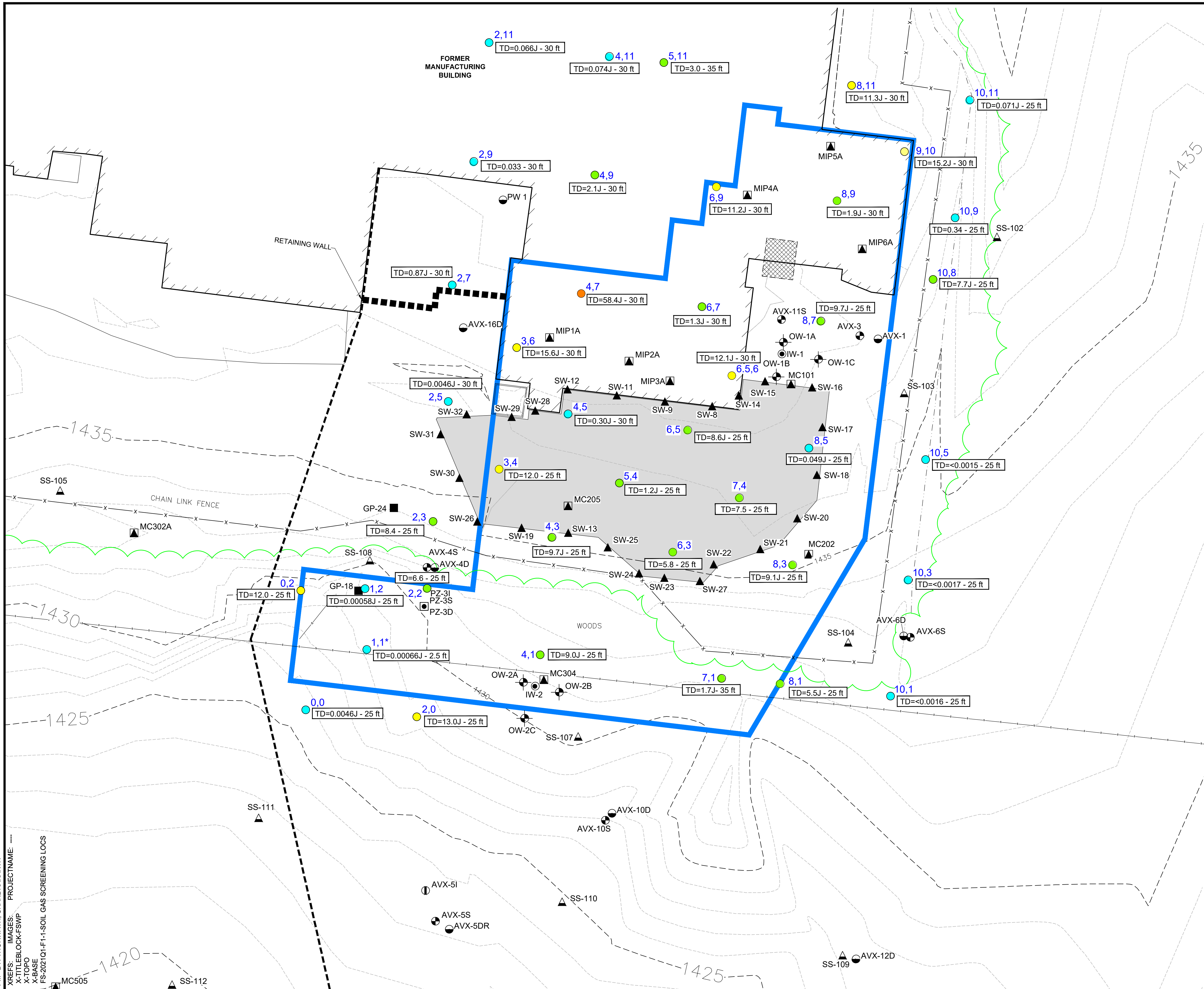

LEGEND:

AVX-3	SHALLOW MONITORING WELL LOCATION
AVX-2B	INTERMEDIATE MONITORING WELL LOCATION
AVX-1	DEEP MONITORING WELL LOCATION
PZ-1S	PIEZOMETER LOCATION
IW-1	INJECTION WELL LOCATION
OW-1	OBSERVATION WELL LOCATION
MIP1A/MC700	MEMBRANE INTERFACE PROBE CONFIGURATION SOIL SAMPLING 2011
SS-110	SURFACE SOIL SAMPLING LOCATION (2011)
SW-11	POST-EXCAVATION SIDEWALL SOIL SAMPLING LOCATION (2000)
GP-24	GEOPROBE BORING SOIL SAMPLING LOCATION (2004)
	UTILITY POLE
	BENCHMARK
	PROPERTY BOUNDARY
	SANITARY SEWER LINE
	SPDES DISCHARGE PIPE
	APPROXIMATE LOCATION OF FORMER UNDERGROUND STORAGE TANK EXCAVATION
	APPROXIMATE EDGE OF VEGETATION
	SOURCE AREA AS DEFINED BY 2015 FEASIBILITY STUDY
	STAGE 1 REMEDIAL ACTION EXCAVATION AREA (2000)
10,3	WHOLE CORE SOIL SAMPLING LOCATION (2020)
	ND-1
	>1-10
	>10-25
	>25-100
	>100-1000
	>1000
TD=0.16J - 25 ft	CONCENTRATION OF TOTAL SELECT CVOCS (mg/kg) AT THE BASE OF BORING AND TOTAL DEPTH OF THE BORING (TD)

ND-1, >1-10, >10-25, >25-100, >100-1000, >1000: MAXIMUM LAB- DETERMINED TOTAL SELECT CVOC CONCENTRATIONS (mg/kg)

NOTES:

1. PROPERTY LINE (JANUARY 13, 1981) AND SANITARY SEWER LINE (OCTOBER 2003) LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES.
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4. TOPOGRAPHIC CONTOURS AND SPDES DISCHARGE PIPE LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY FISHER ASSOCIATES ON JUNE 29, 2018.
5. WHOLE CORE SOIL SAMPLING LOCATIONS SURVEYED BY OR MEASURED FROM LOCATIONS SURVEYED BY FISHER ASSOCIATES ON NOVEMBER 17, 2020.
6. SELECT CVOCS ARE THOSE FOR WHICH THERE ARE PROJECT–DEFINED SOIL RAOS LISTED IN THE 2017 AMENDED REMEDIAL DESIGN/REMEDIAL ACTION CONSENT DECREE.
7. * WHOLE CORE SOIL SAMPLING LOCATION SS–1,1 HAS ONLY ONE SAMPLE WHICH WAS COLLECTED FROM A DEPTH OF 2.5 FEET BGS. A DECISION WAS MADE TO SHIFT THE LOCATION FOR DEEPER SAMPLES TO SS–1,2, WHICH IS COLLOCATED WITH HISTORICAL BORING GP–18.

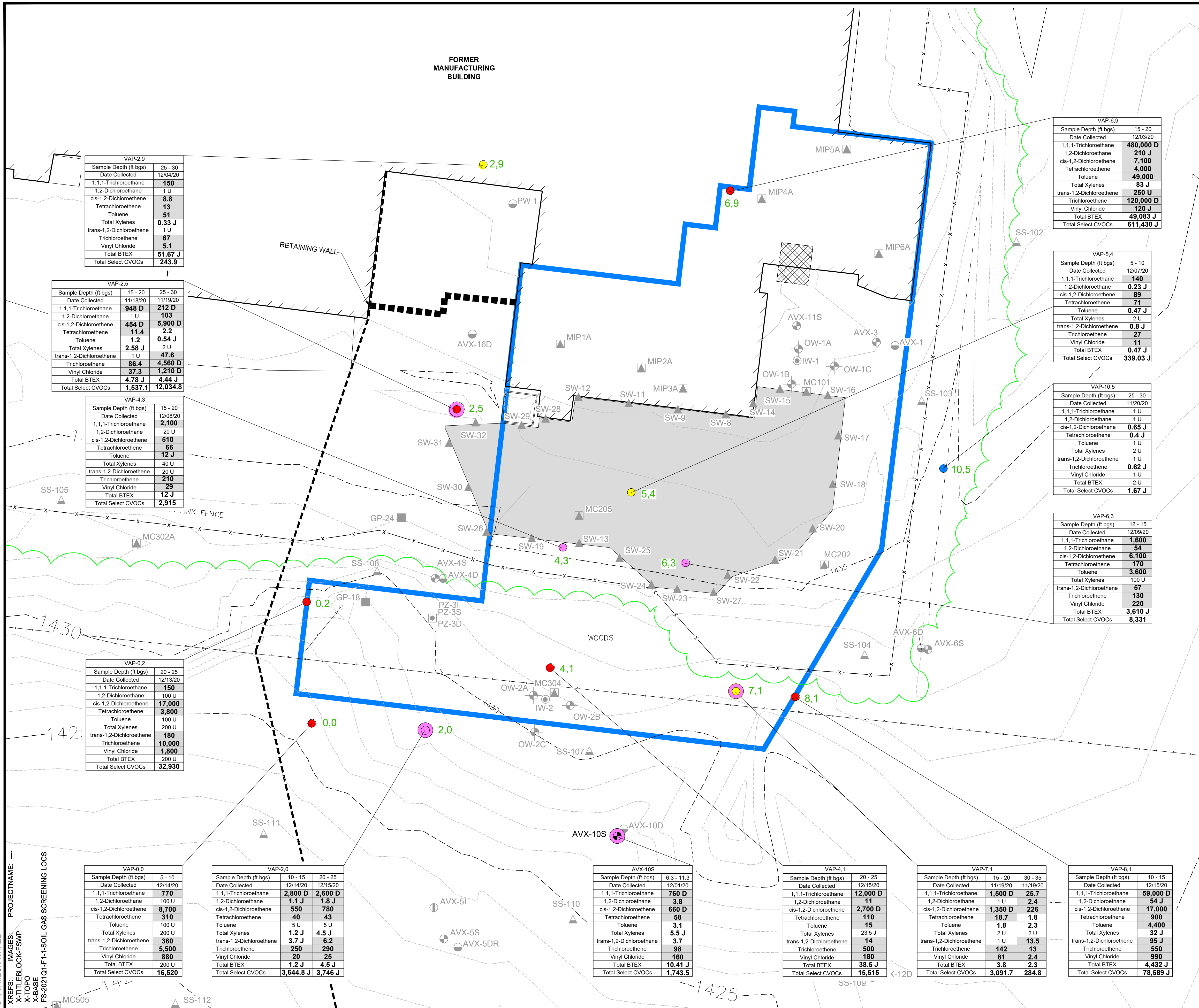
0 20' 40'
GRAPHIC SCALE

KYOCERA AVX COMPONENTS CORPORATION
OLEAN, NEW YORK
OU-5 FEASIBILITY STUDY REPORT - SOURCE AREA

DISTRIBUTION OF TOTAL SELECT CVOC CONCENTRATIONS IN SOIL AT BORING TOTAL DEPTH

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-3



VAP-2,9	
Sample Depth (ft bgs)	25 - 30
Date Collected	12/04/20
1,1,1-Trichloroethane	**150**
1,2-Dichloroethane	1 U
cis-1,2-Dichloroethene	**8.8**
Tetrachloroethene	**13**
Toluene	**51**
Total Xylenes	**0.33 J**
trans-1,2-Dichloroethene	1 U
Trichloroethene	**67**
Vinyl Chloride	**5.1**
Total BTEX	**51.67 J**
Total Select CVOCs	**243.9**

VAP-2,5		
Sample Depth (ft bgs)	15 - 20	25 - 30
Date Collected	11/18/20	11/19/20
1,1,1-Trichloroethane	**948 D**	**212 D**
1,2-Dichloroethane	1 U	**103**
cis-1,2-Dichloroethene	**454 D**	**5,900 D**
Tetrachloroethene	**11.4**	**2.2**
Toluene	**1.2**	**0.54 J**
Total Xylenes	**2.58 J**	2 U
trans-1,2-Dichloroethene	1 U	**47.6**
Trichloroethene	**86.4**	**4,560 D**
Vinyl Chloride	**37.3**	**1,210 D**
Total BTEX	**4.78 J**	**4.44 J**
Total Select CVOCs	**1,537.1**	**12,034.8**

VAP-4,3	
Sample Depth (ft bgs)	15 - 20
Date Collected	12/08/20
1,1,1-Trichloroethane	**2,100**
1,2-Dichloroethane	20 U
cis-1,2-Dichloroethene	**510**
Tetrachloroethene	**66**
Toluene	**12 J**
Total Xylenes	40 U
trans-1,2-Dichloroethene	20 U
Trichloroethene	**210**
Vinyl Chloride	**29**
Total BTEX	**12 J**
Total Select CVOCs	**2,915**

VAP-0,2	
Sample Depth (ft bgs)	20 - 25
Date Collected	12/13/20
1,1,1-Trichloroethane	**150**
1,2-Dichloroethane	100 U
cis-1,2-Dichloroethene	**17,000**
Tetrachloroethene	**3,800**
Toluene	100 U
Total Xylenes	200 U
trans-1,2-Dichloroethene	**180**
Trichloroethene	**10,000**
Vinyl Chloride	**1,800**
Total BTEX	200 U
Total Select CVOCs	**32,930**

VAP-0,0	
Sample Depth (ft bgs)	5 - 10
Date Collected	12/14/20
1,1,1-Trichloroethane	**770**
1,2-Dichloroethane	100 U
cis-1,2-Dichloroethene	**8,700**
Tetrachloroethene	**310**
Toluene	100 U
Total Xylenes	200 U
trans-1,2-Dichloroethene	**360**
Trichloroethene	**5,500**
Vinyl Chloride	**880**
Total BTEX	200 U
Total Select CVOCs	**16,520**

VAP-2,0		
Sample Depth (ft bgs)	10 - 15	20 - 25
Date Collected	12/14/20	12/15/20
1,1,1-Trichloroethane	**2,800 D**	**2,600 D**
1,2-Dichloroethane	**1.1 J**	**1.8 J**
cis-1,2-Dichloroethene	**550**	**780**
Tetrachloroethene	**40**	**43**
Toluene	5 U	5 U
Total Xylenes	**1.2 J**	**4.5 J**
trans-1,2-Dichloroethene	**3.7 J**	**6.2**
Trichloroethene	**250**	**290**
Vinyl Chloride	**20**	**25**
Total BTEX	**1.2 J**	**4.5 J**
Total Select CVOCs	**3,644.8 J**	**3,746 J**

AVX-10S	
Sample Depth (ft bgs)	6.3 - 11.3
Date Collected	12/01/20
1,1,1-Trichloroethane	**760 D**
1,2-Dichloroethane	**3.8**
cis-1,2-Dichloroethene	**660 D**
Tetrachloroethene	**58**
Toluene	**3.1**
Total Xylenes	**5.5 J**
trans-1,2-Dichloroethene	**3.7**
Trichloroethene	**98**
Vinyl Chloride	**160**
Total BTEX	**10.41 J**
Total Select CVOCs	**1,743.5**

VAP-4,1	
Sample Depth (ft bgs)	20 - 25
Date Collected	12/15/20
1,1,1-Trichloroethane	**12,000 D**
1,2-Dichloroethane	**11**
cis-1,2-Dichloroethene	**2,700 D**
Tetrachloroethene	**110**
Toluene	**15**
Total Xylenes	23.5 J
trans-1,2-Dichloroethene	**14**
Trichloroethene	**500**
Vinyl Chloride	**180**
Total BTEX	**38.5 J**
Total Select CVOCs	**15,515**

VAP-7,1		
Sample Depth (ft bgs)	15 - 20	30 - 35
Date Collected	11/19/20	11/19/20
1,1,1-Trichloroethane	**1,500 D**	**25.7**
1,2-Dichloroethane	1 U	**2.4**
cis-1,2-Dichloroethene	**1,350 D**	**226**
Tetrachloroethene	**18.7**	**1.8**
Toluene	**1.8**	**2.3**
Total Xylenes	2 U	2 U
trans-1,2-Dichloroethene	1 U	**13.5**
Trichloroethene	**142**	**13**
Vinyl Chloride	**81**	**2.4**
Total BTEX	**3.8**	**2.3**
Total Select CVOCs	**3,091.7**	**284.8**

VAP-8,1	
Sample Depth (ft bgs)	10 - 15
Date Collected	12/15/20
1,1,1-Trichloroethane	**59,000 D**
1,2-Dichloroethane	**54 J**
cis-1,2-Dichloroethene	**17,000**
Tetrachloroethene	**900**
Toluene	**4,400**
Total Xylenes	**32 J**
trans-1,2-Dichloroethene	**95 J**
Trichloroethene	**550**
Vinyl Chloride	**990**
Total BTEX	**4,432 J**
Total Select CVOCs	**78,589 J**

VAP-6,9	
Sample Depth (ft bgs)	15 - 20
Date Collected	12/03/20
1,1,1-Trichloroethane	**480,000 D**
1,2-Dichloroethane	**210 J**
cis-1,2-Dichloroethene	**7,100**
Tetrachloroethene	**4,000**
Toluene	**49,000**
Total Xylenes	**83 J**
trans-1,2-Dichloroethene	**250 U**
Trichloroethene	**120,000 D**
Vinyl Chloride	**120 J**
Total BTEX	**49,083 J**
Total Select CVOCs	**611,430 J**

VAP-5,4	
Sample Depth (ft bgs)	5 - 10
Date Collected	12/07/20
1,1,1-Trichloroethane	**140**
1,2-Dichloroethane	**0.23 J**
cis-1,2-Dichloroethene	**89**
Tetrachloroethene	**71**
Toluene	**0.47 J**
Total Xylenes	2 U
trans-1,2-Dichloroethene	**0.8 J**
Trichloroethene	**27**
Vinyl Chloride	**11**
Total BTEX	**0.47 J**
Total Select CVOCs	**339.03 J**

VAP-10,5	
Sample Depth (ft bgs)	25 - 30
Date Collected	11/20/20
1,1,1-Trichloroethane	1 U
1,2-Dichloroethane	1 U
cis-1,2-Dichloroethene	**0.65 J**
Tetrachloroethene	**0.4 J**
Toluene	1 U
Total Xylenes	2 U
trans-1,2-Dichloroethene	1 U
Trichloroethene	**0.62 J**
Vinyl Chloride	1 U
Total BTEX	2 U
Total Select CVOCs	**1.67 J**

VAP-6,3	
Sample Depth (ft bgs)	12 - 15
Date Collected	12/09/20
1,1,1-Trichloroethane	**1,600**
1,2-Dichloroethane	**54**
cis-1,2-Dichloroethene	**6,100**
Tetrachloroethene	**170**
Toluene	**3,600**
Total Xylenes	100 U
trans-1,2-Dichloroethene	**57**
Trichloroethene	**130**
Vinyl Chloride	**220**
Total BTEX	**3,610 J**
Total Select CVOCs	**8,331**

LEGEND:

- AVX-3 SHALLOW MONITORING WELL LOCATION
- AVX-2B INTERMEDIATE MONITORING WELL LOCATION
- AVX-1 DEEP MONITORING WELL LOCATION
- PZ-1S PIEZOMETER LOCATION
- IW-1 INJECTION WELL LOCATION
- OW-1 OBSERVATION WELL LOCATION
- MIP1A/MC700 MEMBRANE INTERFACE PROBE CONFIGURATION SOIL SAMPLING 2011
- SS-110 SURFACE SOIL SAMPLING LOCATION (2011)
- SW-11 POST-EXCAVATION SIDEWALL SOIL SAMPLING LOCATION (2000)
- GP-24 GEOPROBE BORING SOIL SAMPLING LOCATION (2004)
- UTILITY POLE
- BENCHMARK
- PROPERTY BOUNDARY
- SANITARY SEWER LINE
- SPDES DISCHARGE PIPE
- APPROXIMATE LOCATION OF FORMER UNDERGROUND STORAGE TANK EXCAVATION
- APPROXIMATE EDGE OF VEGETATION
- SOURCE AREA AS DEFINED BY 2015 FEASIBILITY STUDY
- STAGE 1 REMEDIAL ACTION EXCAVATION AREA (2000)
- 10,5 VERTICAL AQUIFER PROFILE SAMPLING LOCATION (2020) - WHERE TWO COLORS ARE PRESENTED, THE INNER COLOR REPRESENTS THE DEEPER SAMPLE
- >10,000 μg/L
- 1,000 – 10,000 μg/L
- 100 – 1,000 μg/L
- 10 – 100 μg/L
- 1 – 10 μg/L
- ND – 1 μg/L

NOTES:

1. PROPERTY LINE (JANUARY 13, 1981) AND SANITARY SEWER LINE (OCTOBER 2003) LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES.
2. AVX-18S LOCATION (FEBRUARY 2, 2005), AVX-19S, AVX-20S, AVX-18D AND AVX-19D LOCATIONS (JUNE 5, 2006), AVX-21S, AVX-22S, AVX-23S, AVX-24S, AND MW-XX LOCATIONS (MAY 5, 2008) OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES.
3. PIEZOMETER (PZ), INJECTION WELL (IW) , OBSERVATION WELL (OW) AND MEMBRANE INTERFACE PROBE (MIP) LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON APRIL 28, 2011.
4. TOPOGRAPHIC CONTOURS AND SPDES DISCHARGE PIPE LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY FISHER ASSOCIATES ON JUNE 29, 2018.
5. VERTICAL AQUIFER PROFILE SAMPLING LOCATIONS SURVEYED BY OR MEASURED FROM LOCATIONS SURVEYED BY FISHER ASSOCIATES ON NOVEMBER 17, 2020
6. BOLD INDICATES A DETECTED ANALYTE.
7. SHADING INDICATES RESULT EXCEEDS TOGS 1.1.1 GROUNDWATER QUALITY STANDARDS.
8. D = CONCENTRATION IS BASED ON DILUTED SAMPLE.
9. U = COMPOUND NOT DETECTED ABOVE REPORTED SAMPLE QUANTITATION LIMIT.
10. J = ESTIMATED VALUE.
11. μg/L = MICROGRAMS PER LITER.
12. CVOC = CHLORINATED VOLATILE ORGANIC COMPOUNDS

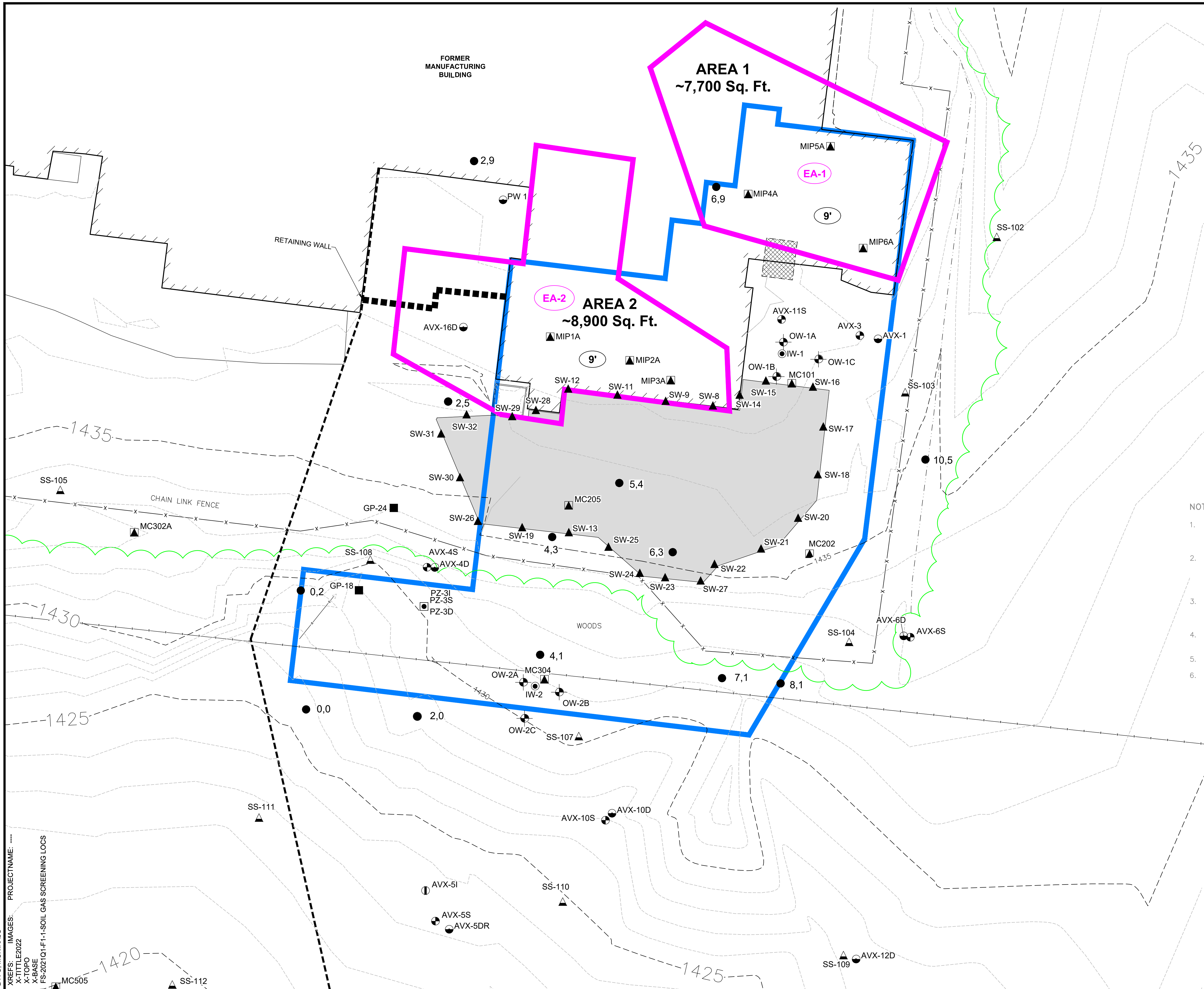
0 20' 40'
GRAPHIC SCALE

KYOCERA AVX COMPONENTS CORPORATION
OLEAN, NEW YORK
OU-5 FEASIBILITY STUDY REPORT - SOURCE AREA

VERTICAL AQUIFER PROFILE AND AVX-10S SAMPLING LOCATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-4



LEGEND:

AVX-3	SHALLOW MONITORING WELL LOCATION
AVX-2B	INTERMEDIATE MONITORING WELL LOCATION
AVX-1	DEEP MONITORING WELL LOCATION
PZ-1S	PIEZOMETER LOCATION
IW-1	INJECTION WELL LOCATION
OW-1	OBSERVATION WELL LOCATION
MIP1A/MC700	MEMBRANE INTERFACE PROBE CONFIGURATION SOIL SAMPLING 2011
SS-110	SURFACE SOIL SAMPLING LOCATION (2011)
SW-11	POST-EXCAVATION SIDEWALL SOIL SAMPLING LOCATION (2000)
GP-24	GEOPROBE BORING SOIL SAMPLING LOCATION (2004)
	UTILITY POLE
	BENCHMARK
	PROPERTY BOUNDARY
	SANITARY SEWER LINE
	SPDES DISCHARGE PIPE
	APPROXIMATE LOCATION OF FORMER UNDERGROUND STORAGE TANK EXCAVATION
	APPROXIMATE EDGE OF VEGETATION
	SOURCE AREA AS DEFINED BY 2015 FEASIBILITY STUDY
	STAGE 1 REMEDIAL ACTION EXCAVATION AREA (2000)
10,5	VERTICAL AQUIFER PROFILE SAMPLING LOCATION (2020) - WHERE TWO COLORS ARE PRESENTED, THE INNER COLOR REPRESENTS THE DEEPER SAMPLE
	APPROXIMATE EXTENT OF EXCAVATION
EA-1	EXCAVATION AREA ID
9'	APPROXIMATE EXCAVATION DEPTH

NOTES:

1. PROPERTY LINE (JANUARY 13, 1981) AND SANITARY SEWER LINE (OCTOBER 2003) LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES.
2. AVX-18S LOCATION (FEBRUARY 2, 2005), AVX-19S, AVX-20S, AVX-18D AND AVX-19D LOCATIONS (JUNE 5, 2006), AVX-21S, AVX-22S, AVX-23S, AVX-24S, AND MW-XX LOCATIONS (MAY 5, 2008) OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES.
3. PIEZOMETER (PZ), INJECTION WELL (IW) , OBSERVATION WELL (OW) AND MEMBRANE INTERFACE PROBE (MIP) LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON APRIL 28, 2011.
4. TOPOGRAPHIC CONTOURS AND SPDES DISCHARGE PIPE LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY FISHER ASSOCIATES ON JUNE 29, 2018.
5. WHOLE CORE SOIL SAMPLING LOCATIONS SURVEYED BY OR MEASURED FROM LOCATIONS SURVEYED BY FISHER ASSOCIATES ON NOVEMBER 17, 2020.
6. * WHOLE CORE SOIL SAMPLING LOCATION SS-1,1 HAS ONLY ONE SAMPLE WHICH WAS COLLECTED FROM A DEPTH OF 2.5 FEET BGS A DECISION WAS MADE TO SHIFT THE LOCATION FOR DEEPER SAMPLES TO SS-1,2, WHICH IS LOCATED WITH HISTORICAL BORING OP-18.

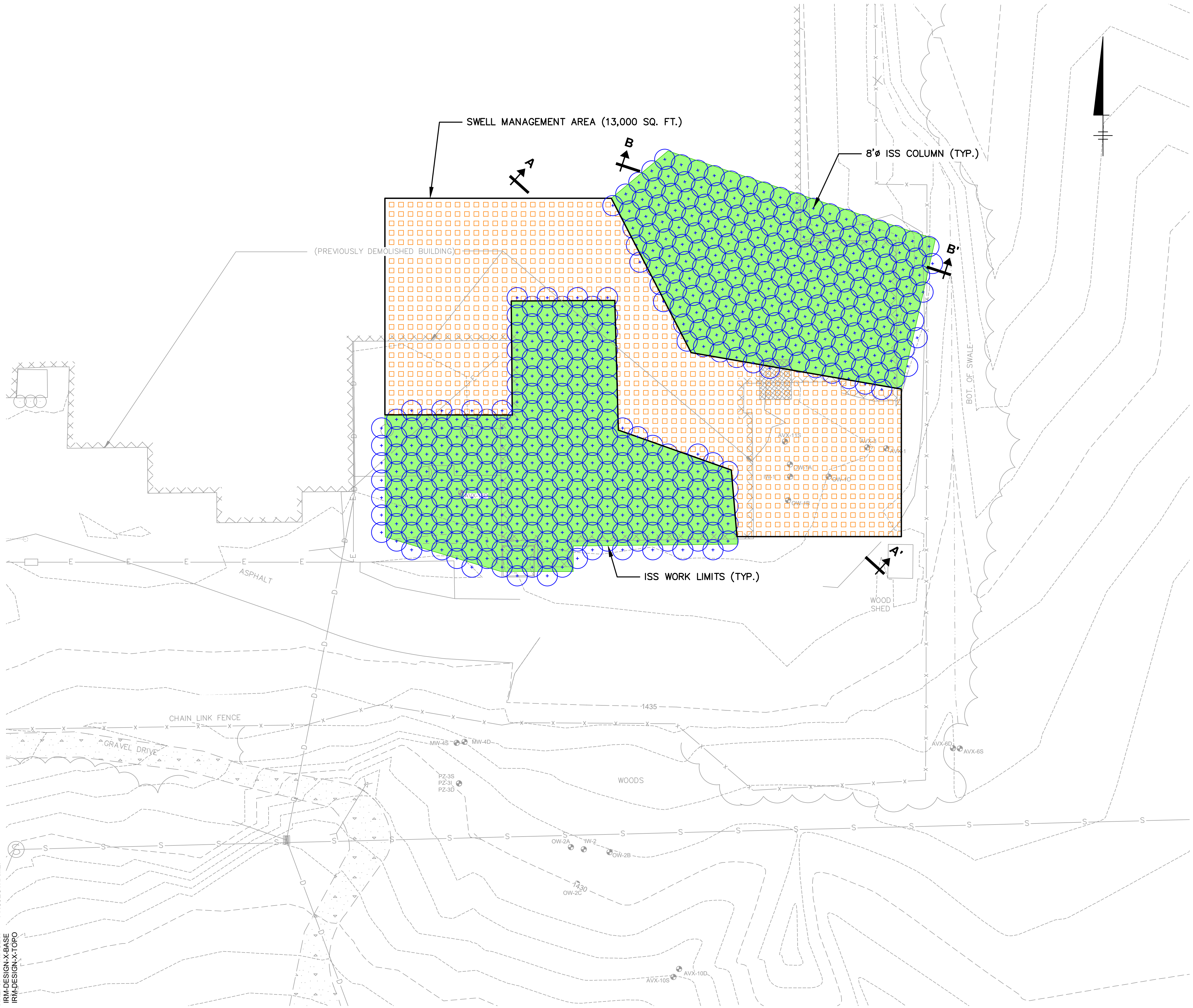
0 20' 40'
GRAPHIC SCALE

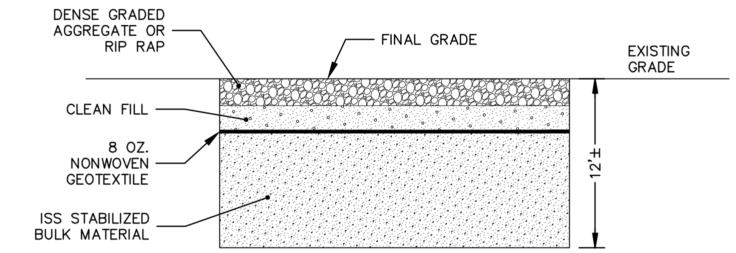
KYOCERA AVX COMPONENTS CORPORATION
OLEAN, NEW YORK
OU-5 FEASIBILITY STUDY REPORT - SOURCE AREA

PROPOSED EXCAVATION AREA

ARCADIS

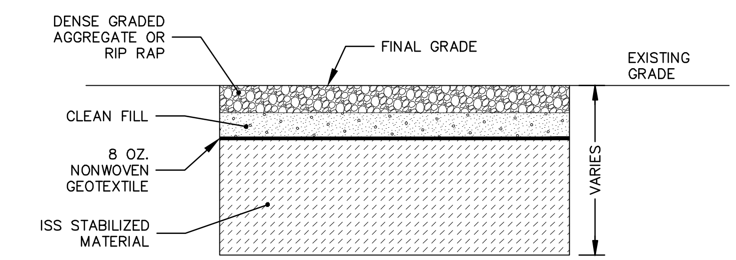
FIGURE
6-1





SECTION A-A'
SWELL MANAGEMENT AREA
RESTORATION DETAIL

NOT TO SCALE



SECTION B-B'
ISS AREAS
RESTORATION DETAIL

NOT TO SCALE

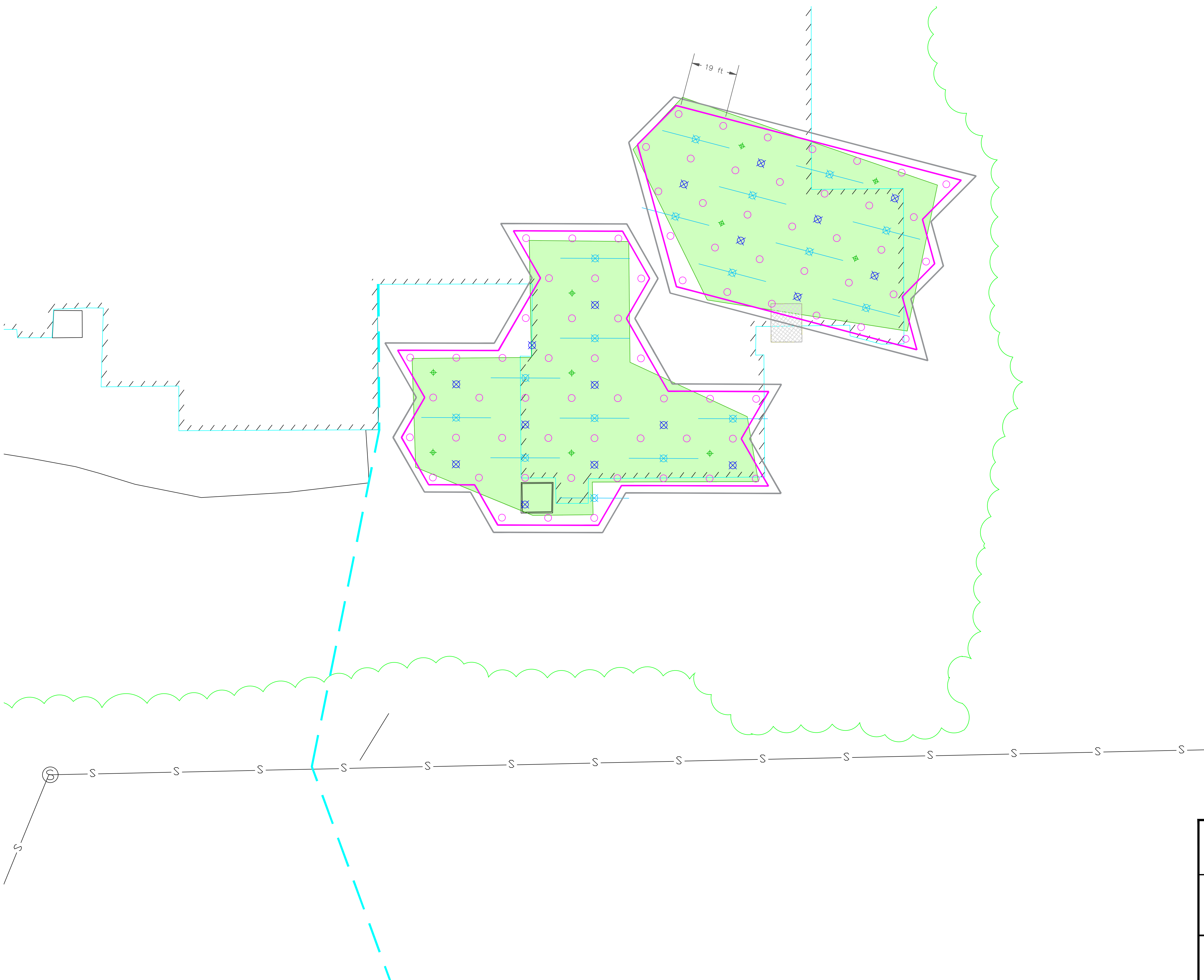
0 20' 40'
GRAPHIC SCALE

KYOCERA AVX COMPONENTS CORPORATION
OLEAN, NEW YORK
OU-5 FEASIBILITY STUDY REPORT - SOURCE AREA

ISS CONCEPT PLAN

ARCADIS

FIGURE
6-2



LEGEND:

- CONCEPT TREATMENT AREAS [16,600 FT2]
- CONCEPT HEATED AREA [18,500 FT2]
- CONCEPT THERMAL INSULATION LAYER [21,400 FT2]
- ERH ELECTRODE LOCATION [75]
- MPE WELL LOCATION [17]
- HORIZONTAL SVE TRENCH [17 x 25 FT]
- TEMPERATURE SENSOR WELL [10]
- SANITARY SEWER LINE
- SPDES DISCHARGE PIPE
- APPROXIMATE EDGE OF VEGETATION
- FORMER BUILDING FOOTPRINT
- APPROXIMATE LOCATION OF FORMER UNDERGROUND STORAGE TANK EXCAVATION

NOTES:

1. FOR REVIEW AND COMMENT ONLY – NOT FOR CONSTRUCTION. PRELIMINARY CONCEPTUAL DRAWING ONLY FOR FEASIBILITY STUDY.
2. CONCEPT TREATMENT AREA EXTENDS TO 1430 FT AMSL (AVERAGE DEPTH OF APPROXIMATELY 8.8 FT). CONCEPT HEATED VOLUME EXTENDS 3 FT DEEPER THAN CONCEPT TREATMENT AREA FOR CONSERVATISM.
3. EXISTING MONITORING WELL AND BORING LOCATIONS NOT SHOWN.
4. GROUND SURFACE ELEVATIONS NOT SHOWN.
5. BASE MAP OBTAINED FROM 2018 PRE-DESIGN INVESTIGATION REPORT, AVX PROPERTY, OU2, OLEAN WELL FIELD SUPERFUND SITE, PREPARED BY ARCADIS U.S., INC. EXISTING SITE CONDITIONS MAY DIFFER FROM THOSE SHOWN. NO REPRESENTATION IS MADE REGARDING THE ACCURACY OF ANY DEPICTED FEATURES.

0 20' 40'
GRAPHIC SCALE

KYOCERA AVX COMPONENTS CORPORATION
OLEAN, NEW YORK
OU-5 FEASIBILITY STUDY REPORT - SOURCE AREA

ALTERNATIVE 5: IN SITU THERMAL REMEDIATION ALTERNATIVE

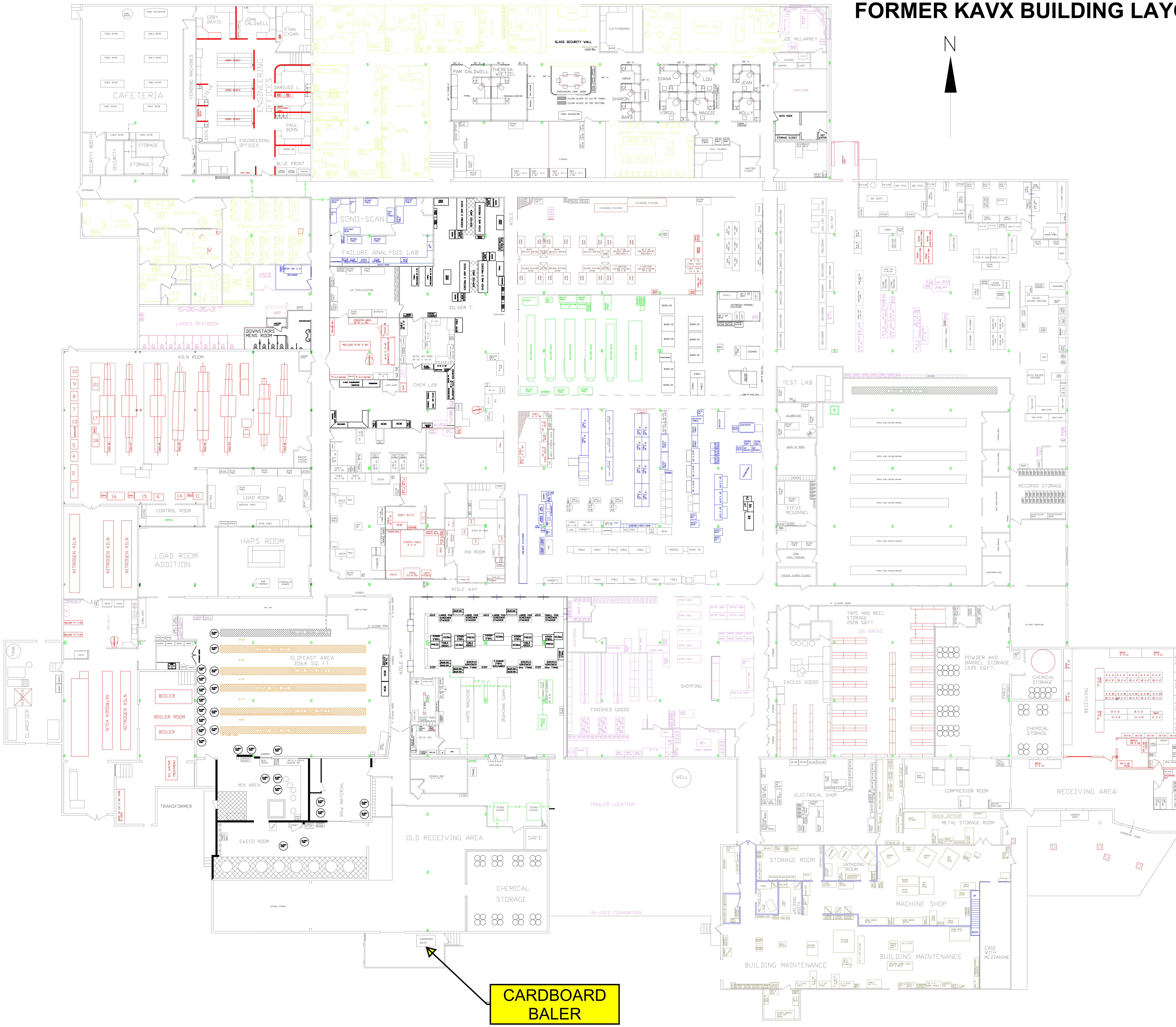
ARCADIS

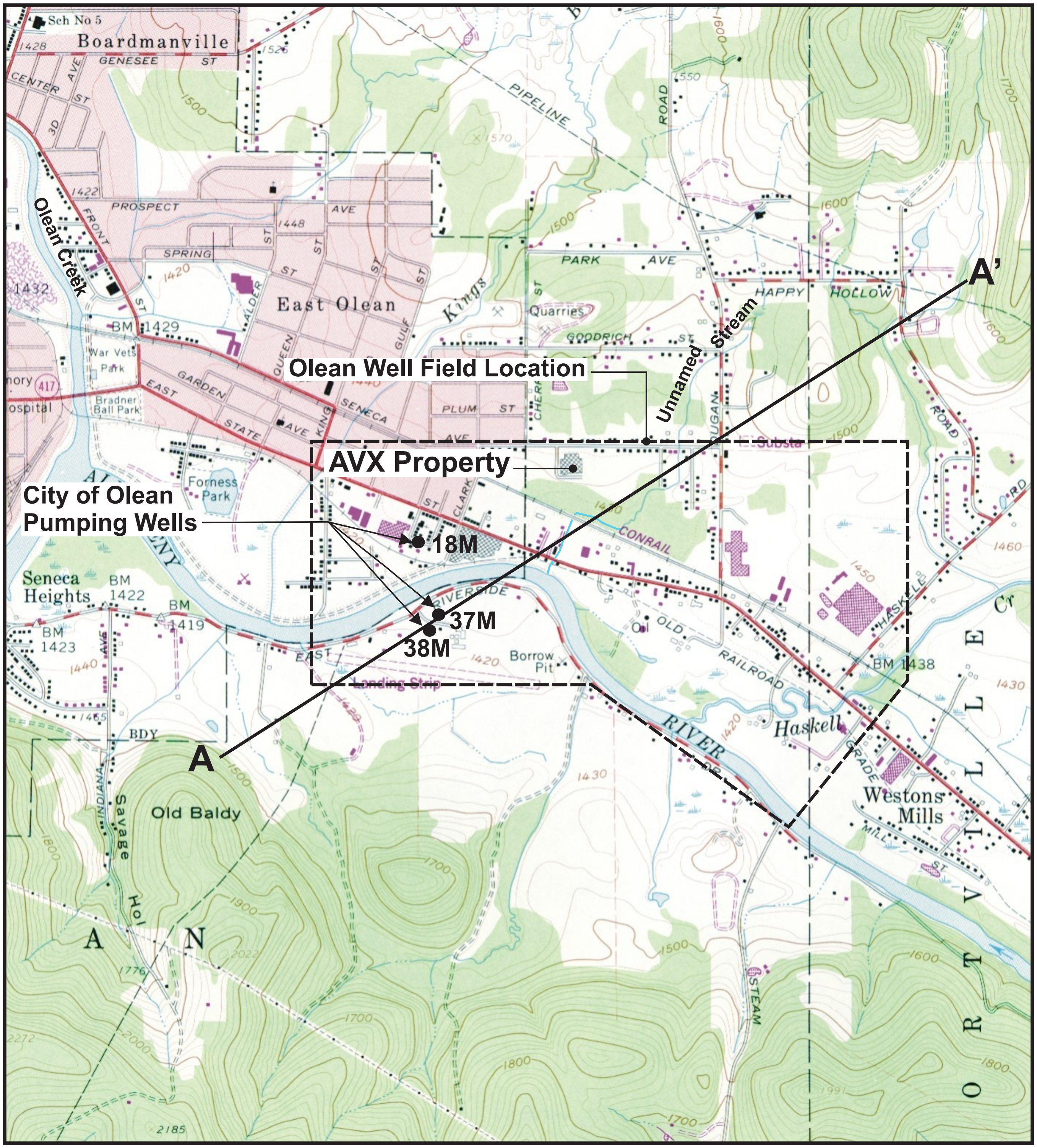
FIGURE
6-3

Appendix A

Former Building Layout Figure and Select Figures from the 2013 Feasibility Study Investigation Report

FORMER KAVX BUILDING LAYOUT

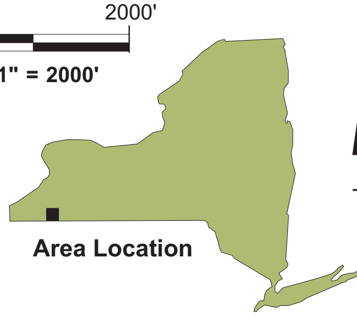




REFERENCE: BASE MAP USGS 7.5 MIN. QUAD. OLEAN, NEW YORK, 1961.

2000' 0 2000'

Approximate Scale: 1" = 2000'



Area Location

AVX CORPORATION
OLEAN, NEW YORK

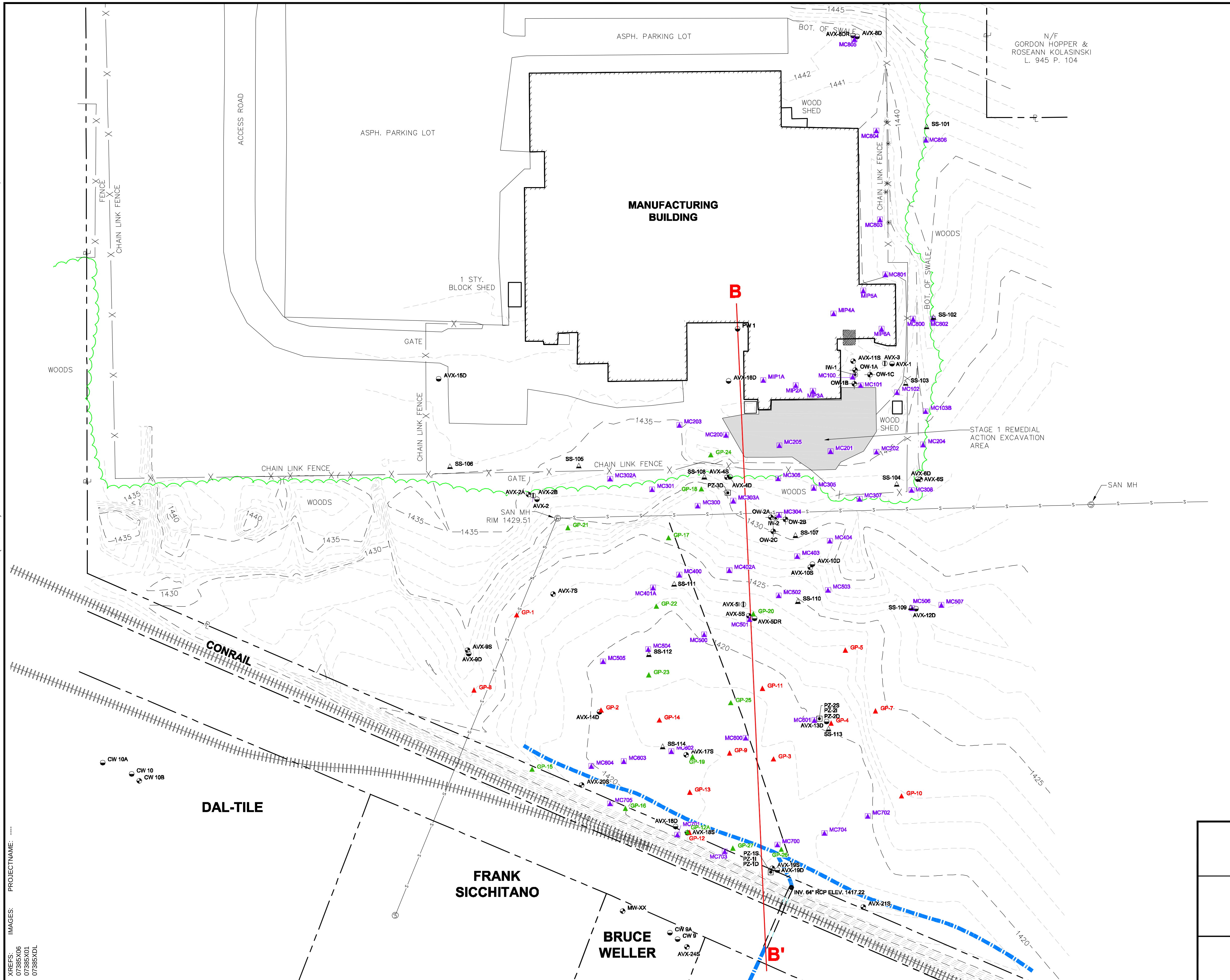
FS INVESTIGATION REPORT

FACILITY LOCATION

ARCADIS

FIGURE
1

10/21/2011 SYRACUSE-141ENV-DJHOWES
B0007385/0000/00036/CDR/07385N03.CDR



LEGEND:

AVX-3	SHALLOW MONITORING WELL LOCATION
AVX-2B	INTERMEDIATE MONITORING WELL LOCATION
AVX-1	DEEP MONITORING WELL LOCATION
PZ-1S	PIEZOMETER LOCATION
IW-1	INJECTION WELL LOCATION
OW-1	OBSERVATION WELL LOCATION
MC700	DIRECT SENSING BORING LOCATION
SS-101	SURFACE SOIL SAMPLE LOCATION
GP-1	2003 GEOPROBE BORING LOCATION
GP-24	2004 GEOPROBE BORING LOCATION
	STAGE 1 REMEDIAL ACTION EXCAVATION AREA
	UTILITY POLE
	BENCHMARK
	INVERT OF CULVERT PASSING BENEATH RAILROAD TRACKS
	PROPERTY BOUNDARY
	SANITARY SEWER LINE
	SPDES DISCHARGE PIPE
	UN-NAMED CREEK
	APPROXIMATE LOCATION OF FORMER UNDERGROUND STORAGE TANK EXCAVATION
B———B'	CROSS-SECTION LOCATION

NOTES:

1. PROPERTY LINE (JANUARY 13, 1981), SANITARY SEWER LINE (OCTOBER 2003), TOPOGRAPHIC CONTOURS (SOUTH OF FACILITY FENCE) (OCTOBER 2004), AND SPDES DISCHARGE PIPE (FEBRUARY 2, 2005) LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES.

2. AVX-18S LOCATION (FEBRUARY 2, 2005), AVX-18D AND AVX-19D LOCATIONS (JUNE 5, 2006), AVX-21S, AVX-22S, AVX-23S, AVX-24S, AND MW-XX LOCATIONS (MAY 5, 2008) OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES.

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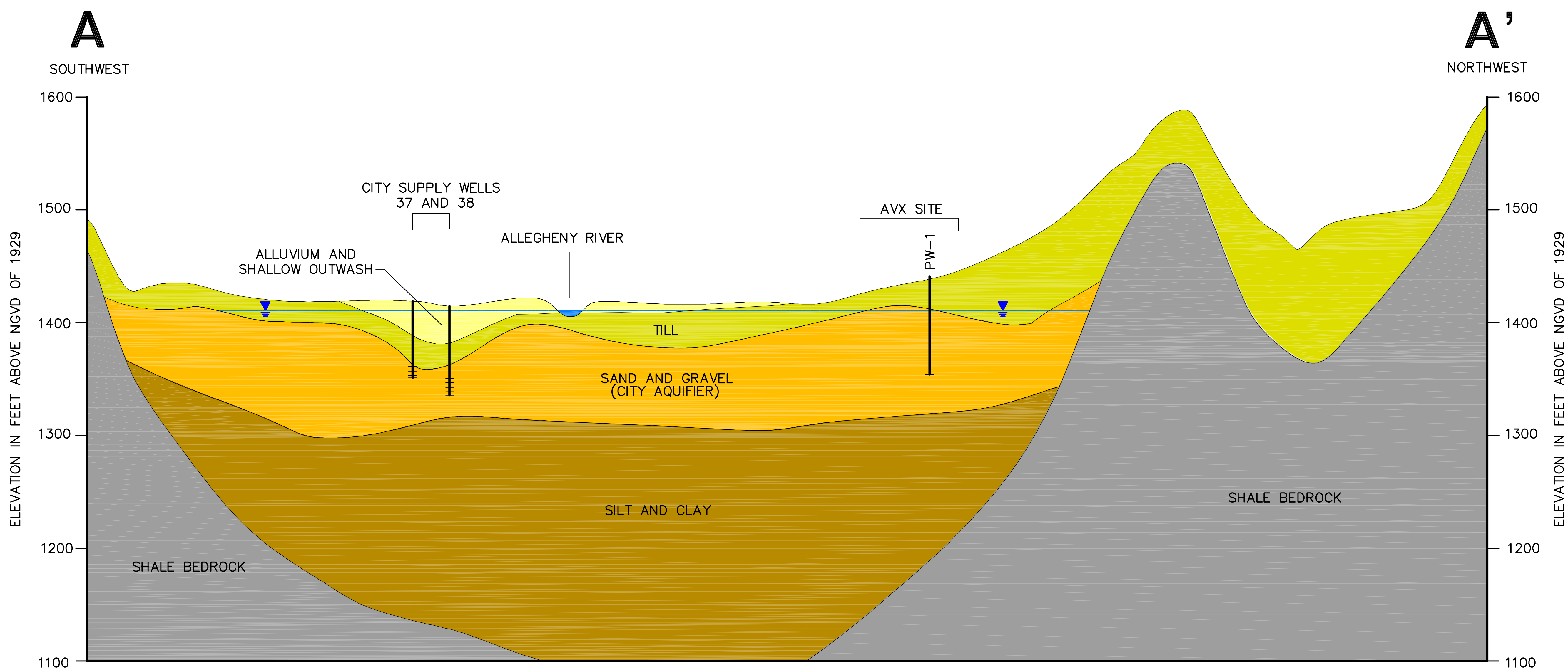
0 50' 100'
GRAPHIC SCALE

AVX CORPORATION
OLEAN, NEW YORK
FS INVESTIGATION REPORT

FACILITY MAP

ARCADIS

FIGURE
2



LEGEND:

- ALLUVIUM AND SHALLOW OUTWASH – RECENT ALLUVIAL DEPOSITS OF PREDOMINANTLY SILT AND CLAY. MAY INCLUDE LOCAL SILT, SAND AND GRAVEL OUTWASH DEPOSITS.
- TILL – POORLY SORTED SILTY TILL, WITH CLAY, SAND, GRAVEL AND COBBLES. INCLUDES LOCAL BEDS OF FINE OR FINE TO MEDIUM SAND.
- SAND AND GRAVEL (CITY AQUIFER) – GLACIAL OUTWASH, PREDOMINANTLY SAND AND GRAVEL INTERBEDDED WITH SILT AND SILTY SAND. BASAL PORTION MAY INCLUDE SILTY OR CLAYEY GRAVEL.
- SILT AND CLAY – LACUSTRINE DEPOSITS. MAY INCLUDE SAND AND GRAVEL DELTAIC DEPOSITS AT BASE.
- BEDROCK – DEVONIAN AGED SHALE
- 38 WELL ID
- SCREENED INTERVAL

0 1000' 2000'

APPROXIMATE HORIZONTAL SCALE

VERTICAL EXAGGERATION = 10x

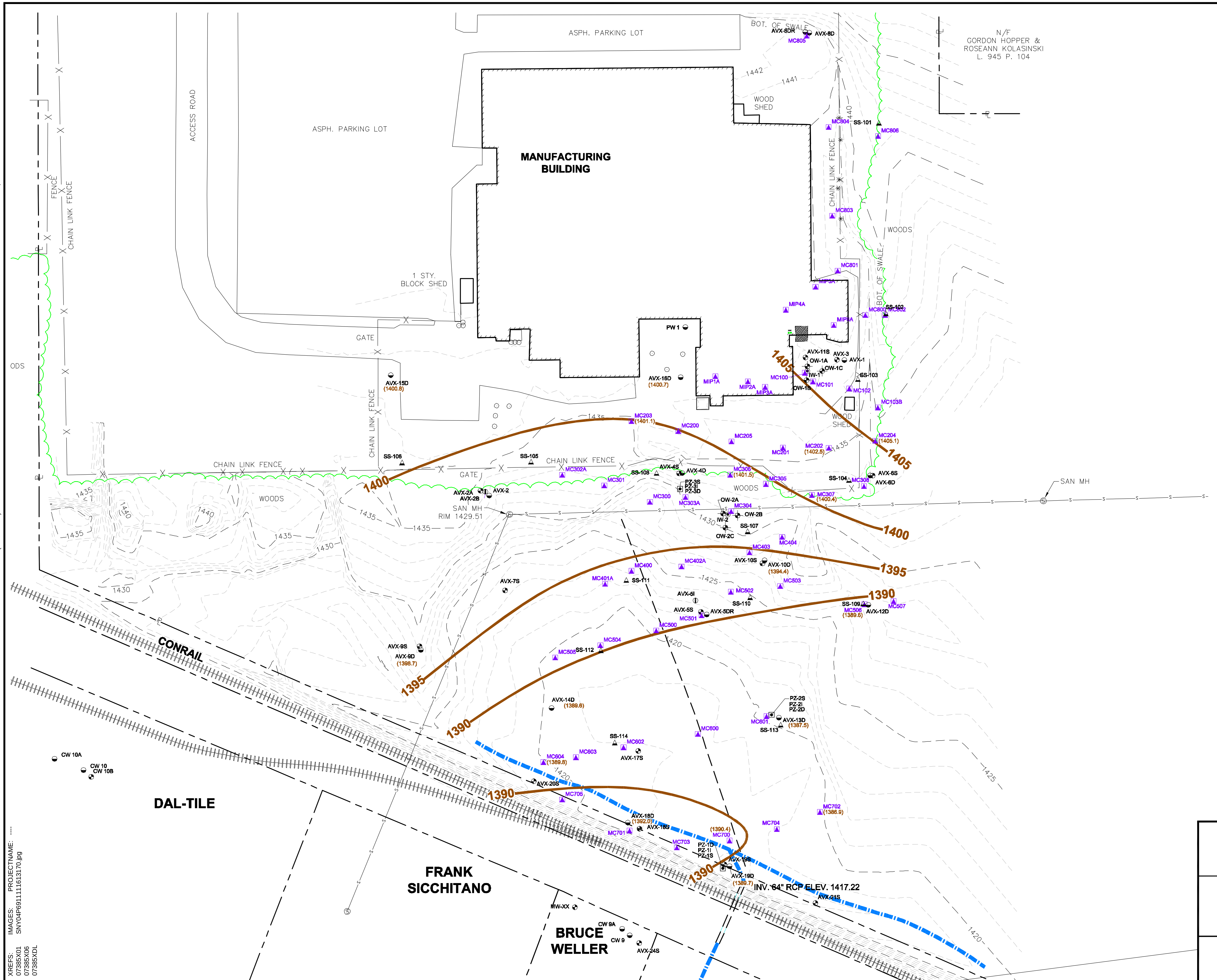
ADAPTED FROM: ZARRIELLO, P.J. AND REYNOLDS, R.J., HYDROGEOLOGY OF THE OLEAN AREA, CATTARAUGUS COUNTY, NEW YORK, USGS WRI 85-4157 SECTION G-G'.

AVX CORPORATION
OLEAN, NEW YORK
FS INVESTIGATION REPORT

SIMPLIFIED GEOLOGIC CROSS-SECTION A - A'

ARCADIS

FIGURE **3**



LEGEND:

AVX-3	SHALLOW MONITORING WELL LOCATION
AVX-2B	INTERMEDIATE MONITORING WELL LOCATION
AVX-1	DEEP MONITORING WELL LOCATION
PZ-1S	PIEZOMETER LOCATION
IW-1	INJECTION WELL LOCATION
OW-1	OBSERVATION WELL LOCATION
MC700	DIRECT SENSING BORING LOCATION
SS-101	UTILITY POLE
	BENCHMARK
	INVERT OF CULVERT PASSING BENEATH RAILROAD TRACKS
	PROPERTY BOUNDARY
	SANITARY SEWER LINE
	SPDES DISCHARGE PIPE
	UN-NAMED CREEK
	APPROXIMATE LOCATION OF FORMER UNDERGROUND STORAGE TANK EXCAVATION
1408 (1409)	APPROXIMATE ELEVATION OF THE TOP OF CITY AQUIFER (FT AMSL)
	TOP OF CITY AQUIFER ELEVATION CONTOUR (FT AMSL)

NOTES:

1. PROPERTY LINE (JANUARY 13, 1981), SANITARY SEWER LINE (OCTOBER 2003), TOPOGRAPHIC CONTOURS (SOUTH OF FACILITY FENCE) (OCTOBER 2004), AND SPDES DISCHARGE PIPE (FEBRUARY 2, 2005) LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES.

2. AVX-18S LOCATION (FEBRUARY 2, 2005), AVX-19S, AVX-20S, AVX-18D AND AVX-19D LOCATIONS (JUNE 5, 2006), AVX-21S, AVX-22S, AVX-23S, AVX-24S, AND MW-XX LOCATIONS (MAY 5, 2008) OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES.

3. PIEZOMETER (PZ), INJECTION WELL (IW), OBSERVATION WELL (OW) AND MEMBRANE INTERFACE PROBE (MIP) LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON APRIL 28, 2011.

0 50' 100'
GRAPHIC SCALE

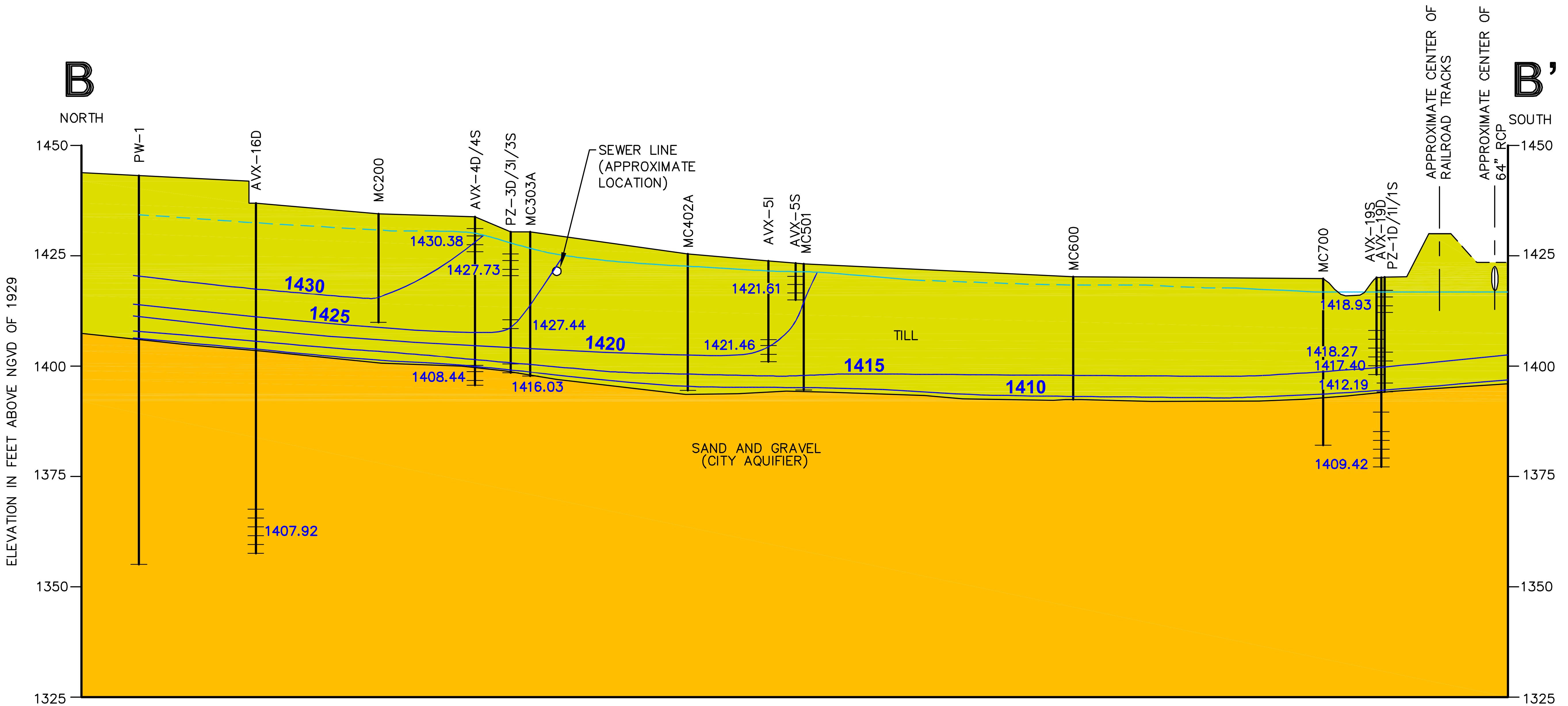
AVX CORPORATION
OLEAN, NEW YORK
FS INVESTIGATION REPORT

TOP OF CITY AQUIFER STRUCTURE CONTOUR MAP

ARCADIS

FIGURE 5

CITY: SYRACUSE, NY GROUP: ENVCAD DB: R. BASSETT A.Schilling PM/TM: M. HANISH LYR:ON=*;OFF=REF, (FRZ)
G:\ENVCAD\SYRACUSE\ACT\B0007385\0000\00036\DWG\07385W01.DWG LAYOUT: 5 SAVED: 11/16/2011 2:05 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 11/16/2011 2:05 PM BY: SCHILLING, ADAM
XREFS: 07385X01 07385X06 07385XDL IMAGES: SNY04P69111613170.jpg PROJECTNAME: ----



LEGEND:

TILL – POORLY SORTED SILTY TILL, WITH CLAY, SAND, GRAVEL AND COBBLES. INCLUDES LOCAL BEDS OF FINE OR FINE TO MEDIUM SAND.

SAND AND GRAVEL (CITY AQUIFER) – GLACIAL OUTWASH, PREDOMINANTLY SAND AND GRAVEL INTERBEDDED WITH SILT AND SILTY SAND. BASAL PORTION MAY INCLUDE SILTY OR CLAYEY GRAVEL.

AVX-5S WELL ID

SCREENED INTERVAL

BOTTOM OF BORING

1407.92 JUNE 27, 2011 GROUNDWATER ELEVATION

1415 GROUNDWATER ELEVATION CONTOUR

WATER TABLE (TILL)(DASHED WHERE INFERRED)

0 50' 100'

HORIZONTAL SCALE: 1" 50'

VERTICAL EXAGGERATION = 2x

AVX CORPORATION
OLEAN, NEW YORK
FS INVESTIGATION REPORT

GEOLOGIC CROSS-SECTION B - B'

ARCADIS

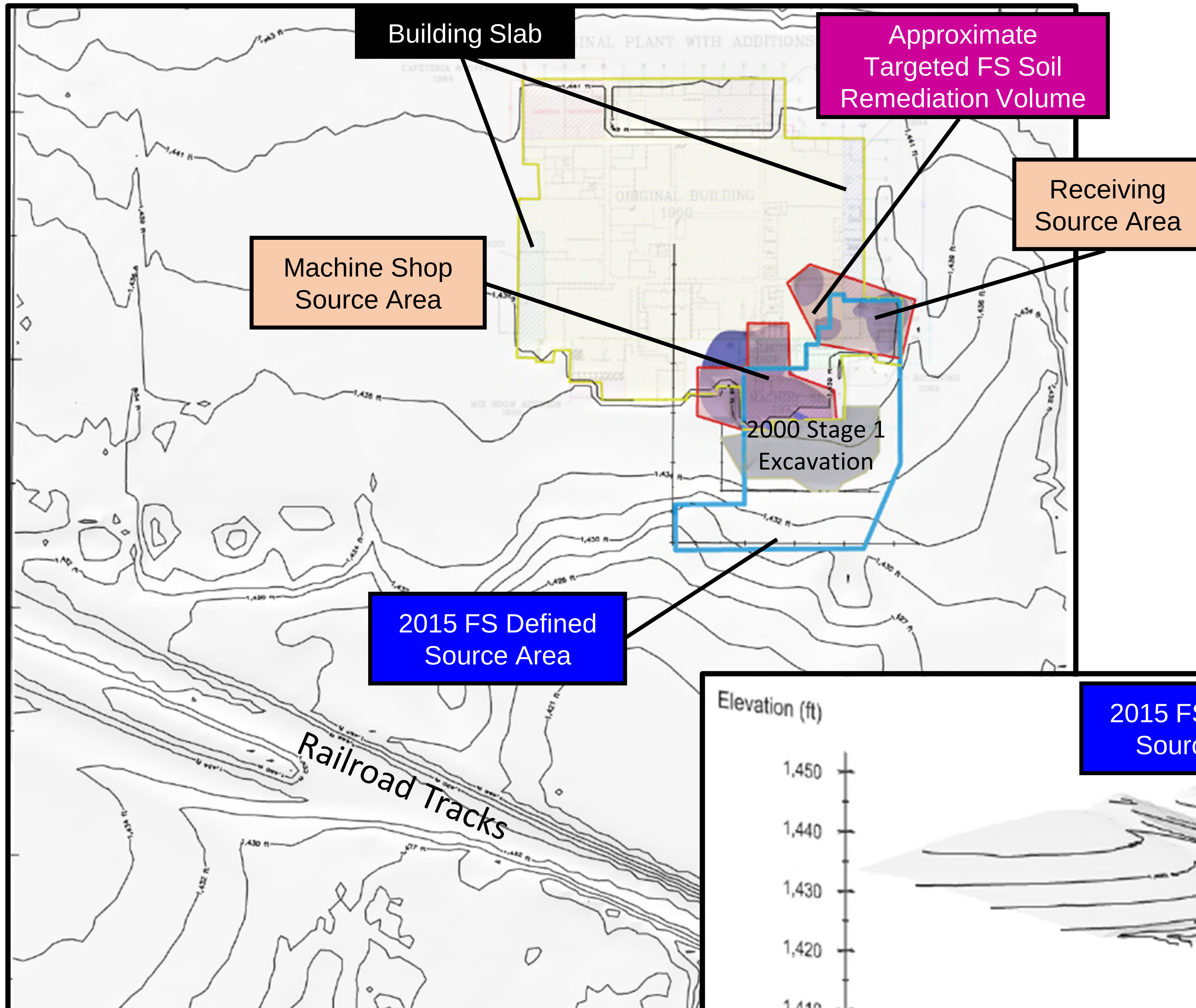
FIGURE
6

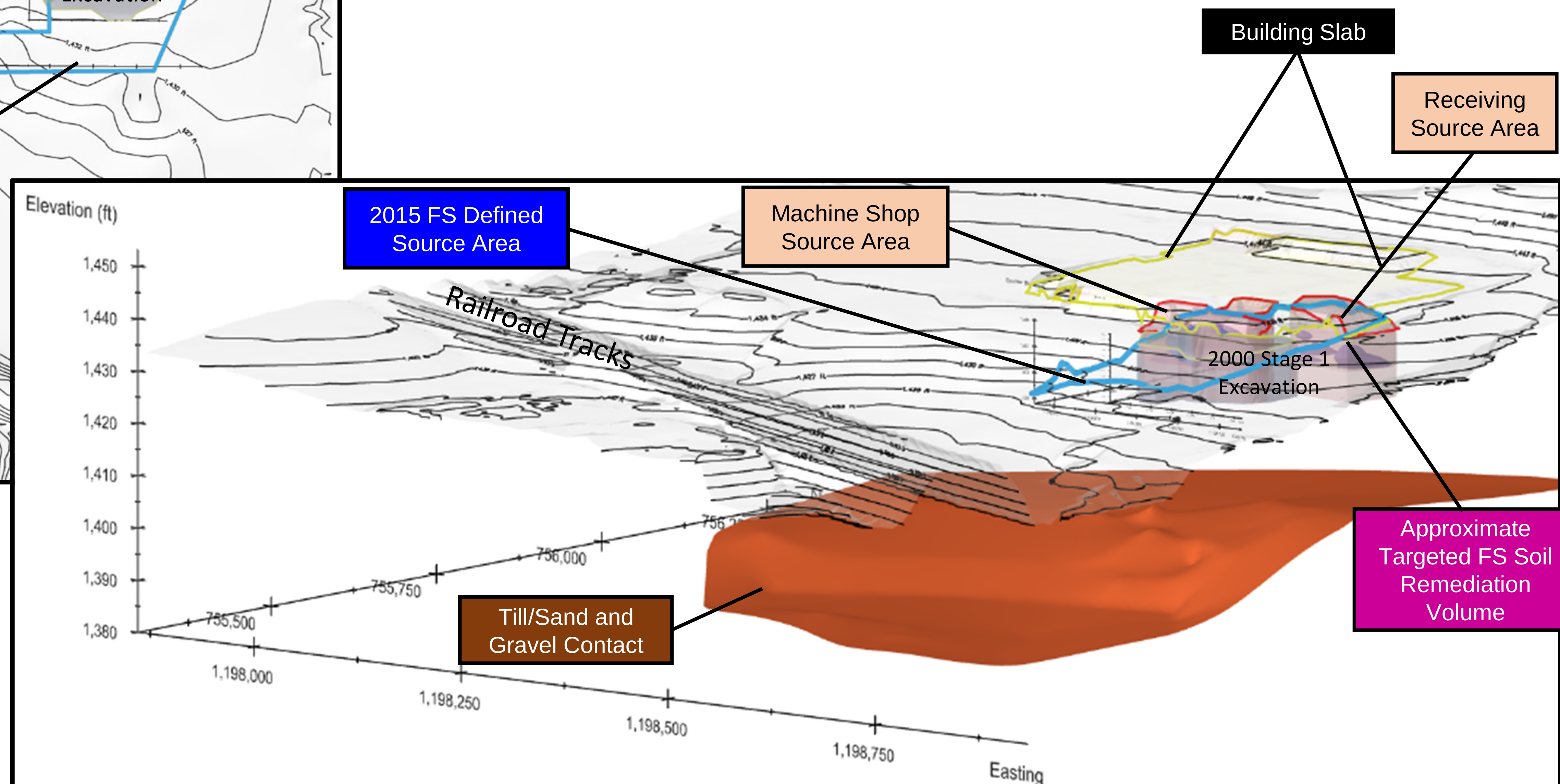
CITY: Syracuse DIV/GROUP: EnvCAD DB: W. JONES, R. BASSETT, A.Schilling PM/TM: M. HANISH LYR: ON=*;OFF=REF, (FRZ)
G:\ENVCAD\SYRACUSE\ACT\B0007385\0000\00036\DWG\07385V04.DWG LAYOUT: 6SAVED: 11/14/2011 2:59 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: ----PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 11/14/2011 2:59 PM BY: SCHILLING, ADAM
XREFS: 07385X00 IMAGES: PROJECTNAME: ----

Appendix B

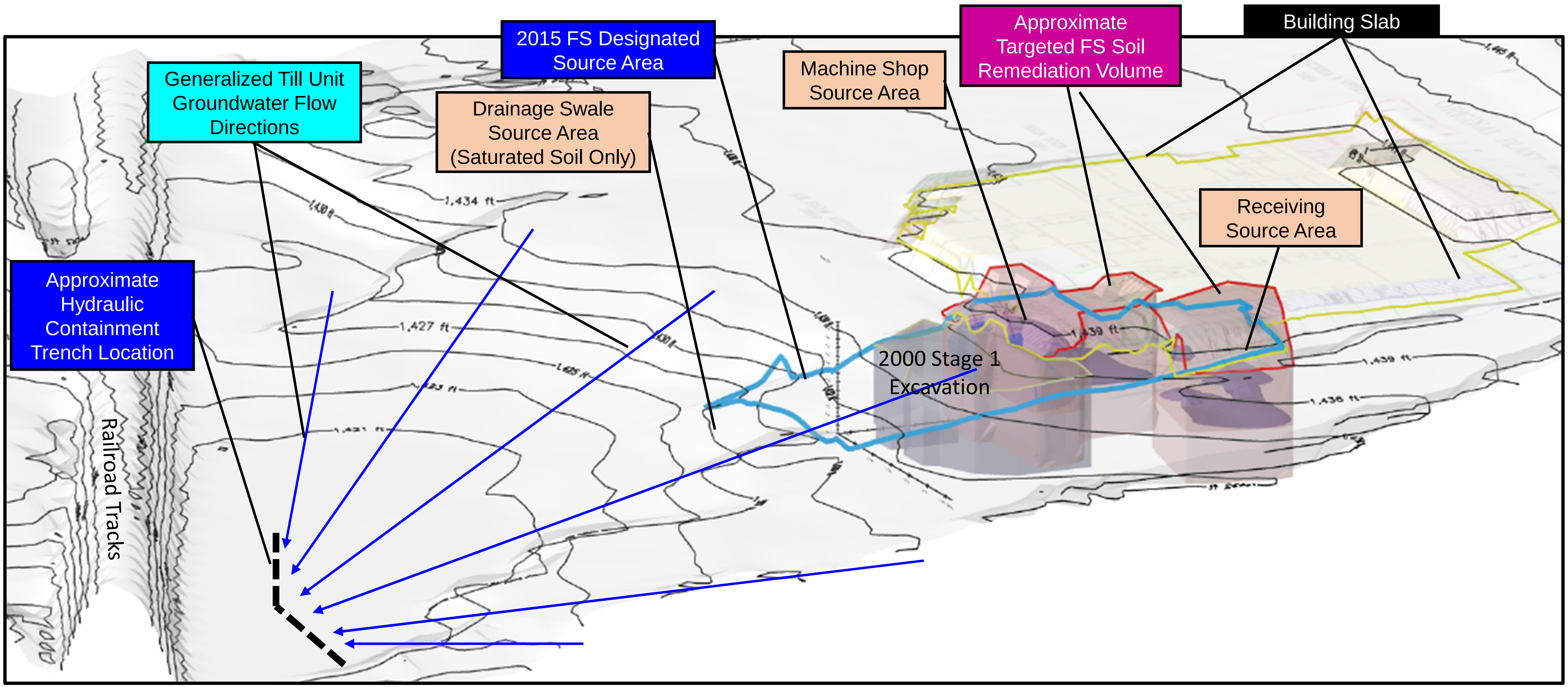
EVS 3-D Modeled VOC Distributions and Elevation of Water Table Analysis

3-D Model View of Key Property Features





3-D Model View of Key Property Features



Hanish, Mark

From: Hanish, Mark
Sent: Monday, April 10, 2023 3:36 PM
To: 'Wurtz, Maeve'
Cc: Mannino, Pietro; Scorca, Michael; Zarella, Paul; Jim Zemak; Jacqueline Frazier; Longino, Bettina; Popham, William; Kivowitz, Sharon (she/her/hers)
Subject: RE: KAVX Olean OU5 Feasibility Study Comments - Summary of February 16, 2023 Conference Call
Attachments: 2022-10-27 - Till Unit Water Table Contour Map.pdf; 2022-10-27 Table 1 (GW Gauging) from 2023-02 GWMR.pdf; Table 2 GW Gauging (October 2022) for Sat Zone Elevation Calc.pdf; 2023-04-10 Vol and Mass Est Image to EPA.pptx

Hi Maeve,

As a follow-up to your March 29th email transmitting the USEPA's comments on the February 16th meeting summary notes (email titled *RE: KAVX Olean OU5 Feasibility Study Comments - Summary of February 16, 2023 Conference Call*), our March 31st reply email, and subsequent telephone conversations, we have performed additional 3-D modeling to better define/depict the area/volume of volatile organic compound (VOCs) in unsaturated soil to be targeted for remediation. A pair of side by side images is attached (PowerPoint file) that show the approximate horizontal and vertical extent of the soil remediation area for the Feasibility Study. The following paragraphs provide additional detail.

Based on our conversations and your email, we understand that the USEPA is requesting that the remedial alternatives in the Feasibility Study target the volume of soil that contains site-related VOCs at concentrations above the remedial goals (horizontal limit) and that is unsaturated (vertical limit). As I clarified in our follow-up call, the surface of the groundwater table along the southern edge of the former building is not at an elevation of 1424 feet above mean sea level (ft amsl) but rather several feet above that. As described in the prior version of the Feasibility Study and other related documents, we know that the prior Stage 1 Excavation penetrated the water table and extended some distance into the saturated zone. The groundwater surface that marks the unsaturated/saturated soil boundary is in fact at approximately 1432 ft amsl, as shown on **Figure 3** for an October 27, 2022, gauging event presented in our February 2023 Groundwater Monitoring. That figure presents the groundwater contour map for the till water-bearing zone based on groundwater gauging on October 27, 2022.

Table 1 (attached) from the October 2022 groundwater monitoring event report summarizes the last 10 groundwater gauging events, dating back to April 2018. Focusing on the wells that are clustered near the southern edge of the former building (wells AVX-3, IW-1, OW-1A, OW-1B and OW-1C), the minimum (i.e., or lowest) groundwater elevation at any of those wells over that period was higher than 1431 ft amsl (see **Table 2**). Expanding the area of interest further south beyond the former Stage 1 Excavation, the average groundwater elevation at monitoring wells AVX-4S and AVX-6S also is higher than 1430 ft amsl (see **Table 2**). Therefore, 1430 ft amsl has been chosen as a conservatively low saturated/unsaturated zone elevation estimate and as such that elevation will serve as the targeted bottom elevation for the soil remedy evaluated in the Feasibility Study.

With regard to the horizontal extent of the soil remediation target area for one minor adjustment was made to slightly limit the area of remediation to protect pumping well PW-1. Furthermore, Arcadis understands that some additional pre-design investigation of soil will be performed at the "plume" perimeter to that will be used to refine the area of remediation during the remedial design phase.

We will also make appropriate revisions to the FS based on the other comments your provided on March 29th.

Please let us know is you have any additional thoughts about the above. We are proceeding with revising the OU-5 Feasibility Study based on the above assumption.

Regards

Mark

From: Wurtz, Maeve <Wurtz.Maeve@epa.gov>
Sent: Wednesday, March 29, 2023 4:57 PM
To: Hanish, Mark <Mark.Hanish@arcadis.com>
Cc: Mannino, Pietro <Mannino.Pietro@epa.gov>; Scorca, Michael <Scorca.Michael@epa.gov>; Zarella, Paul <zarella.paul@epa.gov>; Jim Zemak <jim.zemak@kyocera-avx.com>; Jacqueline Frazier <jacqueline.g.frazier@usace.army.mil>; Longino, Bettina <Bettina.Longino@arcadis.com>; Popham, William <William.Popham@arcadis.com>; Kivowitz, Sharon (she/her/hers) <Kivowitz.Sharon@epa.gov>
Subject: RE: KAVX Olean OU5 Feasibility Study Comments - Summary of February 16, 2023 Conference Call

Mark,

The following are our comments to the February 16th meeting summary notes sent 2/27/23 as well as additional direction regarding the target volumes for each of the remedial alternatives.

In addition, in response to KAVX's 2/7/23 request for an extension, EPA hereby grants a 75 day extension from the original deadline of 2/25/23, bringing the due date to submit the response to comments and the revised FS to 5/11/23.

Comment #40: Remove "precedent". Revise the bullet that refers to the Stage 1 Excavation to: The soil remedy approach takes into consideration the historical Stage 1 Excavation Area remediation. At that time, the Stage 1 Excavation focused on addressing unsaturated soils, however a portion of the soil from the saturated zone were also removed. The remedial alternatives considered as part of this FS consider active remediation to the water table (an elevation of approximately 1,424 feet amls).

Comment #79:

1) The summary notes refer to "MNA". Please remove references to MNA and replace with long term monitoring. Simply inserting LTM may not be grammatically correct, and additional revisions to the text may be necessary.

2) The soil target area in the draft FS comprises of unsaturated soils with concentrations above 10 mg/kg. On 3/2/23 KAVX provided additional mass and volume information for saturated soils. Based on EPA's review, each of the remedial alternatives evaluated in the FS should apply to unsaturated soils. EPA suggests that each alternative description include the flexibility to target additional soils (using the same technology to the extent practicable) in the saturated zone during implementation of the remedial action, should additional data collect as part of the PDI demonstrate a significant benefit to doing so.

3) While EPA's previous comments described the evaluation of the excavation alternative using the protection of groundwater criteria as a one-off, the NYS protection of groundwater criteria, instead of the 10 mg/kg value, should be applied to each of the alternatives

Tables Comment #1: This topic is not limited to 1,4-dioxane, but also includes PFOA and PFOS.

Tables Comment #2 and Comment #3: Please refer to Alternative 2 as LTM and not MNA. EPA will review the surrogate monitoring approach when it is submitted. However, to demonstrate that RAOs for soil can be met, soils data will be necessary. The frequency and amount of soil data would depend on the alternative being evaluated.

Tables Comment #31: A schedule for the submission of the Section 4 markup is needed.

Figures Comment #1: Remove …"and approvable"

Please let me know if you would like to schedule a call to talk about the comments.

Thanks,
Maeve

Maeve Wurtz
Remedial Project Manager
United States Environmental Protection Agency
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(212) 637-4230

From: Hanish, Mark <Mark.Hanish@arcadis.com>
Sent: Monday, February 27, 2023 7:43 AM
To: Wurtz, Maeve <Wurtz.Maeve@epa.gov>
Cc: Mannino, Pietro <Mannino.Pietro@epa.gov>; Scorca, Michael <Scorca.Michael@epa.gov>; Zarella, Paul <Zarella.Paul@epa.gov>; Jim Zemak <jim.zemak@kyocera-avx.com>; Jacqueline Frazier <jacqueline.g.frazier@usace.army.mil>; Longino, Bettina <Bettina.Longino@arcadis.com>; Popham, William <William.Popham@arcadis.com>
Subject: KAVX Olean OU5 Feasibility Study Comments - Summary of February 16, 2023 Conference Call

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Hi Maeve,

As promised, attached is a summary of our understanding of the discussions we had during the above-referenced conference call regarding the USEPA's comments to the KAVX Olean Property (OU-5) November 2022 FS Report. Please review and provide comments or clarifications, if necessary.

The one longer lead item that KAVX/Arcadis is working on include comparative estimates of the volume/mass of additional remediation target area/volume scenarios, using the EVS that we have constructed for the project. The alternative scenarios, that will be developed for discussion purposes, will be based on remediation scenarios that expand the target of the remedy to include the area/volume exceeding Remediation Goals. The modeler that performed the prior EVS modeling for this project was on vacation last week, so we hope to get started on this effort this week. I will follow up with you on a time estimate for additional EVS modeling scenarios after I have had a chance to discuss the task with the modeler and understand his schedule.

Regards

Mark

From: Wurtz, Maeve <Wurtz.Maeve@epa.gov>
Sent: Friday, February 17, 2023 1:32 PM
To: Hanish, Mark <Mark.Hanish@arcadis.com>
Cc: Longino, Bettina <Bettina.Longino@arcadis.com>
Subject: RE: Olean OU5 Feasibility Study Comments

Hi Mark, here are the presentations/info on EK-ISCO/BIO that Mike mentioned during our call yesterday.

-----Original Appointment-----
From: Wurtz, Maeve
Sent: Tuesday, February 14, 2023 9:04 AM
To: Wurtz, Maeve; Mannino, Pietro; Hanish, Mark; Longino, Bettina
Cc: Scorca, Michael; Zarella, Paul
Subject: Olean OU5 Feasibility Study Comments
When: Thursday, February 16, 2023 1:30 PM-2:30 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Microsoft Teams Meeting

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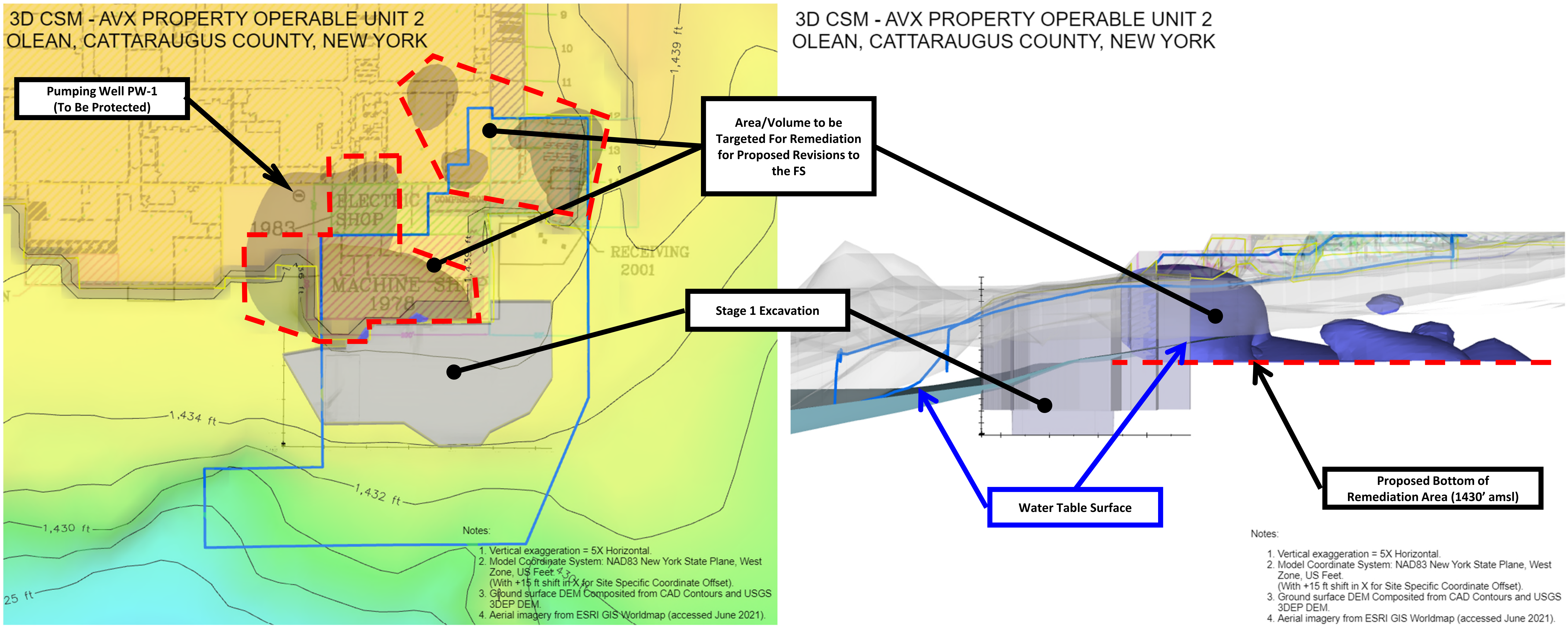
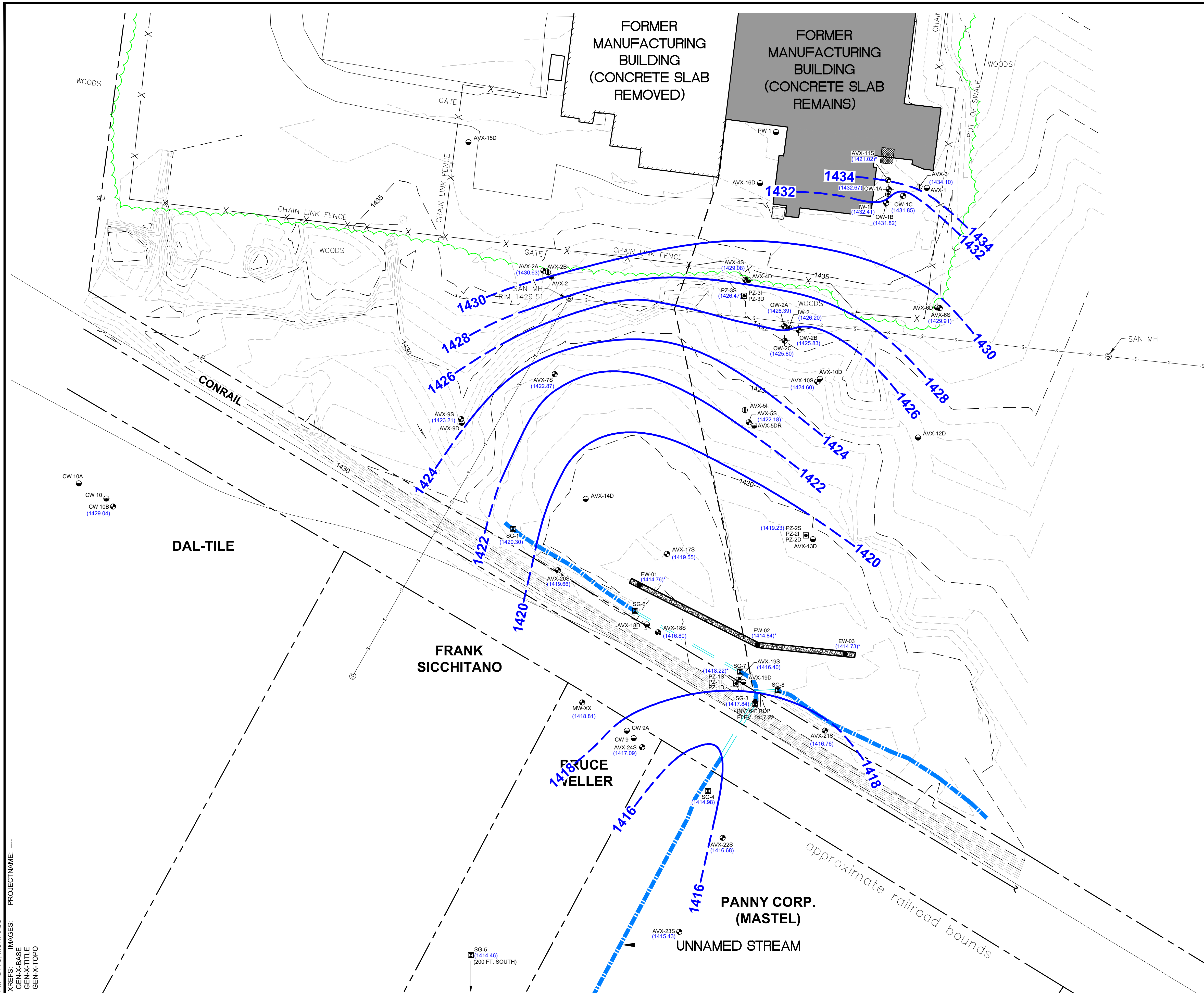
Targeting Soil RGs (Protection of Groundwater) to 1430’ amsl (Base of Unsaturated Zone)

Remediation Area, Volume, and Mass Scenarios





LEGEND:

AVX-3	SHALLOW MONITORING WELL LOCATION
AVX-2B	INTERMEDIATE MONITORING WELL LOCATION
AVX-1	DEEP MONITORING WELL LOCATION
EW-01	EXTRACTION WELL/SUMP
PZ-2S	PIEZOMETER LOCATION
IW-1	INJECTION TEST WELL LOCATIONS
OW-1	OBSERVATION WELL LOCATION
SG-1	STAFF GAUGE
	PROPERTY BOUNDARY
	SANITARY SEWER LINE
	SPDES DISCHARGE PIPE
	UNNAMED STREAM
	STREAM WITH CULVERT
	APPROXIMATE EDGE OF VEGETATION
1435	5 FOOT GROUND SURFACE CONTOUR
	1 FOOT GROUND SURFACE CONTOUR
	APPROXIMATE LOCATION OF FORMER UNDERGROUND STORAGE TANK EXCAVATION
	HYDRAULIC CONTAINMENT TRENCH
(1434.10)	GROUNDWATER ELEVATION (FT AMSL)
1434	GROUNDWATER ELEVATION CONTOUR (FT AMSL) (DASHED WHERE INFERRED)
*	NOT USED FOR DEVELOPMENT OF THE GROUNDWATER ELEVATION CONTOURS

NOTES:

1. PROPERTY LINE (JANUARY 13, 1981), SANITARY SEWER LINE (OCTOBER 2003) AND TOPOGRAPHIC CONTOURS (SOUTH OF FACILITY FENCE) (OCTOBER 2004) LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES. TOPOGRAPHIC CONTOURS AND SPDES DISCHARGE PIPE LOCATIONS UPDATED FROM SURVEY PERFORMED BY FISHER ASSOCIATES ON JUNE 29, 2018.
2. AVX–18S LOCATION (FEBRUARY 2, 2005), AVX–19S, AVX–20S, AVX–18D AND AVX–19D LOCATIONS (JUNE 5, 2006), AVX–21S, AVX–22S, AVX–23S, AVX–24S, AND MW–XX LOCATIONS (MAY 5, 2008) OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON THE CORRESPONDING DATES.
3. PIEZOMETER (PZ), INJECTION WELL (IW) AND OBSERVATION WELL (OW) LOCATIONS OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON APRIL 28, 2011.
4. STAFF GAUGE (SG) LOCATIONS SG–1, SG–3, AND SG–4 OBTAINED FROM SURVEY MAPS PREPARED BY D. MICHAEL CANADA ON OCTOBER 14, 2011.
5. REFERENCE ELEVATIONS FOR ALL WELLS AND STAFF GAUGES WERE RE–ESTABLISHED BY D. MICHAEL CANADA ON AUGUST 27, 2012.
6. STAFF GAUGE SG–2 (NOT DEPICTED) REMOVED DURING PRE–DESIGN INVESTIGATION PREPARATORY CONSTRUCTION ACTIVITIES.
7. STAFF GAUGE LOCATIONS SG–6, SG–7 AND SG–8 ARE APPROXIMATE AND HAVE NOT BEEN SURVEYED.
8. HYDRAULIC CONTAINMENT TRENCH AND EXTRACTION WELLS EW–1, EW–2, AND EW–3 INSTALLED IN SEPTEMBER 2022, REFERENCE ELEVATION ESTABLISHED BY ARCADIS ON NOVEMBER 14, 2022.

0 50' 100'
GRAPHIC SCALE

KYOCERA AVX COMPONENTS CORPORATION
OLEAN, NEW YORK
GROUNDWATER SAMPLING EVENT NO. 51

GROUNDWATER ELEVATION CONTOURS SHALLOW WELLS OCTOBER 27, 2022

ARCADIS

FIGURE 3

CITY: Syracuse DIV/GROUP: EnvCAD DB: R.BASSETT, E. KRAHMER, A.Schilling TM: D.Kingsley LYR:ON=*;OFF=REF (FRZ)
C:\Users\cms5224\ACCDocs\Arcadis\AUS-AVX-OLEAN-OLEAN New York\Project Files\2023\01-In Progress\01-DWG\GWM-2022Q4-F03-GW SHALLOW.dwg LAYOUT: 3 SAVED: 2/3/2023 6:10 PM ACADVER: 24.2S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 2/9/2023 2:55
PM BY: C. MUNIRAJU
XREFS: GEN-X-BASE GEN-X-TITLE GEN-X-TOPO IMAGES: PROJECTNAME: ----

Table 1
Groundwater Elevation Summary
Groundwater Sampling Event No. 51 Report
KYOCERA AVX Components Corporation
Olean, New York

Date	Reference Elevation (ft amsl)	Well Installation Date	April 4, 2018		October 24, 2018		April 24, 2019		October 28, 2019		April 9, 2020	
Well I.D.			Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)
Shallow Wells and Piezometers												
AVX-2A	1436.80	10/29/84	4.74	1432.06	5.50	1431.30	5.05	1431.75	5.05	1431.75	5.22	1431.58
AVX-3	1440.63	10/25/84	5.58	1435.05	6.70	1433.93	5.90	1434.73	5.64	1434.99	5.68	1434.95
AVX-4S	1434.36	05/03/85	2.89	1431.47	3.46	1430.90	3.51	1430.85	3.26	1431.10	3.40	1430.96
AVX-5S	1425.83	04/23/85	2.82	1423.01	3.19	1422.64	3.23	1422.60	3.38	1422.45	3.87	1421.96
AVX-6S	1436.01	04/30/85	3.30	1432.71	4.07	1431.94	3.80	1432.21	4.20	1431.81	3.79	1432.22
AVX-7S	1425.91	04/29/85	2.84	1423.07	2.90	1423.01	2.93	1422.98	2.93	1422.98	2.87	1423.04
AVX-9S	1430.91	04/17/98	6.51	1424.40	7.15	1423.76	6.31	1424.60	7.69	1423.22	6.34	1424.57
AVX-10S	1429.61	04/21/98	4.02	1425.59	4.20	1425.41	4.23	1425.38	4.18	1425.43	4.14	1425.47
AVX-11S	1436.18	08/09/00	22.46	1413.72	15.15	1421.03	15.09	1421.09	23.46	1412.72	15.01	1421.17
AVX-17S	1422.05	06/03/03	2.27	1419.78	2.25	1419.80	2.29	1419.76	2.25	1419.80	2.25	1419.80
AVX-18S	1421.68	12/20/04	2.96	1418.72	3.20	1418.48	3.12	1418.56	3.17	1418.51	3.02	1418.66
AVX-19S	1422.02	05/03/06	3.47	1418.55	3.81	1418.21	3.62	1418.40	3.65	1418.37	3.59	1418.43
AVX-20S	1423.33	05/04/06	3.49	1419.84	3.58	1419.75	3.60	1419.73	3.60	1419.73	3.60	1419.73
AVX-21S	1423.16	03/24/08	4.88	1418.28	5.12	1418.04	4.94	1418.22	5.01	1418.15	4.88	1418.28
AVX-22S	1425.86	03/25/08	8.18	1417.68	8.65	1417.21	8.32	1417.54	8.62	1417.24	8.25	1417.61
AVX-23S	1423.79	03/26/08	7.30	1416.49	8.11	1415.68	7.60	1416.19	8.01	1415.78	7.30	1416.49
AVX-24S	1429.22	03/25/08	11.33	1417.89	11.49	1417.73	11.31	1417.91	11.46	1417.76	11.22	1418.00
MW-XX	1428.96	NA	9.99	1418.97	10.04	1418.92	9.92	1419.04	10.06	1418.90	10.05	1418.91
CW-10B	1435.25	pre-1984	2.26	1432.99	4.61	1430.64	3.12	1432.13	5.28	1429.97	3.23	1432.02
IW-1	1435.96	03/08/11	1.72	1434.24	1.85	1434.11	1.70	1434.26	1.70	1434.26	1.75	1434.21
IW-2	1430.42	03/21/11	1.60	1428.82	2.83	1427.59	2.73	1427.69	2.90	1427.52	2.77	1427.65
OW-1A	1436.03	03/17/11	1.75	1434.28	1.92	1434.11	1.79	1434.24	3.09	1432.94	1.45	1434.58
OW-1B	1436.01	03/17/11	1.64	1434.37	2.45	1433.56	1.89	1434.12	3.48	1432.53	1.72	1434.29
OW-1C	1435.76	03/18/11	1.17	1434.59	2.39	1433.37	1.52	1434.24	2.40	1433.36	1.45	1434.31
OW-2A	1434.01	03/23/11	5.89	1428.12	6.34	1427.67	6.22	1427.79	7.32	1426.69	6.02	1427.99
OW-2B	1433.72	03/22/11	6.10	1427.62	6.47	1427.25	6.33	1427.39	7.01	1426.71	6.19	1427.53
OW-2C	1433.68	03/22/11	6.33	1427.35	6.68	1427.00	6.59	1427.09	6.69	1426.99	6.40	1427.28
PZ-1S	1423.44	03/15/11	4.29	1419.15	4.81	1418.63	4.68	1418.76	4.49	1418.95	4.62	1418.82
PZ-1I	1423.43	03/15/11	6.21	1417.22	6.45	1416.98	6.08	1417.35	6.63	1416.80	6.05	1417.38
PZ-1D	1423.44	03/15/11	13.41	1410.03	14.50	1408.94	13.06	1410.38	15.51	1407.93	11.57	1411.87
PZ-2S	1422.87	03/16/11	3.42	1419.45	3.69	1419.18	3.50	1419.37	3.55	1419.32	3.42	1419.45
PZ-2I	1422.88	03/16/11	4.24	1418.64	4.31	1418.57	4.25	1418.63	4.60	1418.28	4.03	1418.85
PZ-2D	1422.88	03/16/11	13.13	1409.75	14.19	1408.69	12.81	1410.07	15.23	1407.65	11.23	1411.65
PZ-3S	1433.00	03/19/11	4.69	1428.31	5.18	1427.82	5.02	1427.98	5.07	1427.93	4.71	1428.29
PZ-3I	1433.00	03/19/11	5.06	1427.94	5.30	1427.70	5.13	1427.87	5.30	1427.70	5.10	1427.90
PZ-3D	1433.02	03/19/11	21.43	1411.59	21.96	1411.06	20.62	1412.40	21.15	1411.87	19.70	1413.32
EW-1	1422.06	09/10/22	--	--	--	--	--	--	--	--	--	--
EW-2	1421.69	09/10/22	--	--	--	--	--	--	--	--	--	--
EW-3	1421.63	09/10/22	--	--	--	--	--	--	--	--	--	--
Intermediate Wells												
AVX-2B	1437.14	10/29/84	16.31	1420.83	16.65	1420.49	16.44	1420.70	17.03	1420.11	15.5	1421.64
AVX-5I	1426.38	05/05/85	4.1	1422.28	4.02	1422.36	4.11	1422.27	4.40	1421.98	4.05	1422.33
Deep Wells												
PW-1	1442.29	1959	41.25	1401.04	43.18	1399.11	40.13	1402.16	43.51	1398.78	37.25	1405.04
AVX-1	1439.75	10/24/84	33.02	1406.73	34.69	1405.06	32.30	1407.45	35.90	1403.85	30.42	1409.33
AVX-2	1437.34	10/27/84	30.41	1406.93	32.21	1405.13	29.84	1407.50	33.31	1404.03	28.22	1409.12
AVX-4D	1433.22	05/04/85	26.21	1407.01	27.91	1405.31	25.53	1407.69	29.06	1404.16	23.55	1409.67
AVX-5DR	1426.07	12/18/01	18.73	1407.34	20.46	1405.61	18.06	1408.01	21.65	1404.42	16.29	1409.78
AVX-6D	1435.29	05/03/85	28.00	1407.29	29.82	1405.47	27.41	1407.88	31.04	1404.25	25.43	1409.86
AVX-8D	1444.48	04/15/98	37.22	1407.26	39.10	1405.38	36.80	1407.68	39.80	1404.68	34.71	1409.77
AVX-8DR	1444.70	06/03/03	37.66	1407.04	39.41	1405.29	37.03	1407.67	40.51	1404.19	35.08	1409.62
AVX-9D	1431.11	04/16/98	23.90	1407.21	25.61	1405.50	23.26	1407.85	26.78	1404.33	21.44	1409.67
AVX-10D	1429.84	04/21/98	22.63	1407.21	24.40	1405.44	22.03	1407.81	25.54	1404.30	20.12	1409.72
AVX-12D	1430.29	01/02/02	22.98	1407.31	24.65	1405.64	22.32	1407.97	25.83	1404.46	20.45	1409.84
AVX-13D	1422.37	01/07/02	14.92	1407.45	16.72	1405.65	14.31	1408.06	17.86	1404.51	12.46	1409.91
AVX-14D	1422.89	01/11/02	15.55	1407.34	17.27	1405.62	14.92	1407.97	18.45	1404.44	13.11	1409.78
AVX-15D	1439.84	01/15/02	33.28	1406.56	34.93	1404.91	32.62	1407.22	36.15	1403.69	30.71	1409.13
AVX-16D	1434.67	01/22/02	28.42	1406.25	30.07	1404.60	27.69	1406.98	31.25	1403.42	25.73	1408.94
AVX-18D	1422.33	05/05/06	14.88	1407.45	16.69	1405.64	14.31	1408.02	17.81	1404.52	12.47	1409.86
AVX-19D	1422.60	05/04/06	15.13	1407.47	16.91	1405.69	14.51	1408.09	18.01	1404.59	12.70	1409.90
CW-9	1428.10	pre-1984	20.74	1407.36	22.39	1405.71	20.05	1408.05	21.82	1406.28	18.29	1409.81
CW-9A	1428.75	pre-1984	21.34	1407.41	23.00	1405.75	20.63	1408.12	21.95	1406.80	18.95	1409.80
CW-10	1436.31	pre-1984	29.13	1407.18	30.76	1405.55	28.45	1407.86	31.94	1404.37	26.67	1409.64
CW-10A	1436.57	pre-1984	29.48	1407.09	31.17	1405.40	28.75	1407.82	32.32	1404.25	27.03	1409.54
Staff Gauges												
SG-1	1421.65	NA	1.26	1420.39	1.48	1420.17	1.49	1420.16	1.99	1419.66	1.25	1420.40
SG-2	1420.52	NA	--	--	--	--	--	--	--	--	--	--
SG-3	1424.81	NA	6.13	1418.68	6.80	1418.01	6.82	1417.99	6.51	1418.30	6.75	1418.06
SG-4	1416.97	NA	1.65	1415.32	1.93	1415.04	1.91	1415.06	1.93	1415.04	1.92	1415.05
SG-5	1419.44	NA	5.96	1413.48	6.35	1413.09	6.30	1413.14	6.18	1413.26	6.34	1413.10
SG-6	NA	NA	--	--	1.75	--	1.81	--	1.74	--	1.71	--
SG-7	NA	NA	--	--	1.79	--	1.75	--	1.76	--	2.72	--
SG-8	NA	NA	--	--	1.71	--	1.71	--	1.69	--	1.65	--

Notes:
Reference elevations replaced with new survey information on 11/21/2012, reflecting survey performed by D. Michael Canada, 8/27/2012.
-- = denotes data not collected
A/S = suffix indicating shallow wells
B/I = suffix indicating intermediate wells
D = suffix indicating deep wells
ft amsl = feet above mean sea level

Table 1
Groundwater Elevation Summary
Groundwater Sampling Event No. 51 Report
KYOCERA AVX Components Corporation
Olean, New York

ARCADIS

Date / Well I.D.	Reference Elevation (ft amsl)	Well Installation Date	October 19, 2020		April 28, 2021		October 26, 2021		April 27, 2022		October 27, 2022	
			Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)
Shallow Wells and Piezometers												
AVX-2A	1436.80	10/29/84	6.09	1430.71	5.78	1431.02	4.58	1432.22	4.65	1432.15	6.17	1430.63
AVX-3	1440.63	10/25/84	6.68	1433.95	6.21	1434.42	4.18	1436.45	4.75	1435.88	6.53	1434.10
AVX-4S	1434.36	05/03/85	6.97	1427.39	4.64	1429.72	3.42	1430.94	3.22	1431.14	5.28	1429.08
AVX-5S	1425.83	04/23/85	4.55	1421.28	3.55	1422.28	3.37	1422.46	2.98	1422.85	3.65	1422.18
AVX-6S	1436.01	04/30/85	8.11	1427.90	5.03	1430.98	3.65	1432.36	3.49	1432.52	6.10	1429.91
AVX-7S	1425.91	04/29/85	3.35	1422.56	3.01	1422.90	3.37	1422.54	2.87	1423.04	3.04	1422.87
AVX-9S	1430.91	04/17/98	8.29	1422.62	6.74	1424.17	7.40	1423.51	6.33	1424.58	7.70	1423.21
AVX-10S	1429.61	04/21/98	6.19	1423.42	4.85	1424.76	3.69	1425.92	3.99	1425.62	5.01	1424.60
AVX-11S	1436.18	08/09/00	23.47	1412.71	23.18	1413.00	23.78	1412.40	23.79	1412.39	15.16	1421.02
AVX-17S	1422.05	06/03/03	2.49	1419.56	2.33	1419.72	2.07	1419.98	2.13	1419.92	2.50	1419.55
AVX-18S	1421.68	12/20/04	2.50	1419.18	3.33	1418.35	2.90	1418.78	2.89	1418.79	4.88	1416.80
AVX-19S	1422.02	05/03/06	3.68	1418.34	3.82	1418.20	3.46	1418.56	3.48	1418.54	5.62	1416.40
AVX-20S	1423.33	05/04/06	3.51	1419.82	3.73	1419.60	3.30	1420.03	3.34	1419.99	3.67	1419.66
AVX-21S	1423.16	03/24/08	5.57	1417.59	5.23	1417.93	4.78	1418.38	4.78	1418.38	6.40	1416.76
AVX-22S	1425.86	03/25/08	9.45	1416.41	8.78	1417.08	8.28	1417.58	8.10	1417.76	9.18	1416.68
AVX-23S	1423.79	03/26/08	8.51	1415.28	8.23	1415.56	7.36	1416.43	7.01	1416.78	8.36	1415.43
AVX-24S	1429.22	03/25/08	12.77	1416.45	12.71	1416.51	11.31	1417.91	11.21	1418.01	12.13	1417.09
MW-XX	1428.96	NA	12.20	1416.76	10.30	1418.66	10.05	1418.91	9.95	1419.01	10.15	1418.81
CW-10B	1435.25	pre-1984	3.12	1432.13	5.25	1430.00	4.80	1430.45	3.98	1431.27	6.21	1429.04
IW-1	1435.96	03/08/11	1.80	1434.16	1.73	1434.23	1.85	1434.11	1.69	1434.27	3.55	1432.41
IW-2	1430.42	03/21/11	4.61	1425.81	3.42	1427.00	2.41	1428.01	2.78	1427.64	4.22	1426.20
OW-1A	1436.03	03/17/11	4.76	1431.27	2.13	1433.90	2.43	1433.60	1.92	1434.11	3.36	1432.67
OW-1B	1436.01	03/17/11	4.68	1431.33	2.39	1433.62	1.59	1434.42	1.09	1434.92	4.19	1431.82
OW-1C	1435.76	03/18/11	4.62	1431.14	2.02	1433.74	1.39	1434.37	1.02	1434.74	3.91	1431.85
OW-2A	1434.01	03/23/11	8.22	1425.79	7.06	1426.95	5.63	1428.38	5.75	1428.26	7.62	1426.39
OW-2B	1433.72	03/22/11	8.13	1425.59	7.11	1426.61	5.78	1427.94	6.88	1426.84	7.89	1425.83
OW-2C	1433.68	03/22/11	8.60	1425.08	7.43	1426.25	6.02	1427.66	6.16	1427.52	7.88	1425.80
PZ-1S	1423.44	03/15/11	5.35	1418.09	5.11	1418.33	4.15	1419.29	4.44	1419.00	5.22	1418.22
PZ-1I	1423.43	03/15/11	7.36	1416.07	6.53	1416.90	6.06	1417.37	6.00	1417.43	7.88	1415.55
PZ-1D	1423.44	03/15/11	15.30	1408.14	13.43	1410.01	11.98	1411.46	11.53	1411.91	14.10	1409.34
PZ-2S	1422.87	03/16/11	3.02	1419.85	3.79	1419.08	3.39	1419.48	3.40	1419.47	3.64	1419.23
PZ-2I	1422.88	03/16/11	7.03	1415.85	4.45	1418.43	4.16	1418.72	4.07	1418.81	4.73	1418.15
PZ-2D	1422.88	03/16/11	15.05	1407.83	13.21	1409.67	11.58	1411.30	11.02	1411.86	13.62	1409.26
PZ-3S	1433.00	03/19/11	6.81	1426.19	5.93	1427.07	4.44	1428.56	4.59	1428.41	6.53	1426.47
PZ-3I	1433.00	03/19/11	7.00	1426.00	5.95	1427.05	4.75	1428.25	4.81	1428.19	6.38	1426.62
PZ-3D	1433.02	03/19/11	23.27	1409.75	21.66	1411.36	19.76	1413.26	19.06	1413.96	20.11	1412.91
EW-1	1424.60	09/10/22	--	--	--	--	--	--	--	--	7.30	1414.76
EW-2	1424.84	09/10/22	--	--	--	--	--	--	--	--	6.85	1414.84
EW-3	1425.10	09/10/22	--	--	--	--	--	--	--	--	6.90	1414.73
Intermediate Wells												
AVX-2B	1437.14	10/29/84	17.48	1419.66	16.85	1420.29	14.89	1422.25	15.29	1421.85	16.26	1420.88
AVX-5I	1426.38	05/05/85	5.40	1420.98	4.45	1421.93	3.92	1422.46	4.05	1422.33	4.29	1422.09
Deep Wells												
PW-1	1442.29	1959	45.49	1396.80	40.22	1402.07	38.89	1403.40	38.21	1404.08	41.57	1400.72
AVX-1	1439.75	10/24/84	35.40	1404.35	32.55	1407.20	31.13	1408.62	30.41	1409.34	33.91	1405.84
AVX-2	1437.34	10/27/84	32.92	1404.42	30.08	1407.26	28.51	1408.83	28.02	1409.32	31.37	1405.97
AVX-4D	1433.22	05/04/85	28.59	1404.63	25.83	1407.39	24.96	1408.26	10.69	1422.53	27.13	1406.09
AVX-5DR	1426.07	12/18/01	21.25	1404.82	18.67	1407.40	17.09	1408.98	16.35	1409.72	19.70	1406.37
AVX-6D	1435.29	05/03/85	30.52	1404.77	27.79	1407.50	26.26	1409.03	25.60	1409.69	29.04	1406.25
AVX-8D	1444.48	04/15/98	39.35	1405.13	37.13	1407.35	35.41	1409.07	34.86	1409.62	38.36	1406.12
AVX-8DR	1444.70	06/03/03	40.00	1404.70	37.35	1407.35	35.77	1408.93	35.15	1409.55	38.70	1406.00
AVX-9D	1431.11	04/16/98	26.32	1404.79	23.52	1407.59	22.15	1408.96	21.50	1409.61	24.71	1406.40
AVX-10D	1429.84	04/21/98	25.14	1404.70	22.33	1407.51	21.18	1408.66	20.25	1409.59	23.64	1406.20
AVX-12D	1430.29	01/02/02	25.42	1404.87	22.63	1407.66	21.35	1408.94	20.50	1409.79	23.85	1406.44
AVX-13D	1422.37	01/07/02	17.53	1404.84	14.63	1407.74	13.24	1409.13	12.53	1409.84	15.83	1406.54
AVX-14D	1422.89	01/11/02	18.09	1404.80	15.21	1407.68	13.85	1409.04	13.17	1409.72	16.41	1406.48
AVX-15D	1439.84	01/15/02	35.69	1404.15	32.87	1406.97	31.41	1408.43	30.79	1409.05	34.13	1405.71
AVX-16D	1434.67	01/22/02	30.80	1403.87	27.91	1406.76	26.52	1408.15	25.80	1408.87	29.20	1405.47
AVX-18D	1422.33	05/05/06	17.40	1404.93	14.59	1407.74	13.21	1409.12	12.55	1409.78	15.84	1406.49
AVX-19D	1422.60	05/04/06	17.64	1404.96	14.81	1407.79	13.39	1409.21	12.75	1409.85	16.03	1406.57
CW-9	1428.10	pre-1984	21.30	1406.80	20.39	1407.71	18.86	1409.24	18.33	1409.77	21.45	1406.65
CW-9A	1428.75	pre-1984	23.40	1405.35	21.01	1407.74	19.48	1409.27	18.93	1409.82	22.25	1406.50
CW-10	1436.31	pre-1984	31.67	1404.64	28.70	1407.61	27.20	1409.11	26.69	1409.62	29.91	1406.40
CW-10A	1436.57	pre-1984	31.90	1404.67	29.03	1407.54	27.55	1409.02	27.03	1409.54	30.27	1406.30
Staff Gauges						7.74		7.74		7.74		7.74
SG-1	1421.65	NA	1.43	1420.22	1.49	1420.16	0.95	1420.70	1.16	1420.49	1.35	1420.30
SG-2	1420.52	NA	--	--	--	--	--	--		--		--
SG-3	1424.81	NA	6.79	1418.02	6.92	1417.89	6.40	1418.41	6.65	1418.16	6.97	1417.84
SG-4	1416.97	NA	1.90	1415.07	1.95	1415.02	1.49	1415.48	1.78	1415.19	1.99	1414.98
SG-5	1419.44	NA	6.42	1413.02	6.35	1413.09	6.02	1413.42	6.26	1413.18	4.98	1414.46
SG-6	NA	NA	1.90	--	1.85	--	1.35	--	1.46	--	--	--
SG-7	NA	NA	1.76	--	1.85	--	1.30	--	1.61	--	1.88	--
SG-8	NA	NA	1.93	--	1.80	--	1.17	--	1.55	--	1.58	--

Notes:
Reference elevations replaced with new survey information on 11/21/2012, reflecting survey performed by D. Michael Canada, 8/27/2012.
-- = denotes data not collected
A/S = suffix indicating shallow wells
B/I = suffix indicating intermediate wells
D = suffix indicating deep wells
ft amsl = feet above mean sea level

Table 2
Groundwater Elevation Statistics for Key Wells
KYOCERA AVX Components Corporation
Olean, New York

Date / Well I.D.	Reference Elevation (ft amsl)	Well Installation Date	April 4, 2018		October 24, 2018		April 24, 2019		October 28, 2019		April 9, 2020	
			Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)
Shallow Wells and Piezometers												
AVX-2A	1436.80	10/29/84	4.74	1432.06	5.50	1431.30	5.05	1431.75	5.05	1431.75	5.22	1431.58
AVX-3	1440.63	10/25/84	5.58	1435.05	6.70	1433.93	5.90	1434.73	5.64	1434.99	5.68	1434.95
AVX-4S	1434.36	05/03/85	2.89	1431.47	3.46	1430.90	3.51	1430.85	3.26	1431.10	3.40	1430.96
AVX-5S	1425.83	04/23/85	2.82	1423.01	3.19	1422.64	3.23	1422.60	3.38	1422.45	3.87	1421.96
AVX-6S	1436.01	04/30/85	3.30	1432.71	4.07	1431.94	3.80	1432.21	4.20	1431.81	3.79	1432.22
AVX-7S	1425.91	04/29/85	2.84	1423.07	2.90	1423.01	2.93	1422.98	2.93	1422.98	2.87	1423.04
AVX-9S	1430.91	04/17/98	6.51	1424.40	7.15	1423.76	6.31	1424.60	7.69	1423.22	6.34	1424.57
AVX-10S	1429.61	04/21/98	4.02	1425.59	4.20	1425.41	4.23	1425.38	4.18	1425.43	4.14	1425.47
AVX-11S	1436.18	08/09/00	22.46	1413.72	15.15	1421.03	15.09	1421.09	23.46	1412.72	15.01	1421.17
AVX-17S	1422.05	06/03/03	2.27	1419.78	2.25	1419.80	2.29	1419.76	2.25	1419.80	2.25	1419.80
AVX-18S	1421.68	12/20/04	2.96	1418.72	3.20	1418.48	3.12	1418.56	3.17	1418.51	3.02	1418.66
AVX-19S	1422.02	05/03/06	3.47	1418.55	3.81	1418.21	3.62	1418.40	3.65	1418.37	3.59	1418.43
AVX-20S	1423.33	05/04/06	3.49	1419.84	3.58	1419.75	3.60	1419.73	3.60	1419.73	3.60	1419.73
AVX-21S	1423.16	03/24/08	4.88	1418.28	5.12	1418.04	4.94	1418.22	5.01	1418.15	4.88	1418.28
AVX-22S	1425.86	03/25/08	8.18	1417.68	8.65	1417.21	8.32	1417.54	8.62	1417.24	8.25	1417.61
AVX-23S	1423.79	03/26/08	7.30	1416.49	8.11	1415.68	7.60	1416.19	8.01	1415.78	7.30	1416.49
AVX-24S	1429.22	03/25/08	11.33	1417.89	11.49	1417.73	11.31	1417.91	11.46	1417.76	11.22	1418.00
MW-XX	1428.96	NA	9.99	1418.97	10.04	1418.92	9.92	1419.04	10.06	1418.90	10.05	1418.91
CW-10B	1435.25	pre-1984	2.26	1432.99	4.61	1430.64	3.12	1432.13	5.28	1429.97	3.23	1432.02
IW-1	1435.96	03/08/11	1.72	1434.24	1.85	1434.11	1.70	1434.26	1.70	1434.26	1.75	1434.21
IW-2	1430.42	03/21/11	1.60	1428.82	2.83	1427.59	2.73	1427.69	2.90	1427.52	2.77	1427.65
OW-1A	1436.03	03/17/11	1.75	1434.28	1.92	1434.11	1.79	1434.24	3.09	1432.94	1.45	1434.58
OW-1B	1436.01	03/17/11	1.64	1434.37	2.45	1433.56	1.89	1434.12	3.48	1432.53	1.72	1434.29
OW-1C	1435.76	03/18/11	1.17	1434.59	2.39	1433.37	1.52	1434.24	2.40	1433.36	1.45	1434.31
OW-2A	1434.01	03/23/11	5.89	1428.12	6.34	1427.67	6.22	1427.79	7.32	1426.69	6.02	1427.99
OW-2B	1433.72	03/22/11	6.10	1427.62	6.47	1427.25	6.33	1427.39	7.01	1426.71	6.19	1427.53
OW-2C	1433.68	03/22/11	6.33	1427.35	6.68	1427.00	6.59	1427.09	6.69	1426.99	6.40	1427.28
PZ-1S	1423.44	03/15/11	4.29	1419.15	4.81	1418.63	4.68	1418.76	4.49	1418.95	4.62	1418.82
PZ-1I	1423.43	03/15/11	6.21	1417.22	6.45	1416.98	6.08	1417.35	6.63	1416.80	6.05	1417.38
PZ-1D	1423.44	03/15/11	13.41	1410.03	14.50	1408.94	13.06	1410.38	15.51	1407.93	11.57	1411.87
PZ-2S	1422.87	03/16/11	3.42	1419.45	3.69	1419.18	3.50	1419.37	3.55	1419.32	3.42	1419.45
PZ-2I	1422.88	03/16/11	4.24	1418.64	4.31	1418.57	4.25	1418.63	4.60	1418.28	4.03	1418.85
PZ-2D	1422.88	03/16/11	13.13	1409.75	14.19	1408.69	12.81	1410.07	15.23	1407.65	11.23	1411.65
PZ-3S	1433.00	03/19/11	4.69	1428.31	5.18	1427.82	5.02	1427.98	5.07	1427.93	4.71	1428.29
PZ-3I	1433.00	03/19/11	5.06	1427.94	5.30	1427.70	5.13	1427.87	5.30	1427.70	5.10	1427.90
PZ-3D	1433.02	03/19/11	21.43	1411.59	21.96	1411.06	20.62	1412.40	21.15	1411.87	19.70	1413.32
EW-1	1422.06	09/10/22	--	--	--	--	--	--	--	--	--	--
EW-2	1421.69	09/10/22	--	--	--	--	--	--	--	--	--	--
EW-3	1421.63	09/10/22	--	--	--	--	--	--	--	--	--	--

Notes:

Reference elevations replaced with new survey information on 11/21/2012, reflecting survey performed by D. Michael Canada, 8/27/2012.
-- = denotes data not collected
A/S = suffix indicating shallow wells
B/I = suffix indicating intermediate wells
D = suffix indicating deep wells
ft amsl = feet above mean sea level

Table 2
Groundwater Elevation Statistics for Key Wells
KYOCERA AVX Components Corporation
Olean, New York

Date / Well I.D.	Reference Elevation (ft amsl)	Well Installation Date	October 19, 2020		April 28, 2021		October 26, 2021		April 27, 2022		October 27, 2022		Ave./Max/Min For Last 10 Gauging Events (Since April 2018)		
			Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)	Groundwater Elevation (ft amsl)		
Shallow Wells and Piezometers													**Average**	**Maximum**	**Minimum**
AVX-2A	1436.80	10/29/84	6.09	1430.71	5.78	1431.02	4.58	1432.22	4.65	1432.15	6.17	1430.63			
AVX-3	1440.63	10/25/84	6.68	1433.95	6.21	1434.42	4.18	1436.45	4.75	1435.88	6.53	1434.10	**1434.85**	**1436.45**	**1433.93**
AVX-4S	1434.36	05/03/85	6.97	1427.39	4.64	1429.72	3.42	1430.94	3.22	1431.14	5.28	1429.08	**1430.36**	**1431.47**	**1427.39**
AVX-5S	1425.83	04/23/85	4.55	1421.28	3.55	1422.28	3.37	1422.46	2.98	1422.85	3.65	1422.18			
AVX-6S	1436.01	04/30/85	8.11	1427.90	5.03	1430.98	3.65	1432.36	3.49	1432.52	6.10	1429.91	**1431.46**	**1432.71**	**1427.90**
AVX-7S	1425.91	04/29/85	3.35	1422.56	3.01	1422.90	3.37	1422.54	2.87	1423.04	3.04	1422.87			
AVX-9S	1430.91	04/17/98	8.29	1422.62	6.74	1424.17	7.40	1423.51	6.33	1424.58	7.70	1423.21			
AVX-10S	1429.61	04/21/98	6.19	1423.42	4.85	1424.76	3.69	1425.92	3.99	1425.62	5.01	1424.60			
AVX-11S	1436.18	08/09/00	23.47	1412.71	23.18	1413.00	23.78	1412.40	23.79	1412.39	15.16	1421.02			
AVX-17S	1422.05	06/03/03	2.49	1419.56	2.33	1419.72	2.07	1419.98	2.13	1419.92	2.50	1419.55			
AVX-18S	1421.68	12/20/04	2.50	1419.18	3.33	1418.35	2.90	1418.78	2.89	1418.79	4.88	1416.80			
AVX-19S	1422.02	05/03/06	3.68	1418.34	3.82	1418.20	3.46	1418.56	3.48	1418.54	5.62	1416.40			
AVX-20S	1423.33	05/04/06	3.51	1419.82	3.73	1419.60	3.30	1420.03	3.34	1419.99	3.67	1419.66			
AVX-21S	1423.16	03/24/08	5.57	1417.59	5.23	1417.93	4.78	1418.38	4.78	1418.38	6.40	1416.76			
AVX-22S	1425.86	03/25/08	9.45	1416.41	8.78	1417.08	8.28	1417.58	8.10	1417.76	9.18	1416.68			
AVX-23S	1423.79	03/26/08	8.51	1415.28	8.23	1415.56	7.36	1416.43	7.01	1416.78	8.36	1415.43			
AVX-24S	1429.22	03/25/08	12.77	1416.45	12.71	1416.51	11.31	1417.91	11.21	1418.01	12.13	1417.09			
MW-XX	1428.96	NA	12.20	1416.76	10.30	1418.66	10.05	1418.91	9.95	1419.01	10.15	1418.81			
CW-10B	1435.25	pre-1984	3.12	1432.13	5.25	1430.00	4.80	1430.45	3.98	1431.27	6.21	1429.04			
IW-1	1435.96	03/08/11	1.80	1434.16	1.73	1434.23	1.85	1434.11	1.69	1434.27	3.55	1432.41	**1434.03**	**1434.27**	**1432.41**
IW-2	1430.42	03/21/11	4.61	1425.81	3.42	1427.00	2.41	1428.01	2.78	1427.64	4.22	1426.20			
OW-1A	1436.03	03/17/11	4.76	1431.27	2.13	1433.90	2.43	1433.60	1.92	1434.11	3.36	1432.67	**1433.57**	**1434.58**	**1431.27**
OW-1B	1436.01	03/17/11	4.68	1431.33	2.39	1433.62	1.59	1434.42	1.09	1434.92	4.19	1431.82	**1433.50**	**1434.92**	**1431.33**
OW-1C	1435.76	03/18/11	4.62	1431.14	2.02	1433.74	1.39	1434.37	1.02	1434.74	3.91	1431.85	**1433.57**	**1434.74**	**1431.14**
OW-2A	1434.01	03/23/11	8.22	1425.79	7.06	1426.95	5.63	1428.38	5.75	1428.26	7.62	1426.39			
OW-2B	1433.72	03/22/11	8.13	1425.59	7.11	1426.61	5.78	1427.94	6.88	1426.84	7.89	1425.83			
OW-2C	1433.68	03/22/11	8.60	1425.08	7.43	1426.25	6.02	1427.66	6.16	1427.52	7.88	1425.80			
PZ-1S	1423.44	03/15/11	5.35	1418.09	5.11	1418.33	4.15	1419.29	4.44	1419.00	5.22	1418.22			
PZ-1I	1423.43	03/15/11	7.36	1416.07	6.53	1416.90	6.06	1417.37	6.00	1417.43	7.88	1415.55			
PZ-1D	1423.44	03/15/11	15.30	1408.14	13.43	1410.01	11.98	1411.46	11.53	1411.91	14.10	1409.34			
PZ-2S	1422.87	03/16/11	3.02	1419.85	3.79	1419.08	3.39	1419.48	3.40	1419.47	3.64	1419.23			
PZ-2I	1422.88	03/16/11	7.03	1415.85	4.45	1418.43	4.16	1418.72	4.07	1418.81	4.73	1418.15			
PZ-2D	1422.88	03/16/11	15.05	1407.83	13.21	1409.67	11.58	1411.30	11.02	1411.86	13.62	1409.26			
PZ-3S	1433.00	03/19/11	6.81	1426.19	5.93	1427.07	4.44	1428.56	4.59	1428.41	6.53	1426.47			
PZ-3I	1433.00	03/19/11	7.00	1426.00	5.95	1427.05	4.75	1428.25	4.81	1428.19	6.38	1426.62			
PZ-3D	1433.02	03/19/11	23.27	1409.75	21.66	1411.36	19.76	1413.26	19.06	1413.96	20.11	1412.91			
EW-1	1424.60	09/10/22	--	--	--	--	--	--	--	--	7.30	1414.76			
EW-2	1424.84	09/10/22	--	--	--	--	--	--	--	--	6.85	1414.84			
EW-3	1425.10	09/10/22	--	--	--	--	--	--	--	--	6.90	1414.73			

Notes:

-- = denotes data not collected
A/S = suffix indicating shallow wells
B/I = suffix indicating intermediate wells
D = suffix indicating deep wells
ft amsl = feet above mean sea level

Appendix C

Remedial Alternatives Costing Detail

Table C-1
Summary of Costs for Targeted Source Area Soil Remedial Alternatives

Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Remedial Alternative	Capital Cost	Annual O&M Cost	Total Annual Maintenance Cost	Total Project Cost	Net Present Value
1. No Action	$0	$0	$0	$0	$0
2. LTM with Institutional Controls and Surface Cover Maintenance	$44,000	$117,000	$450,000	$611,000	$291,000
3. Excavation with Institutional Controls and Surface Cover Maintenance	$2,228,000	$0	$450,000	$2,678,000	$2,414,000
4. ISS with Institutional Controls and Surface Cover Maintenance	$2,715,000	$0	$450,000	$3,165,000	$2,901,000
5. ISTR with Institutional Controls, and Surface Cover Maintenance	$3,395,000	$0	$450,000	$3,845,000	$3,581,000

Abbreviations:
ISS = in situ soil solidification
ISTR = in situ thermal remediation
LTM = long-term monitoring

Table C-2
Summary of Costs for Alternative 2: LTM with Institutional Controls and Surface Cover Maintenance

Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Item Description	Estimated Quantity	Unit	Unit Price	Cost
Site Preparation				
Permits and Notifications	1	Lump Sum	$ 2,500.00	$ 2,500.00
Submittals	1	Lump Sum	$ 2,500.00	$ 2,500.00
			Subtotal	**$5,000**
Alternative Implementation				
Installation of 4 new monitoring wells	1	Lump Sum	$ 25,000.00	$ 25,000.00
			Subtotal	**$25,000**
Site Restoration				
General Fill	N/A	Lump Sum	$ -	$ -
			Subtotal	**$0**
Management				
Engineering Design and Coordination	1	Lump Sum	$ 2,500.00	$ 2,500.00
Construction Oversight	1	Lump Sum	$ 5,000.00	$ 5,000.00
			Subtotal	**$7,500**
Monitoring (per event) [1]				
Sample for VOC analysis (includes 2 QA/QC samples)	6	sample	$ 100.00	$ 600.00
Sample for MNA parameters (includes 2 QA/QC samples)	6	sample	$ 350.00	$ 2,100.00
Labor (1 day with equipment and vehicle)	1	day	$ 1,200.00	$ 1,200.00
			Subtotal	**$3,900**
			Total	**$37,500**
		Construction Contingency (20%)		**$6,000**

Note 1: Monitoring assumed to occur semi-annually for first 5 years and every 5 quarters for next 25 years.

CAPITAL COST	**$44,000**
ANNUAL LONG-TERM MONITORING COSTS	**$117,000**
ANNUAL INSPECTION AND COVER/FENCE MAINTENANCE COSTS	**$15,000**
TOTAL ALTERNATIVE 2 COST	**$611,000**
PRESENT VALUE (7% Discount Rate)	**$291,000**

Table C-3
Summary of Costs for Alternative 3: Excavation with Institutional Controls and Surface Cover Maintenance

Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Item Description	Estimated Quantity	Unit	Unit Price	Cost
Site Preparation				
Permits and Notifications	1	Lump Sum	$5,000.00	$5,000
Submittals	1	Lump Sum	$5,000.00	$5,000
Mobilization	1	Lump Sum	$134,000.00	$134,000
Temporary Controls, Facilities, and Project Support	1	Lump Sum	$40,000.00	$40,000
Construction Layout and Surveying	1	Lump Sum	$20,000.00	$20,000
Utility Termination / Utility Protection	1	Lump Sum	$5,000.00	$5,000
			Subtotal	**$209,000**
Alternative Implementation				
On-Site Construction Wastewater Handling	1	Lump Sum	$ 30,000.00	$30,000
Imported Fill Material Geotechnical Sampling	2	Per Sample	$ 600.00	$1,200
Imported Fill Chemical Sampling	15	Per Sample	$ 1,160.00	$17,400
Concrete Removal	13,000	Square Feet	$ 1.50	$19,500
Soil Excavation - Benching/Sloping	275	Cubic Yard	$ 30.00	$8,250
Excavation Support - Trench Box	1	Lump Sum	$ 25,000.00	$25,000
Soil Excavation	5,500	Cubic Yard	$ 30.00	$165,000
Post-Excavation Soil Sampling	27	Per Sample	$ 55.00	$1,464
Soil Drying Agent	20	Ton	$ 400.00	$8,000
Waste Characterization Sampling	5	Per Sample	$ 600.00	$3,000
Transportation and Disposal - C&D Debris	600	Ton	$ 40.00	$24,000
Transportation and Disposal - Non-Hazardous Soil and Debris	10,000	Ton	$ 65.00	$650,000
			Subtotal	**$952,814**
Site Restoration				
General Fill	8,700	Ton	$26.00	$226,200
Type 2 Subbase	1,200	Ton	$80.00	$96,000
Demobilization	1	Lump Sum	$110,000.00	$110,000
			Subtotal	**$432,200**
Management				
Engineering Design and Coordination	1	Lump Sum	$ 90,000.00	$90,000
Construction Oversight	1	Lump Sum	$ 225,000.00	$225,000
			Subtotal	**$315,000**
			Total	**$1,909,014**
		Construction Contingency (20%)		**$318,803**

CAPITAL COST	**$2,228,000**
ANNUAL INSPECTION AND COVER/FENCE MAINTENANCE COSTS	**$15,000**
TOTAL ALTERNATIVE 3 COST	**$2,678,000**
NET PRESENT VALUE (7% Discount Rate)	**$2,414,000**

Table C-4
Summary of Costs for Alternative 4: ISS with Institutional Controls and Surface Cover Maintenance

Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Item Description	Estimated Quantity	Unit	Unit Price	Cost
Site Preparation				
Mobilization/Demobilization (10% of Construction Costs exclulsing T&D)	1	Lump Sum	$151,200.00	$151,200
Construction Survey, Layout & As-Builts	1	Lump Sum	$22,500.00	$22,500
Stabilized Construction Entrance including maintenance	2	Lump Sum	$10,000.00	$20,000
Utility Survey and Mark out	2	Day	$2,250.00	$4,500
Soil Erosion & Sediment Controls	1	Lump Sum	$50,000.00	$50,000
Office Trailer/Utilities/Sanitation Services	4	Month	$10,000.00	$40,000
Perimeter Air Monitoring / Community Air Monitoring Program (CAMP)	14	Week	$1,700.00	$23,872
Material Staging Area	1	Lump Sum	$10,000.00	$10,000
Concrete Saw Cutting	1	Lump Sum	$11,000.00	$11,000
Concrete - Demolition and Material Staging	760	Cubic Yard	$50.00	$38,000
Asphalt - Demolition and Material Staging	40	Cubic Yard	$25.00	$1,000
Concrete/Asphalt/Construction Debris - Transportation and Disposal	1,280	Ton	$65.00	$83,200
Dust & Odor Control	4	Month	$20,000.00	$80,000
			Subtotal	**$535,272**
Alternative Implementation				
Portland Cement - Grout Plant - Mob/Demob/Rental	1	Lump Sum	$ 75,000.00	$75,000
Water Source	1	Lump Sum	$ 8,500.00	$8,500
Pre-Excavation Support - Soil Berms and Subgrade Work	1	Lump Sum	$ 35,000.00	$35,000
In-Situ Soil Mixing - Mixing Head/Excavator Bucket	5,500	Cubic Yard	$ 80.00	$440,000
Cement - 2.5% Portland and 4.5% Ground Blast Furnace Slag Cement by Weight	648	Tons	$ 400.00	$259,325
Performance Monitoring - 1 Per 250 Cubic Yards	22	Each	$ 350.00	$7,700
ISS Swell Cap Area - Subgrade Preparation	3,755	Cubic Yard	$ 10.00	$37,552
ISS Swell Cap Area - Material Relocation and Temporary Stockpiling	1	Lump Sum	$ 10,000.00	$10,000
Material Relocation - ISS Swell and Top 3 feet of ISS Area (assumes 35% swell)	3,755	Cubic Yard	$ 8.00	$30,042
In-Situ Soil Mixing - Mixing Head/Excavator Bucket - Cap Subgrade	3,755	Cubic Yard	$ 29.00	$108,902
Portland Cement - 3% by Weight	192	Tons	$ 400.00	$76,607
			Subtotal	**$1,088,628**
Site Restoration				
Furnish and Install Geotextile - Demarcation Fabric	29,310	Square Feet	$ 1.00	$29,310
Furnish and Install Reuse Soils	3,755	Cubic Yard	$ 10.00	$37,552
Furnish and Install Gravel Cap	1,303	Ton	$ 45.00	$58,620
Landscape - Trees/Mulch	1	Lump Sum	$ 7,500.00	$7,500
			Subtotal	**$132,982**
Management				
Project Management (5% of Construction Costs, Excludes T&D Costs)	1	Lump Sum	$ 83,684.11	$83,684
Site/Construction Management (3 Site Personnel)	70	Day	$ 3,925.00	$275,808
			Subtotal	**$359,492**
			Total	**$2,116,374**
		Construction Contingency (20%)		**$351,376**

Note 1: Additional 10% contingency due to current unknowns on stabilization requirements.

CAPITAL COST [1]	**$2,715,000**
ANNUAL INSPECTION AND COVER/FENCE MAINTENANCE COSTS	**$15,000**
TOTAL ALTERNATIVE 4 COST	**$3,165,000**
NET PRESENT VALUE (7% Discount Rate)	**$2,901,000**

Table C-5
Summary of Costs for Alternative 5: ISTR with Institutional Controls and Surface Cover Maintenance

Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Item Description	Estimated Quantity	Unit	Unit Price	Cost
Site Preparation				
Electrical Permits & Service Application	1	Lump Sum	$10,500.00	$10,500
Well Permit - Construction	1	Lump Sum	$5,250.00	$5,250
Well Permit - Abandonment	2	Lump Sum	$2,625.00	$5,250
Air Emissions Permit	1	Lump Sum	$10,500.00	$10,500
Sewer Discharge or Reinjection Permit	1	Lump Sum	$2,625.00	$2,625
Surveying	4	Day	$2,625.00	$10,500
Utility Locating	2	Day	$2,100.00	$4,200
Utility Connection/Disconnection	2	Lump Sum	$5,250.00	$10,500
Erosion & Sediment Control	250	Foot	$10.50	$2,625
			Subtotal	**$61,950**
Alternative Implementation				
ERH Vendor	1	Lump Sum	$ 736,601.25	$736,601
MPE and Ex Situ Treatment System	1	Lump Sum	$ 315,000.00	$315,000
Thermally Insulating Vapor Cap	21,500	Square Feet	$ 11.55	$248,325
Traffic Control	4	Day	$ 1,575.00	$6,300
Electrode Well Installation (sonic)	900	Foot	$ 115.50	$103,950
Extraction Well Installation, 4-inch SS (sonic)	204	Foot	$ 157.50	$32,130
Temperature Monitoring Well Installation (sonic)	120	Foot	$ 78.75	$9,450
Horizontal Extraction Well Installation (mini-ex)	425	Foot	$ 105.00	$44,625
Well Abandonment (tremie grout, flush to grade)	1,324	Foot	$ 26.25	$34,755
Mobilization/Demobilization (per rig)	4	Lump Sum	$ 5,250.00	$21,000
Personnel	136	Day	$ 210.00	$28,560
Electrical Power Drop	1	Lump Sum	$ 156,450.00	$156,450
Utilities	1	Lump Sum	$ 318,149.67	$318,150
Sampling and Waste Management	1	Lump Sum	$ 65,178.75	$65,179
Equipment and Consumables	1	Lump Sum	$ 197,032.50	$197,033
			Subtotal	**$2,317,507**
Site Restoration				
Mobilization/Demobilization for Bulk Storage	7	Each	$525.00	$3,675
T&D Non-Hazardous Soil	60	Ton	$131.25	$7,875
T&D Hazardous Liquid	5,000	Gal	$2.10	$10,500
T&D Construction Debris	500	Ton	$52.50	$26,250
Media Offsite Reactivation	9,000	Pound	$0.79	$7,088
			Subtotal	**$55,388**
Management				
Engineering Design and Coordination	1	Lump Sum	$ 303,278.00	$303,278
Construction Oversight	1	Lump Sum	$ 168,981.25	$168,981
			Subtotal	**$472,259**
			Total	**$2,907,104**
		Construction Contingency (20%)		**$486,969**

CAPITAL COST	**$3,395,000**
ANNUAL INSPECTION AND COVER/FENCE MAINTENANCE COSTS	**$15,000**
TOTAL ALTERNATIVE 5 COST	**$3,845,000**
NET PRESENT VALUE (7% Discount Rate)	**$3,581,000**

Table C-6
Summary of Net Present Value Calculations

Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Rate =		7%					
ALT 2		**Capital**	**Annual Maintenance**	**Discount**	**Present Value**		
Year	0	$44,000	$7,800	1.00	$51,800		
Year	1	$0	$22,800	0.935	$21,308	**Total Capital Cost =**	**$44,000**
Year	2	$0	$22,800	0.873	$19,914	**Annual Maintenance Cost =**	**$450,000**
Year	3	$0	$22,800	0.816	$18,612	**Total O&M Cost =**	**$117,000**
Year	4	$0	$22,800	0.763	$17,394	**Alternative 2 Present Value =**	**$291,000**
Year	5	$0	$15,000	0.713	$10,695		
Year	6	$0	$18,900	0.666	$12,594		
Year	7	$0	$18,900	0.623	$11,770		
Year	8	$0	$18,900	0.582	$11,000		
Year	9	$0	$18,900	0.544	$10,280		
Year	10	$0	$15,000	0.508	$7,625		
Year	11	$0	$18,900	0.475	$8,979		
Year	12	$0	$18,900	0.444	$8,392		
Year	13	$0	$18,900	0.415	$7,843		
Year	14	$0	$18,900	0.388	$7,330		
Year	15	$0	$15,000	0.362	$5,437		
Year	16	$0	$18,900	0.339	$6,402		
Year	17	$0	$18,900	0.317	$5,983		
Year	18	$0	$18,900	0.296	$5,592		
Year	19	$0	$18,900	0.277	$5,226		
Year	20	$0	$15,000	0.258	$3,876		
Year	21	$0	$18,900	0.242	$4,565		
Year	22	$0	$18,900	0.226	$4,266		
Year	23	$0	$18,900	0.211	$3,987		
Year	24	$0	$18,900	0.197	$3,726		
Year	25	$0	$15,000	0.184	$2,764		
Year	26	$0	$18,900	0.172	$3,254		
Year	27	$0	$18,900	0.161	$3,042		
Year	28	$0	$18,900	0.150	$2,843		
Year	29	$0	$18,900	0.141	$2,657		
Year	30	$0	$15,000	0.131	$1,971		

Table C-6
Summary of Net Present Value Calculations

Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Rate =		7%					
ALT 3		**Capital**	**Annual Maintenance**	**Discount**	**Present Value**		
Year	0	$2,228,000	$0	1.00	$2,228,000		
Year	1	$0	$15,000	0.935	$14,019	**Total Capital Cost =**	**$2,228,000**
Year	2	$0	$15,000	0.873	$13,102	**Annual Maintenance Cost =**	**$450,000**
Year	3	$0	$15,000	0.816	$12,244	**Total O&M Cost =**	**$0**
Year	4	$0	$15,000	0.763	$11,443	**Alternative 3 Present Value =**	**$2,414,000**
Year	5	$0	$15,000	0.713	$10,695		
Year	6	$0	$15,000	0.666	$9,995		
Year	7	$0	$15,000	0.623	$9,341		
Year	8	$0	$15,000	0.582	$8,730		
Year	9	$0	$15,000	0.544	$8,159		
Year	10	$0	$15,000	0.508	$7,625		
Year	11	$0	$15,000	0.475	$7,126		
Year	12	$0	$15,000	0.444	$6,660		
Year	13	$0	$15,000	0.415	$6,224		
Year	14	$0	$15,000	0.388	$5,817		
Year	15	$0	$15,000	0.362	$5,437		
Year	16	$0	$15,000	0.339	$5,081		
Year	17	$0	$15,000	0.317	$4,749		
Year	18	$0	$15,000	0.296	$4,438		
Year	19	$0	$15,000	0.277	$4,148		
Year	20	$0	$15,000	0.258	$3,876		
Year	21	$0	$15,000	0.242	$3,623		
Year	22	$0	$15,000	0.226	$3,386		
Year	23	$0	$15,000	0.211	$3,164		
Year	24	$0	$15,000	0.197	$2,957		
Year	25	$0	$15,000	0.184	$2,764		
Year	26	$0	$15,000	0.172	$2,583		
Year	27	$0	$15,000	0.161	$2,414		
Year	28	$0	$15,000	0.150	$2,256		
Year	29	$0	$15,000	0.141	$2,108		
Year	30	$0	$15,000	0.131	$1,971		

Table C-6
Summary of Net Present Value Calculations

Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Rate =		7%					
ALT 4		**Capital**	**Annual Maintenance**	**Discount**	**Present Value**		
Year	0	$2,715,000	$0	1.00	$2,715,000		
Year	1	$0	$15,000	0.935	$14,019	**Total Capital Cost =**	**$2,715,000**
Year	2	$0	$15,000	0.873	$13,102	**Annual Maintenance Cost =**	**$450,000**
Year	3	$0	$15,000	0.816	$12,244	**Total O&M Cost =**	**$0**
Year	4	$0	$15,000	0.763	$11,443	**Alternative 4 Present Value =**	**$2,901,000**
Year	5	$0	$15,000	0.713	$10,695		
Year	6	$0	$15,000	0.666	$9,995		
Year	7	$0	$15,000	0.623	$9,341		
Year	8	$0	$15,000	0.582	$8,730		
Year	9	$0	$15,000	0.544	$8,159		
Year	10	$0	$15,000	0.508	$7,625		
Year	11	$0	$15,000	0.475	$7,126		
Year	12	$0	$15,000	0.444	$6,660		
Year	13	$0	$15,000	0.415	$6,224		
Year	14	$0	$15,000	0.388	$5,817		
Year	15	$0	$15,000	0.362	$5,437		
Year	16	$0	$15,000	0.339	$5,081		
Year	17	$0	$15,000	0.317	$4,749		
Year	18	$0	$15,000	0.296	$4,438		
Year	19	$0	$15,000	0.277	$4,148		
Year	20	$0	$15,000	0.258	$3,876		
Year	21	$0	$15,000	0.242	$3,623		
Year	22	$0	$15,000	0.226	$3,386		
Year	23	$0	$15,000	0.211	$3,164		
Year	24	$0	$15,000	0.197	$2,957		
Year	25	$0	$15,000	0.184	$2,764		
Year	26	$0	$15,000	0.172	$2,583		
Year	27	$0	$15,000	0.161	$2,414		
Year	28	$0	$15,000	0.150	$2,256		
Year	29	$0	$15,000	0.141	$2,108		
Year	30	$0	$15,000	0.131	$1,971		

Table C-6
Summary of Net Present Value Calculations

Feasibility Study Report - Source Area
KYOCERA AVX Components Corporation
Olean, New York

Rate =		7%					
ALT 5		**Capital**	**Annual Maintenance**	**Discount**	**Present Value**		
Year	0	$3,395,000	$0	1.00	$3,395,000		
Year	1	$0	$15,000	0.935	$14,019	**Total Capital Cost =**	**$3,395,000**
Year	2	$0	$15,000	0.873	$13,102	**Annual Maintenance Cost =**	**$450,000**
Year	3	$0	$15,000	0.816	$12,244	**Total O&M Cost =**	**$0**
Year	4	$0	$15,000	0.763	$11,443	**Alternative 5 Present Value =**	**$3,581,000**
Year	5	$0	$15,000	0.713	$10,695		
Year	6	$0	$15,000	0.666	$9,995		
Year	7	$0	$15,000	0.623	$9,341		
Year	8	$0	$15,000	0.582	$8,730		
Year	9	$0	$15,000	0.544	$8,159		
Year	10	$0	$15,000	0.508	$7,625		
Year	11	$0	$15,000	0.475	$7,126		
Year	12	$0	$15,000	0.444	$6,660		
Year	13	$0	$15,000	0.415	$6,224		
Year	14	$0	$15,000	0.388	$5,817		
Year	15	$0	$15,000	0.362	$5,437		
Year	16	$0	$15,000	0.339	$5,081		
Year	17	$0	$15,000	0.317	$4,749		
Year	18	$0	$15,000	0.296	$4,438		
Year	19	$0	$15,000	0.277	$4,148		
Year	20	$0	$15,000	0.258	$3,876		
Year	21	$0	$15,000	0.242	$3,623		
Year	22	$0	$15,000	0.226	$3,386		
Year	23	$0	$15,000	0.211	$3,164		
Year	24	$0	$15,000	0.197	$2,957		
Year	25	$0	$15,000	0.184	$2,764		
Year	26	$0	$15,000	0.172	$2,583		
Year	27	$0	$15,000	0.161	$2,414		
Year	28	$0	$15,000	0.150	$2,256		
Year	29	$0	$15,000	0.141	$2,108		
Year	30	$0	$15,000	0.131	$1,971		

Appendix D

Green and Sustainable Remediation Analysis

Memo

SUBJECT
KYOCERA AVX Components Corporation
Olean Well Field Superfund Site, Operable Unit 2
Green and Sustainable Remediation Analysis
for Feasibility Study – Source Area

TO
Bettina Longino, Arcadis
Mark Hanish, Arcadis

DATE
May 3, 2023

COPIES TO
Jim Zemak, KAVX

FROM
Julia Vidonish Aspinall, Arcadis
Jessica Gattenby, Arcadis

Arcadis U.S., Inc. has prepared this memorandum to summarize the sustainability assessment performed for the evaluation of remedial alternatives being considered for the targeted area of source remediation of soil on the KYOCERA AVX Components Corporation property located at 1695 Seneca Avenue in Olean, Cattaraugus County, New York (Property). The evaluation was conducted according to 6 New York Codes, Rules, and Regulations (NYCRR) Part 375 following DER-31 (New York State Department of Environmental Conservation [NYSDEC] 2011).

Green and Sustainable Remediation Analysis

Remedial alternatives considered for the Property were evaluated consistent with green remediation guidance from the United States Environmental Protection Agency (USEPA; 2008). In accordance with the guidance, a quantitative life cycle assessment was conducted using SiteWise™. The SiteWise™ green and sustainable remediation (GSR) analysis assessment of the likely impact of Property source area remediation was conducted for the following four remedial alternatives:

1. Long-term monitoring (LTM)
2. Excavation
3. In situ soil solidification (ISS)
4. In situ thermal remediation (ISTR).

The final remedy will ultimately be selected in accordance with a comprehensive evaluation of technical and economic feasibility, of which, the GSR criterion was included to evaluate the environmental impact of the remedy.

The quantitative sustainability assessment for the selected proposed remedial alternatives evaluation includes greenhouse gas (GHG) emissions; energy use (total energy use and electricity from renewable and non-renewable sources); air emissions of criteria pollutants (total emissions and onsite emissions), including nitrogen oxide, sulfur oxide, and particulate matter; water consumption; resource consumption and waste generation (landfill space and top soil consumption); and worker safety (risk of fatality, injury and lost hours). Metric quantification was completed for all activities conducted onsite and transportation associated with movement of materials, waste, and workers to and from the Property.

A discussion of the metrics that were used to complete the quantitative sustainability assessment of the alternatives is as follows:

1. **GHG Emission Footprint Calculation**. The USEPA Climate Leaders Program (USEPA 2009) provides a GHG Inventory Guidance that is used by industry to document emissions of GHGs, including carbon dioxide, methane, and nitrous oxide. The USEPA Climate Leaders GHG Inventory Guidance is a modification of the GHG protocol developed by the World Resources Institute and the World Business Council for Sustainable Development. SiteWise^{TM} also uses emission factors developed by Argonne National Laboratory's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model; USEPA's Mobile 6 model; and USEPA's Non-road model. Emission factors for consumables are life cycle based and obtained from sources that provide life cycle inventories (e.g., the life cycle inventory provided by National Renewable Energy Laboratory).
2. **Energy usage** was calculated by quantifying the fuel, electrical energy, and machinery power requirements (if used) for remedial alternative implementation and operation based on remedy history and fundamental engineering assumptions and manufacturers' specifications for equipment similar to that used in comparable remedial technologies. The energy embodied in fuels is obtained from Argonne National Laboratory's GREET model that provides life-cycle energy consumption.
3. **Air emissions** inventories quantities in SiteWise^{TM} were developed using Mobile 6 and Non-road, two computer programs developed by the USEPA's Office of Transportation and Air Quality that calculate oxides of nitrogen, sulfur oxides, carbon monoxide, volatile organic compounds, and particulate matter emission factors for mobile and non-road equipment, respectively.
4. **Water consumption and impacts** were determined for each alternative based on expected on-Property activities for each remedial alternative.
5. **Resource consumption and waste generation** were quantified by estimating the amount of the key materials to be consumed and waste created for each remedial alternative at the Property during implementation and operation based on fundamental engineering assumptions and material consumption and waste generation expected in comparable remedial technologies. Examples of waste generated include non-hazardous soils and construction and debris removed from the Property. Transportation associated with these materials to and from the Property is quantified under GHG emissions and air emissions.
6. **Worker Safety (risk of fatality, injury, and lost hours)**. Several organizations (including Automobile Transport statistics, Airplane Transport Statistics, Railroad Transport Statistics, and Labor Statistics) provide statistics of both fatalities and injuries that occur during various activities, including transportation by automobile, airplane, and rail. Accident risks were quantified based on number of workers, work durations and the risk associated with their occupation, and exposure to equipment. The results represent the relative probabilities of accident or fatality during remedial activities.

Engineering design assumptions developed by the project team for the relative cost evaluation for each proposed remedial alternative were used to quantify sustainability metrics. Minor impacts common to each remedial alternative, such as routine management and reporting, were not included in this sustainability analysis. Instead, a focus was maintained on activities with significant associated impacts that could be used as differentiators during the analysis and the focus was on evaluating the specific remedial approaches themselves.

The result of the GSR analysis is a relative comparison of the potential remedial alternatives based on the identified criteria to promote consideration of GSR principles as part of the remedy selection process. A summary of the sustainability assessment results for the selected metrics is included in **Table 1**. Additional comparison charts for the remedial alternatives are included as **Attachment 1**.

Alternative 1 – No Action

The “No Action” alternative was not considered as part of the GSR analysis because it does not meet the threshold criteria. Non-adherence to the threshold criteria makes Alternative 1 unsustainable.

Alternative 2 – LTM

Analysis of the sustainability of Alternative 2 determined that this alternative comprises the use of proven attenuation pathways to monitor the reduction of impacts in groundwater; therefore, minimizing waste generation, energy consumption, and mobile source air emissions associated with the transportation of materials and waste.

Key components that influence the GSR analysis of Alternative 2 are the installation of monitoring well infrastructure, activities that require some energy and fuel consumption during monitoring events, use of local labor to reduce fuel use associated with travel, and implementation of best management practices and the duration of the activity until the remedial action objectives are achieved (assumes to be 30 years).

Overall, total impacts associated with this remedial alternative are considerably lower than the other alternatives. **Table 1** summarizes the sustainability assessment results for Alternative 2. Comparative charts are included in **Attachment 1**.

Alternative 3 – Excavation

Analysis of the sustainability of Alternative 3 determined that this alternative comprises the use of a technology that effectively reduces the amount of COCs in soil on the Property.

Key components that influence the GSR analysis of Alternative 3 include project planning to maximize the efficiency of waste transportation to disposal facilities and from clean soil source, limiting truck trips, and the use of low sulfur emission equipment to perform excavation and backfilling work. Additionally, local labor will be used, when possible, to reduce fuel use associated with travel and best management practices will be implemented. Implementation of this remedial alternative requires the operation of fuel-powered equipment with high energy requirements and results in elevated air emissions during the construction phase for the excavation, backfilling, and transportation of waste. Because the waste is being moved to another location and no destruction of COCs is occurring, waste creation is also considered to be an impact of this alternative. The construction phase also requires direct oversight and continuous mobilization of personnel and materials. Additional health and safety risks would be posed by the construction and the use of large-scale construction equipment, and this alternative is also expected to increase the estimated disturbance in the local community.

Overall, total impacts associated with this remedial alternative are higher than the other alternatives. **Table 1** summarizes the sustainability assessment results for Alternative 3. Comparative charts are included in **Attachment 1**.

Alternative 4 – ISS

Analysis of the sustainability of Alternative 4 determined that this alternative comprises the use of a technology that effectively reduces the mass of COCs in soil that can migrate from the stabilized mass on the Property.

Key components that influence the GSR analysis of Alternative 3 are project planning to maximize the efficiency of soil mixing, optimization of the use of mixing equipment use and material transportation to the facility; therefore, limiting truck trips, as well as the use of low sulfur emission equipment to perform work to move the soil as needed. Because slag will be used to stabilize the soil, this alternative creates a diversion of waste from other processes. Additionally, local labor will be used to reduce fuel use associated with travel and best management practices will be implemented. Implementation of this remedy requires the operation of fuel-powered equipment with high energy requirements and results in elevated air emissions during the construction phase for the staging, mixing, and placement of the soil, as well as for the transportation of materials. The construction phase also requires direct oversight and continuous mobilization of personnel and materials. Additional health and safety risks would be posed by the construction and the use of large-scale construction equipment. Because soil treatment operations will be performed within the Property footprint, with limited transportation for stabilization materials, some disturbance in the local community may occur, although less than associated with Alternative 3.

Overall, total impacts associated with this remedial alternative are lower than Alternatives 3 and 5 but higher than Alternative 2. **Table 1** summarizes the sustainability assessment results for Alternative 3. Comparative charts are included in **Attachment 1**.

Alternative 5 – ISTR

Analysis of the sustainability of Alternative 5 determined that this alternative comprises the use of a technology that effectively reduces the amount of COCs in soil through enhanced physical recovery of COCs via soil vapor extraction and, to some degree, enhanced biological degradation.

Key components that influence the GSR analysis of Alternative 5 are reduced waste generation because the soil and groundwater is treated in situ, energy requirements for continuous operation of the system, infrastructure requirements, use of local labor to reduce fuel use associated with travel, and implementation of best management practices. Implementation of this remedy requires the installation of infrastructure (e.g., well installation, trenching, piping) that requires the operation of fuel-powered equipment with high energy requirements and elevated air emissions during the construction phase. However, thermal remediation infrastructure will be recycled from other remediation sites when possible; therefore, utilizing a waste stream and lowering the emissions and reducing natural resource usage associated with new material production. The construction phase also requires direct oversight and continuous mobilization of personnel and materials. The largest contribution to impacts for this alterative is from the operation of equipment to achieve thermal heating. During the period of heating, grid energy is consumed and workers are required to be at the Property to monitor the process. The period of heating needed to achieve the destruction is a key component of the footprint and can vary significantly.

Overall, total impacts associated with this remedial alternative are higher than the other alternatives. **Table 1** summarizes the sustainability assessment results for Alternative 5. Comparative charts are included in **Attachment 1**.

Summary

The results of the GSR analysis are a relative comparison of the potential remedial alternatives developed for the Property to promote consideration of GSR principles as part of the remedy selection process in consideration of DER-31. Beyond the standard feasibility criteria, this quantified sustainability assessment adds dimension in the evaluation and selection of a final remedy that incorporates the commonly accepted principles of GSR. In all instances, the analysis was performed with the fundamental assumption that all remedies must achieve the remediation goals identified for the Property to be retained and qualify for further consideration.

Alternatives	GHG Emissions	Total Energy Used	Water Consumption	Electricity Usage	Combined Emissions	Total NOx Emissions	Total SOx Emissions	Total PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
	metric ton	MMBTU	gallons	MWH	metric ton	metric ton	metric ton	metric ton	%	%
Alternative 2: LTM										
Total	23	2,405	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Alternative 3: Excavation										
Total	490	8,227	0.0	0.0	4.9	1.7	1.3	1.9	0.0	0.2
Alternative 4: ISS										
Total	306	3,182	216,733.5	32.8	1.8	0.6	0.8	0.4	0.0	0.2
Alternative 5: ISTR										
Total	936	20,722	2,841,799.8	2,713.3	2.8	1.0	1.2	0.7	0.0	0.4

Note: Combined Emissions are NOx, SOx, and PM10.

The comparative GSR analysis indicates that Alternative 2 is the most sustainable of the alternatives considered. The environmental impacts associated with the alternatives are directly affected by the impacts generated during implementation, the energy requirements for the operation of the remedy, and the remedy lifetime. Alternative 2 presents the lowest energy requirement, air emission, waste generation, and accident risk because it has less energy requirements than the other alternatives and requires less time in the field using heavy equipment. Alternative 4 provides a more sustainable remedial approach than Alternatives 3 and 5. Alternative 4 diverts waste through the reuse of slag as a soil solidification agent and has lower energy use, air emission, and accident risk than Alternatives 3 and 5.

Incorporation of green best practices into the design and operation of a remedial activity can help achieve cleanup objectives by ensuring protectiveness while decreasing the environmental footprint of the cleanup activity itself. Consistent with the USEPA Principles for Greener Cleanups, and DER-31, a qualitative analysis of the sustainable best management practices for the preferred remedy will be performed during the remedial design.

References

NYSDEC. 2011. DER-31 Green Remediation, New York Department of Environmental Conservation DEC Program Policy. January 20.

USEPA. 2008. Technology Primer - Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites, Office of Solid Waste and Emergency Response, EPA 542-R-08-002. April.

USEPA. 2009. U.S. EPA. 2009. Climate Leaders Program Direct Emissions from Stationary Combustion Sources. May. www.epa.gov/climateleaders.

Enclosures

Table 1 – Summary of the Sustainability Assessment Results for Remedial Alternatives

Attachment 1 – Sustainability Assessment Results Comparative Charts

Table

Table 1. Summary of Sustainability Assessment Results for Remedial Alternatives

Alternatives	GHG Emissions	Total Energy Used	Water Consumption	Electricity Usage	Onsite NOxEmissions	Onsite SOxEmissions	Onsite PM10Emissions	Total NOxEmissions	Total SOxEmissions	Total PM10Emissions	Accident Risk Fatality	Accident Risk Injury
	metric ton	MMBTU	gallons	MWH	metric ton	metric ton	metric ton	metric ton	metric ton	metric ton	%	%
Alternative 2: LTM												
Consumables Production	14.6	2,295.3	NA	NA	NA	NA	NA	0.0	0.0	0.0	NA	NA
Transportation-Personnel	2.3	29.5	NA	NA	NA	NA	NA	0.0	0.0	0.0	0.0	0.0
Equipment Use and Misc	5.6	79.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Residual Handling and Conumables	0.0	0.0	NA	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	22.6	2,404.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alternative 3: Excavation												
Consumables	190.8	3,303.7	NA	NA	NA	NA	NA	0.7	0.9	0.4	NA	NA
Transportation-Personnel	63.8	803.5	NA	NA	NA	NA	NA	0.0	0.0	0.0	0.0	0.1
Equipment Use and Misc	55.3	1,194.8	0.0	0.0	0.3	0.1	0.0	0.4	0.1	0.1	0.0	0.1
Residual Handling	180.5	2,925.3	NA	NA	0.0	0.0	0.0	0.6	0.3	1.5	0.0	0.0
Total	490.3	8,227.2	0.0	0.0	0.3	0.1	0.0	1.7	1.3	1.9	0.0	0.2
Alternative 4: ISS												
Consumables	171.4	1,119.0	NA	NA	NA	NA	NA	0.4	0.7	0.2	NA	NA
Transportation-Personnel	54.7	689.3	NA	NA	NA	NA	NA	0.0	0.0	0.0	0.0	0.1
Equipment Use and Misc	27.4	607.1	216,733.5	32.8	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Residual Handling and Material Tra	52.0	767.0	NA	NA	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.0
Total	305.6	3,182.4	216,733.5	32.8	0.1	0.0	0.0	0.6	0.8	0.4	0.0	0.2
Alternative 5: ISTR												
Consumables Production	22.4	149.7	NA	NA	NA	NA	NA	0.0	0.0	0.0	NA	NA
Transportation-Personnel	28.4	358.4	NA	NA	NA	NA	NA	0.0	0.0	0.0	0.0	0.0
Equipment Use and Misc	882.2	20,176.7	2,841,799.8	2,713.3	0.1	0.0	0.0	1.0	1.2	0.6	0.0	0.4
Residual Handling and Consumable	2.9	37.4	NA	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	935.9	20,722.1	2,841,799.8	2,713.3	0.1	0.0	0.0	1.0	1.2	0.7	0.0	0.4

Notes and Acronyms

MMBTU = 1 million British thermal units

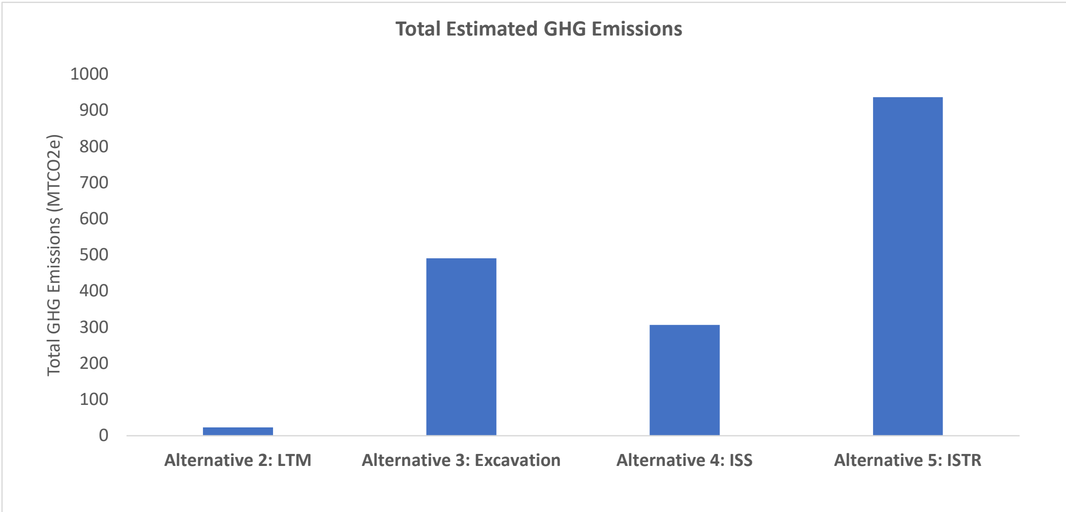
MWH = megawatt hours

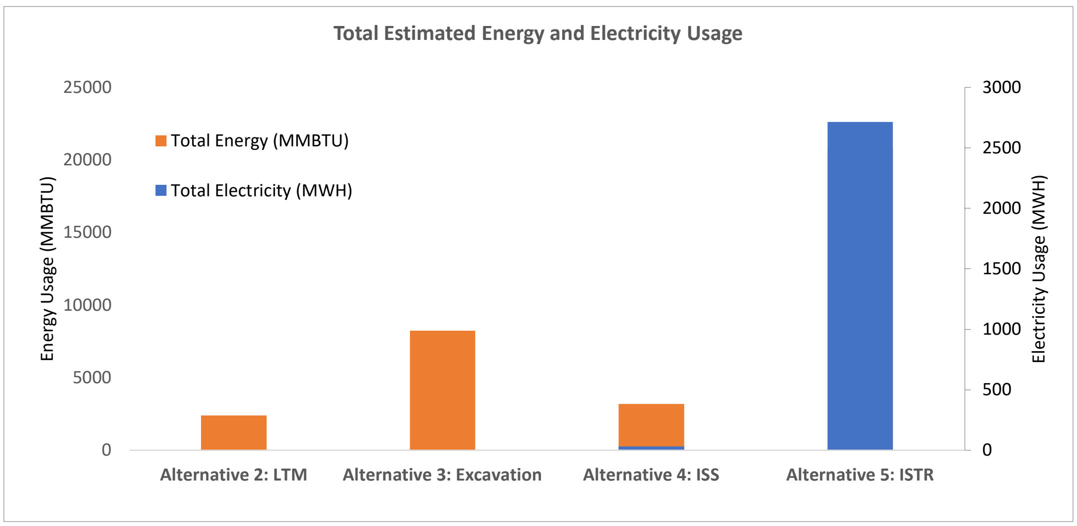
NA = not applicable

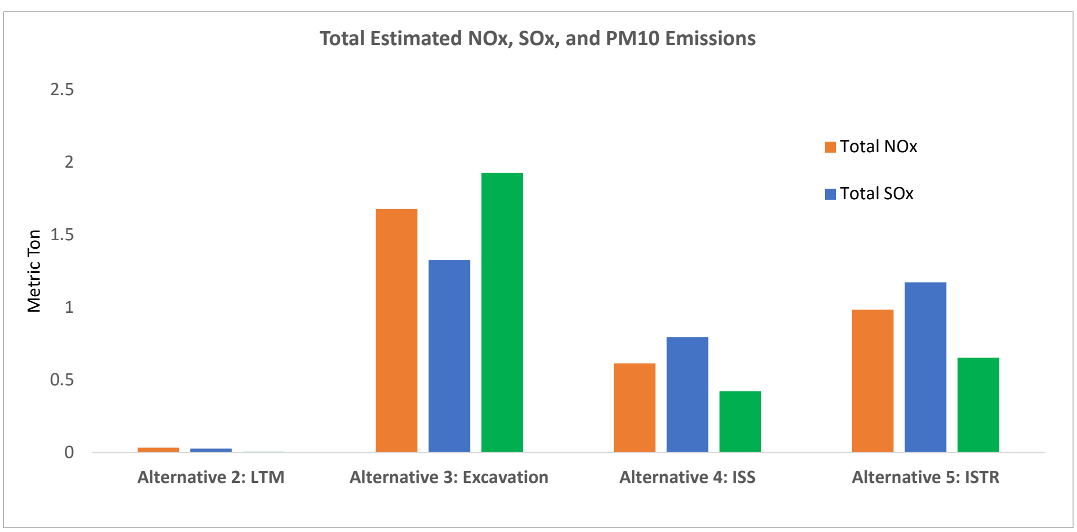
Attachment 1

Sustainability Assessment Results Comparative Charts

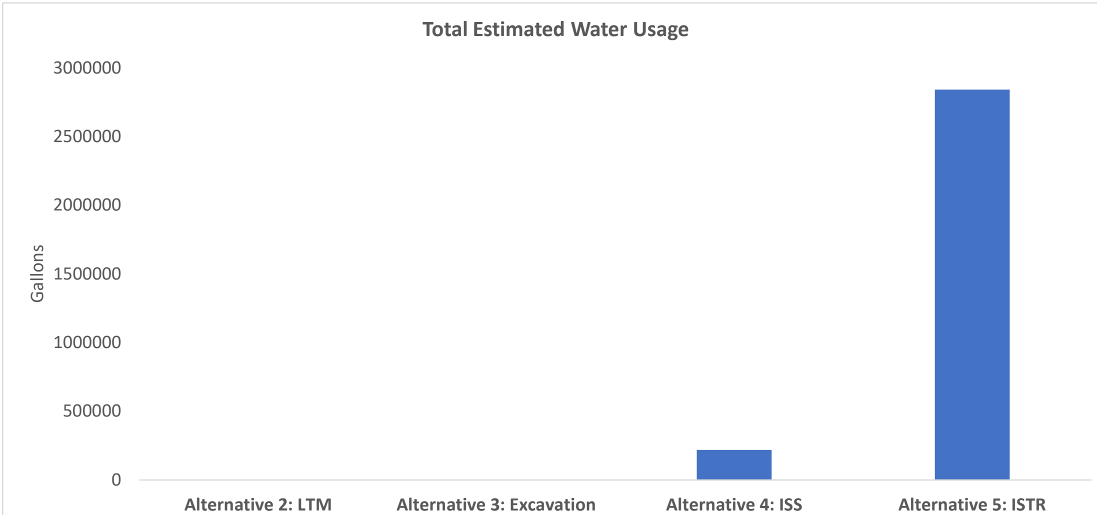
Attachment 1. Sustainability Assessment Results Compariative Charts

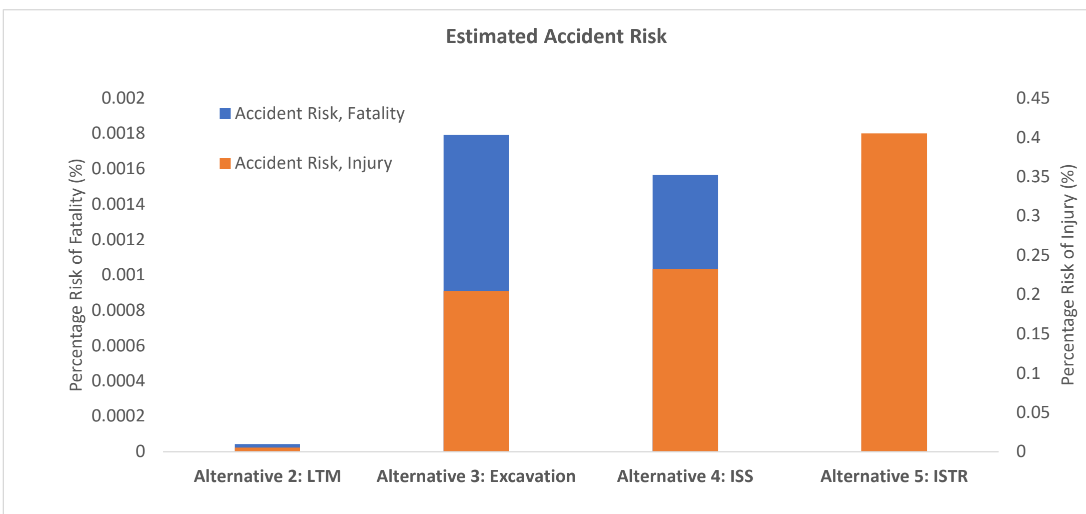






Attachment 1. Sustainability Assessment Results Compariative Charts





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