PROPOSED REMEDIAL ACTION PLAN

Olin Corporation - Chemicals Group
State Superfund Project
Rochester, Monroe County
Site No. 828018A
February 2019

Prepared by
Division of Environmental Remediation
New York State Department of Environmental Conservation

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SECTION 1: SUMMARY AND PURPOSE OF THE PROPOSED PLAN

The New York State Department of Environmental Conservation (the Department), in consultation with the New York State Department of Health (NYSDOH), is proposing a remedy for the above referenced site. The disposal of hazardous wastes at the site has resulted in threats to public health and the environment that would be addressed by the remedy proposed by this Proposed Remedial Action Plan (PRAP). The disposal of hazardous wastes at this site, as more fully described in Section 6 of this document, has contaminated various environmental media. The proposed remedy is intended to attain the remedial action objectives identified for this site for the protection of public health and the environment. This PRAP identifies the preferred remedy, summarizes the other alternatives considered, and discusses the reasons for the preferred remedy.

The New York State Inactive Hazardous Waste Disposal Site Remedial Program (also known as the State Superfund Program) is an enforcement program, the mission of which is to identify and characterize suspected inactive hazardous waste disposal sites and to investigate and remediate those sites found to pose a significant threat to public health and environment.

The Department has issued this document in accordance with the requirements of New York State Environmental Conservation Law and Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York; (6 NYCRR) Part 375. This document is a summary of the information that can be found in the site-related reports and documents in the document repository identified below.

SECTION 2: CITIZEN PARTICIPATION

The Department seeks input from the community on all PRAPs. This is an opportunity for public participation in the remedy selection process. The public is encouraged to review the reports and documents, which are available at the following repository:

Rochester Public Library
956 Lyell Avenue
Rochester, NY 14606
Phone: (585) 428-8218

A public comment period has been set from:

February 27, 2019
to
March 29, 2019

A public meeting is scheduled for the following date: March 18, 2019

Public meeting location:

Rochester Public Library
956 Lyell Avenue
Rochester, NY 14606
Phone: (585) 428-8218

At the meeting, the findings of the remedial investigation (RI) and the feasibility study (FS) amendment will be presented along with a summary of the proposed remedy. After the presentation, a question-and-answer period will be held, during which verbal or written comments may be submitted on the PRAP.

Written comments may also be sent through to:

Todd Caffoe
NYS Department of Environmental Conservation
Division of Environmental Remediation
6274 East Avon-Lima Road
Avon, NY 14414
todd.caffoe@dec.ny.gov

The Department may modify the proposed remedy or select another of the alternatives presented in this PRAP based on new information or public comments. Therefore, the public is encouraged to review and comment on the proposed remedy identified herein. Comments will be summarized and addressed in the responsiveness summary section of the Record of Decision (ROD). The ROD is the Department's final selection of the remedy for this site.

Receive Site Citizen Participation Information By Email

Please note that the Department's Division of Environmental Remediation (DER) is "going paperless" relative to citizen participation information. The ultimate goal is to distribute citizen participation information about contaminated sites electronically by way of county email listservs. Information will be distributed for all sites that are being investigated and cleaned up in a particular county under the State Superfund Program, Environmental Restoration Program, Brownfield Cleanup Program, Voluntary Cleanup Program, and Resource Conservation and Recovery Act Program. We encourage the public to sign up for one or more county listservs at http://www.dec.ny.gov/chemical/61092.html.

SECTION 3: SITE DESCRIPTION AND HISTORY

Location: The Olin Corporation-Chemicals Group (Arch Chemical Site) is located on a 15-acre parcel at 100 McKee Road in a commercial/ industrial area of the City of Rochester.

Site Features: The active manufacturing complex is comprised of several chemical manufacturing facilities including the main manufacturing plant, a chemical tank farm, a waste pretreatment building, and a large warehouse. Significant physical features nearby include the Erie Canal (about 1,200 feet west) and a quarry in the Town of Gates (about 4,000 feet southwest) of the site.

Current Zoning and Land Use: The site is zoned industrial and surrounding land uses are industrial and commercial. The nearest residential neighborhoods are about 2,000 feet east on Mt. Read Blvd. and Varian Lane about 2,000 feet west of the site.

Past Use of the Site: Lonza (Arch before 2012 and Olin Corporation before 1999) has produced specialty chemicals at this location since 1954. Industrial use of the site began in 1948, when Genesee Research, a fully-owned subsidiary of the Puritan Company, established a manufacturing facility for automotive specialty products (e.g., brake fluids, polishes, anti-freeze, and specialty organic chemicals). In 1954, Mathieson Chemical Corporation acquired Puritan and merged with Olin Industries to become Olin Mathieson Chemical Corporation. Production of brake fluid and anti-freeze continued for a time but in the early 1960s, production of specialty organic chemicals, such as Zinc Omadine® and chlorinated pyridines (chloropyridines) began. In 1969, Olin Mathieson changed its name to Olin Corporation (Olin) and in 1999, Olin spun off its specialty chemicals business to form an independent company known as Arch Chemicals, Inc. (Arch). The Arch Rochester plant is the sole manufacturer of chloropyridines in the United States. The primary product line is Omadine® biocides, used in anti-dandruff shampoos and by the metalworking industry. Other products include more than 60 specialty organic chemicals used in personal care products, crop protection, rubber and plastic additives, and the textile industry.

Site Geology and Hydrogeology: Overburden soils, consisting largely of sand and about 10 -20 feet thick overlie a fractured carbonate bedrock formation, the Lockport Dolomite, which is exposed locally in the nearby quarry in the Town of Gates. Groundwater generally flows southwest; groundwater contaminated with chloropyridines discharges into the quarry located about 4,000 feet southwest of the site.

Operable Units: Two operable units were previously established (OU-1; source area remediation and OU-2; contaminated groundwater). The proposed final remedy will combine both OUs and will be included in this document.

A ROD was issued previously for OU-2 in March 2002, which is proposed to be modified by this document

A site location map is attached as Figure 1.

SECTION 4: <u>LAND USE AND PHYSICAL SETTING</u>

The Department may consider the current, intended, and reasonably anticipated future land use of the site and its surroundings when evaluating a remedy for soil remediation. For this site, alternatives (or an alternative) that restrict(s) the use of the site to industrial as described in Part 375-1.8(g) are/is being evaluated in addition to an alternative which would allow for unrestricted use of the site.

A comparison of the results of the investigation to the appropriate standards, criteria and guidance values (SCGs) for the identified land use and the unrestricted use SCGs for the site contaminants is included in the Tables for the media being evaluated in Exhibit A.

SECTION 5: <u>ENFORCEMENT STATUS</u>

Potentially Responsible Parties (PRPs) are those who may be legally liable for contamination at a site. This may include past or present owners and operators, waste generators, and haulers.

The PRPs for the site, documented to date, include:

Lonza

The Department and Arch Chemical executed a Consent Order on August 11, 2003. The Order obligates the responsible party to implement a full remedial program. The previous Order was executed on August 23, 1993, between Olin Chemical and the Department for implementation of a Remedial Investigation/Feasibility Study.

SECTION 6: <u>SITE CONTAMINATION</u>

6.1: <u>Summary of the Remedial Investigation</u>

A Remedial Investigation (RI) has been conducted. The purpose of the RI was to define the nature and extent of any contamination resulting from previous activities at the site. The field activities and findings of the investigation are described in the RI Report.

The following general activities are conducted during an RI:

- Research of historical information,
- Geophysical survey to determine the lateral extent of wastes,
- Test pits, soil borings, and monitoring well installations,
- Sampling of waste, surface and subsurface soils, groundwater, and soil vapor,
- Sampling of surface water and sediment,

- Ecological and Human Health Exposure Assessments.

The analytical data collected on this site includes data for:

- groundwater
- surface water
- soil
- soil vapor
- indoor air
- sub-slab vapor

6.1.1: Standards, Criteria, and Guidance (SCGs)

The remedy must conform to promulgated standards and criteria that are directly applicable or that are relevant and appropriate. The selection of a remedy must also take into consideration guidance, as appropriate. Standards, Criteria and Guidance are hereafter called SCGs.

To determine whether the contaminants identified in various media are present at levels of concern, the data from the RI were compared to media-specific SCGs. The Department has developed SCGs for groundwater, surface water, sediments, and soil. The NYSDOH has developed SCGs for drinking water and soil vapor intrusion. The tables found in Exhibit A list the applicable SCGs in the footnotes. For a full listing of all SCGs see: http://www.dec.ny.gov/regulations/61794.html

6.1.2: RI Results

The data have identified contaminants of concern. A "contaminant of concern" is a hazardous waste that is sufficiently present in frequency and concentration in the environment to require evaluation for remedial action. Not all contaminants identified on the property are contaminants of concern. The nature and extent of contamination and environmental media requiring action are summarized in Exhibit A. Additionally, the RI Report contains a full discussion of the data. The contaminant(s) of concern identified for this Operable Unit at this site is/are:

chloropyridine	chloroform
pyridine	chlorobenzene
carbon tetrachloride	trichloroethene (TCE)
methylene chloride	tetrachloroethene (PCE)

As illustrated in Exhibit A, the contaminant(s) of concern exceed the applicable SCGs for:

- groundwater
- soil
- soil vapor intrusion

6.2: Interim Remedial Measures

An interim remedial measure (IRM) is conducted at a site when a source of contamination or exposure pathway can be effectively addressed before issuance of the Record of Decision.

There were no IRMs performed at this site during the RI.

6.3: Summary of Environmental Assessment

This section summarizes the assessment of existing and potential future environmental impacts presented by the site. Environmental impacts may include existing and potential future exposure pathways to fish and wildlife receptors, wetlands, groundwater resources, and surface water.

Based upon the resources and pathways identified and the toxicity of the contaminants of ecological concern at this site, a Fish and Wildlife Resources Impact Analysis (FWRIA) was deemed not necessary.

There is significant soil within a defined source area and significant groundwater contamination within a fractured bedrock aquifer. The primary site contaminants are chloropyridines and chlorinated volatile organic compounds (VOCs) located beneath and in inaccessible locations at the site.

Nature and Extent of Contamination
Past releases of hazardous wastes, primarily from leaking sewers and spills over years of operation at the site have resulted in significant soil, groundwater contamination, and soil vapor. Several environmental investigations identified and defined the nature and extent of contamination. During these investigations soil and groundwater were sampled for VOCs, semivolatile organic compounds (SVOCs), metals, pesticides, and polychlorinated biphenyls (PCBs). Contaminants of concern include chloropyridines, and VOCs.

Groundwater: An initial investigation in 1981 revealed the presence of significant groundwater contamination and several perimeter overburden monitoring wells were converted to pumping wells in 1983. A two-phased remedial investigation (1995-1997) defined on-site and off-site groundwater contamination which extends to the quarry. A well-defined source area was identified on-site for both VOCs and chloropyridines. High levels of VOCs in contaminated groundwater are generally confined to on-site locations. VOC concentrations in groundwater exceed 10 parts per million (ppm) within the on-site source area; however, contaminant levels drop to less than 10 parts per billion (ppb) within 250 feet of the site boundary. Levels of chloropyridines in groundwater exceed 100 ppm within the source area. Off-site levels of chloropyridines drop below 100 ppb within 500 feet of the site boundary. Chloropyridine contamination in groundwater has migrated off-site in deep bedrock fractures to the quarry approximately 4,000 feet away to the southwest of the site. Currently, levels of chlorpyridines in groundwater adjacent to the quarry range from 5 to 10 ppb. There are no groundwater standards or guidance values for chloropyridines. A groundwater collection system has been in operation since 1985 and has expanded since that time. Over 15 million gallons of contaminated groundwater per year is collected, treated, and discharged to the sanitary sewers. Groundwater is monitored on a semiannual basis.

Surface Soil: Surface soil sampling at the site (17 samples at 0"-2") showed several detections of polycyclic aromatic hydrocarbons (PAHs) and some metals. Of those detections the restricted industrial soil cleanup objectives (SCOs) were exceeded for benzo(a)pyrene (SCO=1 ppm) ranging from 1.1 to 27 ppm, indeno(1,2,3-cd)pyrene (SCO=11 ppm) at 15 ppm, and mercury (SCO=5.7 ppm) ranging from 7.2 to 218 ppm. PAH exceedances were noted sporadically in site surface soils and are currently beneath paved areas of the site or part of existing railway beds located on-site. Mercury was detected in the former lab waste disposal area and was limited to surface soil within a small central portion of the site. These locations are currently under asphalt pavement

Sub-Surface Soil: Sub-surface soil contamination is primarily limited to the on-site groundwater contaminant source area. The highest concentrations of VOCs detected were methylene chloride (Protection of Groundwater (PGW) SCO= 0.05 ppm) at 2.8 ppm, chloroform (PGW SCO=0.37) at 380 ppm, carbon tetrachloride (PGW SCO=0.76 ppm) at 4,200 ppm, trichloroethene (PGW SCO=0.47 ppm) at 73 ppm, and tetrachloroethene (PGW SCO=1.3 ppm) at 520 ppm. Total chloropyridine levels in source are soils range from 13 to 1,200 ppm. The PGW SCO established for 2-chloropyridne is 0.9 ppm and 3-chloropyridine is 0.8 ppm. Most of the soil contamination is confined to depths between 8 and 18 feet below ground surface. Source areas are also suspected beneath certain on-site buildings where sampling could not be conducted.

Surface Water: Chloropyridines were detected in samples from the nearby quarry. Contaminants were detected in bedrock seeps into the quarry, the quarry ponds, the quarry discharge channel along I-390, the quarry discharge point at the Erie Canal, and the Erie Canal. The levels of chloropyridines near the quarry have steadily declined since the 1990s. Most recent sampling shows non-detect levels of chloropyridines at the canal outfall down from an historic high of over 200 ppb during the mid-1990s. These discharges are periodically monitored.

Soil Vapor: Sampling of soil vapor, sub-slab vapor, indoor and outdoor air was conducted in the on-site buildings from 2005 to 2008 (sub-slab vapor, indoor and outdoor air at six locations), at the site perimeter in 2007 and 2009 (soil vapor probes), and offsite in 2006 in two adjacent industrial/commercial buildings (sub-slab vapor and indoor air).

On-site results show significant vapor concentrations under the chemical production area of the plant which diminish rapidly toward the south (i.e., under the warehouse building) and to the northwest (i.e. beneath the office area). The highest concentrations of VOCs detected in the indoor air in the on-site buildings were 2-chloropyridines at 1,800 micrograms per cubic meter (ug/m3), methylene chloride at 280 ug/m3, chloroform at 87 ug/m3, carbon tetrachloride at 5.2 ug/m3, trichloroethene at 0.7 ug/m3, and tetrachloroethene at 2.3 ug/m3. The maximum concentrations in the sub-slab vapor beneath the on-site buildings were 2-chloropyridines at 360,000 ug/m3, methylene chloride at 130,000 ug/m3, chloroform at 2,000,000 ug/m3, carbon tetrachloride at 8,800 ug/m3, trichloroethene at 10,000 ug/m3, and tetrachloroethene at 88,000 ug/m3. The concentrations of these VOCs in outdoor air samples were found to be consistent with background ranges. Due to the current use and production of these chemicals at the facility, exposures are considered occupational and Occupational Safety and Health Administration standards apply.

Soil vapor samples collected along the property line, away from the source area, found low-levels of site-related contaminants at levels generally consistent with background concentrations.

The highest concentrations of VOCs detected in the indoor air in the off-site buildings were methylene chloride at 22 ug/m3, chloroform at 0.98 ug/m3, carbon tetrachloride at 0.69 ug/m3, trichloroethene at 0.33 ug/m3, and tetrachloroethene at 12 ug/m3. The maximum concentrations in the sub-slab vapor beneath the off-site buildings were methylene chloride at 2.8 ug/m3, chloroform at 4.2 ug/m3, carbon tetrachloride at 3.9 ug/m3, trichloroethene at 2.8 ug/m3, and tetrachloroethene at 28 ug/m3. The concentrations of these VOCs in outdoor air samples were found to be consistent with background ranges. Due to the current use of these chemicals at the facility, exposures are considered occupational and Occupational Safety and Health Administration standards apply.

Based on the current use of the buildings on-and off-site, no actions are needed to address exposures related to soil vapor intrusion. However, the potential exists for the inhalation of site contaminants due to soil vapor intrusion for any future on-site development or if there is a change in use of the buildings.

6.4: Summary of Human Exposure Pathways

This human exposure assessment identifies ways in which people may be exposed to site-related contaminants. Chemicals can enter the body through three major pathways (breathing, touching or swallowing). This is referred to as *exposure.*

People are not expected to come into direct contact with site-related contaminants in the soil because buildings and pavement cover most of the site and access to the site is restricted. People may come into direct contact with site-related contaminants if they dig below the surface on-site. People are not drinking contaminated groundwater associated with the site because the area is served by a public water supply that obtains its water from a different source not affected by this contamination. Volatile organic compounds in the groundwater may move into the soil vapor (air spaces within the soil), which in turn may move into overlying buildings and affect the indoor air quality. This process, which is similar to the movement of radon gas from the subsurface into the indoor air of buildings, is referred to as soil vapor intrusion. Sampling indicates a concern for inhalation of site related contaminants due to soil vapor intrusion at buildings on-site and at two adjacent off-site buildings. Based on the current use of the site and the two adjacent off-site buildings, actions to address soil vapor intrusion are deferred for future development or in the event that the current use of those buildings change. In addition, sampling indicates soil vapor intrusion is not a concern for any other off-site buildings.

6.5: Summary of the Remediation Objectives

The objectives for the remedial program have been established through the remedy selection process stated in 6 NYCRR Part 375. The goal for the remedial program is to restore the site to pre-disposal conditions to the extent feasible. At a minimum, the remedy shall eliminate or mitigate all significant threats to public health and the environment presented by the contamination identified at the site through the proper application of scientific and engineering principles.

The remedial action objectives for this site are:

Groundwater

RAOs for Public Health Protection

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of volatiles, from contaminated groundwater.

RAOs for Environmental Protection

- Prevent the discharge of contaminants to surface water.
- Remove the source of ground or surface water contamination.

Soil

RAOs for Public Health Protection

- Prevent ingestion/direct contact with contaminated soil.
- Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil.

RAOs for Environmental Protection

- Prevent migration of contaminants that would result in groundwater or surface water contamination.

Soil Vapor

RAOs for Public Health Protection

- Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at a site.

SECTION 7: SUMMARY OF THE PROPOSED REMEDY

To be selected, the remedy must be protective of human health and the environment, be cost-effective, comply with other statutory requirements, and utilize permanent solutions, alternative technologies or resource recovery technologies to the maximum extent practicable. The remedy must also attain the remedial action objectives identified for the site, which are presented in Section 6.5. Potential remedial alternatives for the Site were identified, screened and evaluated in the FS report.

A summary of the remedial alternatives that were considered for this site is presented in Exhibit B. Cost information is presented in the form of present worth, which represents the amount of money invested in the current year that would be sufficient to cover all present and future costs associated with the alternative. This enables the costs of remedial alternatives to be compared on a common basis. As a convention, a time frame of 30 years is used to evaluate present worth costs for alternatives with an indefinite duration. This does not imply that operation, maintenance, or monitoring would cease after 30 years if remediation goals are not achieved. A summary of the Remedial Alternatives Costs is included as Exhibit C.

The basis for the Department's proposed remedy is set forth at Exhibit D.

The proposed remedy is referred to as Horizontal Groundwater Extraction Wells.

The estimated present worth cost to implement the remedy is $7,011,000. The cost to construct the remedy is estimated to be $1,094,000 and the estimated average annual cost is $325,00 for years 1-25 and $97,000 for years 26-30.

The elements of the proposed remedy are as follows:

1. Remedial Design
   A remedial design program will be implemented to provide the details necessary for the construction, operation, optimization, maintenance, and monitoring of the remedial program. Green remediation principles and techniques will be implemented to the extent feasible in the design, implementation, and site management of the remedy as per DER-31. The major green remediation components are as follows;

   - Considering the environmental impacts of treatment technologies and remedy stewardship over the long term;
   - Reducing direct and indirect greenhouse gases and other emissions;
   - Increasing energy efficiency and minimizing use of non-renewable energy;
   - Conserving and efficiently managing resources and materials;
   - Reducing waste, increasing recycling and increasing reuse of materials which would otherwise be considered a waste;
   - Maximizing habitat value and creating habitat when possible;
   - Fostering green and healthy communities and working landscapes which balance ecological, economic and social goals; and
   - Integrating the remedy with the end use where possible and encouraging green and sustainable re-development.

2. Horizontal Groundwater Extraction Wells
   The existing groundwater extraction and treatment system would be enhanced by installing at least two horizontal groundwater extraction wells beneath the site. The groundwater extraction system will be designed and installed so that the capture zone is sufficient to intercept the contaminant source area and provide a barrier to off-site migration. The extraction system will enhance the existing depression of the water table so that contaminated groundwater is directed toward the extraction wells within the plume area. Groundwater will be extracted from the subsurface using approximately 800 feet of 6-inch diameter well screen that would be installed 5 feet below the top of bedrock (20-30 feet below ground surface) using horizontal drilling technologies. Granular active carbon (GAC) will be used to remove dissolved contaminants from extracted groundwater by adsorption. The GAC system will consist of one or more vessels filled with carbon connected in series and/or parallel. Following treatment, the groundwater will be discharged to the sanitary sewer. The existing GAC treatment system will need to be expanded to handle the increased groundwater recovery.

3. A site cover currently exists in areas not occupied by buildings and will be maintained to allow for industrial use of the site. Any site redevelopment will maintain the existing site cover. The site cover may include paved surface parking areas, sidewalks or soil where the upper one foot of exposed surface soil meets the applicable soil cleanup objectives (SCOs) for industrial use. Any fill material brought to the site will meet the requirements for the identified site use as set forth in 6NYCRR part 375-6.7(d).

4. Modifications to March 2002 ROD
   The following elements from the previously selected remedy would be eliminated: the off-site extraction well adjacent to the quarry; and the overburden groundwater interceptor trench on the southeastern/southern perimeter of the plant property.

5. Financial Assurance
   The Responsible Party shall provide financial assurance using one or more of the financial instruments in 6 NYCRR 373-2.8 in the amount of the net present value of the selected remedy. The amount of financial assurance may decrease as a function of the remaining costs to implement and maintain the selected remedy.

6. Institutional Control
   Imposition of an institutional control in the form of an environmental easement for the controlled property which will:

   - require the remedial party or site owner to complete and submit to the Department a periodic certification of institutional and engineering controls in accordance with Part 375-1.8 (h)(3);
   - allow the use and development of the controlled property for industrial use as defined by Part 375-1.8(g), although land use is subject to local zoning laws;
   - restrict the use of groundwater as a source of potable or process water, without necessary water quality treatment as determined by the NYSDOH or County DOH;
   - and require compliance with the Department approved Site Management Plan.

7. Site Management Plan
   A Site Management Plan is required, which includes the following:

   a. an Institutional and Engineering Control Plan that identifies all use restrictions and engineering controls for the site and details the steps and media-specific requirements necessary to ensure the following institutional and/or engineering controls remain in place and effective:

      Institutional Controls: The environmental easement as discussed in item #6 above.

      Engineering Controls: The groundwater extraction system discussed in paragraph 2 above and the site cover, Paragraph 3 above.

      This plan includes, but may not be limited to:

- an Excavation Plan which details the provisions for management of future excavations in areas of remaining contamination;
- a provision for further investigation and remediation should the chemical plant be closed and demolished, large scale redevelopment occurs, or if the subsurface is otherwise made accessible. The nature and extent of contamination in areas where access was previously limited or unavailable will be immediately and thoroughly investigated pursuant to a plan approved by the Department. Based on the investigation results and the Department determination of the need for a remedy, a Remedial Action Work Plan (RAWP) will be developed for the final remedy for the site, including removal and/or treatment of any source areas to the extent feasible. Citizen Participation Plan (CPP) activities will continue through this process. Any necessary remediation will be completed prior to, or in association with, redevelopment. This would only apply if the main plant over the source area were closed and demolished;
- descriptions of the provisions of the environmental easement including any land use, and/or groundwater use restrictions;
- provisions for the management and inspection of the identified engineering controls;
- a provision for evaluation of the potential for soil vapor intrusion for future buildings developed on the site or in areas affected by site-related contaminants off-site, including provision for implementing actions recommended to address exposures related to soil vapor intrusion;
- maintaining site access controls and Department notification;
- the steps necessary for the periodic reviews and certification of the institutional and/or engineering controls; and
- a schedule for the evaluation and repair of facility piping and equipment that potentially may contribute to future releases to the environment.

b. a Monitoring Plan to assess the performance and effectiveness of the remedy. The plan includes, but may not be limited to:

- monitoring of groundwater and surface water to assess the performance and effectiveness of the remedy;
- monitoring for vapor intrusion for any occupied existing or future buildings developed on the site or in areas affected by site-related contaminants off-site, as may be required by the Institutional and Engineering Control Plan discussed above; and
- a schedule of monitoring and frequency of submittals to the Department.

c. an Operation and Maintenance (O&M) Plan to ensure continued operation, maintenance, optimization, monitoring, inspection, and reporting of any mechanical or physical components of the remedy. The plan includes, but is not limited to:

- procedures for operating and maintaining the remedy;

- compliance monitoring of treatment systems to ensure proper O&M as well as providing the data for any necessary permit or permit equivalent reporting;
- maintaining site access controls and Department notification; and
- providing the Department access to the site and O&M records.

Exhibit A

Nature and Extent of Contamination

This section describes the findings of the Remedial Investigation for all environmental media that were evaluated. As described in Section 6.1, samples were collected from various environmental media to characterize the nature and extent of contamination.

For each medium for which contamination was identified, a table summarizes the findings of the investigation. The tables present the range of contamination found at the site in the media and compares the data with the applicable SCGs for the site. The contaminants are arranged into three categories: volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and inorganics (metals and cyanide). For soil, if applicable, the Restricted Use SCGs identified in Section 4 and Section 6.1.1 are also presented.

Groundwater

Groundwater sampling has been ongoing at the facility since the early 1980s which has yielded an extensive analytical database. The main classes of contaminants of concern are VOCs and SVOCs, which have been detected in overburden and bedrock groundwater beneath the site. Chlorinated VOCs such as methylene chloride, carbon tetrachloride, chloroform, chlorobenzene, trichloroethene (TCE), and tetrachloroethene (PCE) are the main VOCs of concern detected in groundwater. Chloropyridines are the SVOCs that are the contaminants of concern in groundwater. Deep bedrock groundwater flows beneath the Erie Canal and discharges to the quarry located southwest of the site (see Figure 1). In general, the highest contaminant concentrations in groundwater are found at the well B-17 which has been identified as the main source area. VOC concentrations in groundwater exceed 10 parts per million (ppm) within the well B-17 source area; however, contaminant levels drop to less than 10 parts per billion (ppb) within 250 feet of the site boundary. Levels of chloropyridines in groundwater exceed 100 ppm within the source area. Off-site levels of chloropyridines drop below 100 ppb within 500 feet of the site boundary. Chloropyridine contamination in groundwater has migrated off-site in deep bedrock fractures to the quarry approximately 4,000 feet away to the southwest of the site. Currently, levels of chlorpyridines in groundwater adjacent to the quarry range from 5 to 10 ppb. There are no groundwater standards or guidance values for chloropyridines. The extent and magnitude of the VOC and chloropyridine plumes in groundwater from the most recent semiannual sampling (May 2018) are depicted in Figures 2 and 3.

A groundwater pump and treatment system has been in operation since the 1980s. A semi-annual groundwater monitoring program has been underway at this site since the 1990s. The current monitoring points are identified in Figure 4. The pump and treat system was modified and expanded by the March 2002 ROD and the current pumping wells are identified in Figure 7. During the past recent six-month monitoring period over seven million gallons of groundwater was treated by the pump and treat system

Due to the continued persistence of the groundwater contamination, additional remedial alternatives were evaluated and presented in the 2018 Feasibility Study Addendum.

Table #1 – Semi-Annual Groundwater Monitoring Results (2008-2018)

Detected Constituents	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)	Frequency Exceeding SCG
VOCs			
Carbon Tetrachloride	0.3 to 89,000	5	173 of 716
Chlorobenzene	0.46 to 8,100	5	375 of 716
Chloroform	0.38 to 750,000	7	243 of 716
Methylene Chloride	0.45 to 23,300	5	179 of 716
Tetrachloroethene	0.36 to 3,600	5	195 of 716
Trichloroethene	0.51 to 2,000	5	75 of 216
SVOCs			
2,6-dichloropyridine	1.8 to 86,000	NS	681 of 838 detections
2-chloropyridine	2.2 to 926,000	NS	767 of 838 detections
3-chloropyridine	1.6 to 93,500	NS	196 of 838 detections
4-chlororpyridine	7.5 to 97,700	NS	135 of 838 detections
p-fluoroaniline	0.82 to 50,000	NS	273 of 838 detections
Pyridine	1.1 to 93,300	50	75 of 821

a - ppb: parts per billion, which is equivalent to micrograms per liter, ug/L, in water.
b- SCG: Standard Criteria or Guidance - Ambient Water Quality Standards and Guidance Values (TOGs 1.1.1), 6 NYCRR Part 703, Surface water and Groundwater Quality Standards, and Part 5 of the New York State Sanitary Code (10 NYCRR Part 5).
NS – No standard or guidance value

Based on the findings of the RI, the past disposal of hazardous waste has resulted in the contamination of groundwater. The site contaminants that are considered to be the primary contaminants of concern which will drive the remediation of groundwater to be addressed by the remedy selection process are: methylene chloride, carbon tetrachloride, chloroform, chlorobenzene, TCE, PCE, and chloropyridines.

Soil

The Phase I and Phase II Remedial Investigation Reports were finalized in 1995 and 1997 respectively. Since that time, there has been no additional soil investigations conducted at the site. Sample results were compared to the SCOs in 6 NYCRR Part 375 and those exceeding their respective SCOs (either restricted industrial or groundwater protection for analytes detected in groundwater) are depicted in Figures 4 and 5. Table 2 summarizes the soil sample results from the Remedial Investigation Reports.

Surface Soil

Surface soil sampling at the site (17 samples at 0"-2") showed several detections of polycyclic aromatic hydrocarbons (PAHs) and some metals. Of those detections the restricted industrial SCOs were exceeded for benzo(a)pyrene (SCO=1 ppm) ranging from 1.1 to 27 ppm, indeno(1,2,3-cd)pyrene (SCO=11 ppm) at 15 ppm, and mercury (SCO=5.7 ppm) ranging from 7.2 to 218 ppm). PAH exceedences were noted sporadically in site surface soils and are currently beneath paved areas of the site or part of an existing railway beds located on-site. Mercury was detected in the former lab waste disposal area and was limited to surface soil within a small central portion of the site. These locations are currently under asphalt pavement. Please refer to Figure 4 for sample locations and results exceeding the SCOs.

Subsurface Soil

Over fifty direct-push soil samples were collected across the site; the highest concentrations of VOCs and chloropyridines, were detected in the well B-17 area. This was noted as the main source area of groundwater contamination and is formerly from sewer leaks spills from the main plant. One direct-push sample at location T-135, detected levels of contaminants that would be considered Dense Non-Aqueous Phase Liquid (DNAPL) at 18 feet below grade at the top of rock. The highest concentrations of VOCs detected were methylene chloride (SCO= 0.05 ppm) at 2.8 ppm, chloroform (SCO=0.37) at 380 ppm, carbon tetrachloride (SCO=0.76 ppm) at 4,200 ppm, trichloroethene (SCO=0.47 ppm) at 73 ppm, and tetrachloroethene (SCO=1.3 ppm) at 520 ppm. Total chloropyridine levels in source area soils range from 13 to 1,200 ppm. The SCOs established in the 2002 ROD are 0.9 ppm for 2-chloropyridine and 0.8 ppm for 3-chloropyridine. Most of the soil contamination is confined to depths between 8 and 18 feet below ground surface. Given this result and several plant expansions over the years, it is most likely that contamination extends beneath the footprint of the main plant. Figure 5 shows sub-surface soil results exceeding their respective SCOs and Figure 7 shows the location of the approximate area of the main groundwater contamination source.

Since surface soils are currently covered by asphalt and the site is used as an active chemical manufacturing plant. No further remedial alternatives were evaluated to address surface soils. Subsurface soil contamination represents a significant source of groundwater contamination. The portions of the remedy identified in the March 2002 ROD were designed to address off-site migration of groundwater contamination. Further investigations and evaluations were conducted to determine if source area soil remediation is feasible. Those results are identified in the 2018 Feasibility Study Addendum report.

Based on the findings of the Remedial Investigation completed in 1997, the past disposal of hazardous waste has resulted in the contamination of soil. The site contaminants identified in soil which are considered to be the primary contaminants of concern, to be addressed by the remedy selection process are, chlorinated VOCs and chloropyridine isomers.

Table #2 – Soil Sample Results from 1995-1997 Remedial Investigation

Detected Constituents	Concentration Range Detected (ppm)[a]	Groudwater Protection SCG[b] (ppm)	Frequency Exceeding Groundwater Protection SCG
VOCs			
Carbon Tetrachloride	ND to 4,200	0.76	3 of 55
Chloroform	ND to 380	0.37	6 of 55
1,1-Dichloroethene	ND to 1.5	0.33	2 of 55
Methylene Chloride	ND to 2.8	0.05	5 of 55
Tetrachloroethene	ND to 520	1.3	1 of 55
Trichloroethene	ND to 73	0.47	1 of 55
SVOCs		Restricted Industrial Use[c] or Groundater Protection SCG[b] (ppm)	Frequency Exceeding Groundwater Protection SCG
2,6-dichloropyridine	ND to 170	NS	28 of 55
2-chloropyridine	ND to 300	0.9[d]	16 of 55
3-chloropyridine	ND to 51	0.8[d]	4 of 55
4-chlororpyridine	ND to 1,100	NS	4 of 55
Benzo(a)pyrene	ND to 27	1	4 of 55
Indeno(1,2,3-cd)pyrene	ND to 15	11	1 of 55
Inorganics		Restricted Industrial Use SCG[b]	
Mercury	ND to 214	5.7	2 of 18

a - ppm: parts per million, which is equivalent to milligrams per kilogram, mg/kg, in soil;
b - SCG: Part 375-6.8(b), Restricted Use Soil Cleanup Objectives for the Protection of Groundwater.
c - SCG: Part 375-6.8(b), Restricted Use Soil Cleanup Objectives for the Protection of Public Health for Industrial Use, unless otherwise noted.
d - As used in March 2002 ROD
NS - No standard or guidance value

Surface Water

Surface water was investigated during the RI in the 1990s and continues to be monitored as part of the semi—annual groundwater and surface water sampling program at the site. Figure 6 identifies the sampling points for the current semi-annual monitoring program.

During the RI, chloropyridines were detected in samples from the Gates Dolomite quarry seeps, the quarry ponds, the quarry discharge channel along I-390, the quarry discharge point at the Erie Canal, and the Erie Canal. Significant groundwater discharge (small waterfalls, in places) is evident along a bedding-plane fracture in the east wall of the quarry. Historical sample results along this seep have shown total chloropyridine concentrations of up to 4,900 ppb at the southeastern corner of the quarry. Samples from the two dewatering ponds in the SE corner of quarry, which collect groundwater, precipitation, and runoff from the whole quarry have ranged up to about 700 ppb. From the dewatering collection ponds, water is pumped up to a surface drainage channel which drains eastward to a roadside drainage channel along I-390, and eventually discharges to a concrete outfall at the Erie Canal. The quarry acts as a very large collector (roughly 2000 feet by 1000 feet by 100 feet deep) which influences groundwater over a considerable area.

As discussed in March 2002 ROD, a groundwater extraction well was included near the quarry as part of the selected remedy to address chloropyridine contamination at the quarry. A recovery well was never installed; however, since the ROD was issued, the levels of chloropyridines near the quarry have steadily declined as shown Figures 8 and 9. Most recent sampling shows non-detect levels of chloropyridines at the canal outfall (location QO-2) from an historic high of over 200 ppb during the mid-1990s.

These declines can be attributed to better containment of the plume at the site due to continued operation of the on-site pump and treat system. The levels of chloropyridines are anticipated to continually decrease. The data presented in Table 3 are from semi-annual monitoring events dating from 2009 to 2018.

Table #3 – Semiannual surface water sampling results (2009-2018)

Detected Constituents	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)	Frequency Exceeding SCG
SVOCs			
2,6-dichloropyridine	ND to 37	NS	35 of 72
2-chloropyridine	ND to 220	NS	44 of 72
3-chloropyridine	ND to 110	NS	2 of 72

a - ppb: parts per billion, which is equivalent to micrograms per liter, ug/L, in water.
b - SCG: Ambient Water Quality Standards and Guidance Values (TOGs 1.1.1) and 6 NYCRR Part 703: Surface Water and Groundwater Quality Standards.

Based on the findings of the Remedial Investigation, the disposal of hazardous has resulted in the contamination of surface water. The site contaminants that are considered to be the primary contaminants of concern which will drive the remediation of surface water to be addressed by the remedy selection process are, chloropyridines.

Soil Vapor

Significant levels of dissolved-phase VOCs (principally carbon tetrachloride, chloroform, methylene chloride, tetrachloroethene, and trichloroethene) and a semi-volatile suite of chloropyridines are present on-site. Sampling of soil vapor, sub-slab vapor, indoor and outdoor air was conducted in the on-site buildings from 2005 to 2008 (sub-slab vapor, indoor and outdoor air at six locations), at the site perimeter in 2007 and 2009 (soil vapor probes), and off-site in 2006 in two adjacent industrial/commercial buildings (sub-slab vapor and indoor air). On-site results show significant soil vapor concentrations under the chemical production area of the plant which diminish rapidly toward the south (i.e., under the warehouse building) and to the northwest (i.e. beneath the office area). Interpretation of on-site indoor air results is confounded by ongoing chemical manufacturing; exposures are considered occupational and OSHA would apply.

Results from soil vapor probes collected at the on-site perimeter away from the source area, found low-levels of site-related contaminants at levels generally consistent with background concentrations.

Soil vapor intrusion sampling collected at two off-site locations found low-levels of some site-related contaminants, but the associated indoor air samples were either non-detect or in some cases at higher concentrations. The highest concentrations of VOCs detected in the indoor air in the off-site buildings were methylene chloride at 22 ug/m^3, chloroform at .98 ug/m^3, carbon tetrachloride at .69 ug/m^3, trichloroethene at 0.33 ug/m^3, and tetrachloroethene at 12 ug/m^3. The maximum concentrations in the sub-slab vapor beneath the off-site buildings were methylene chloride at 2.8 ug/m^3, chloroform at 4.2 ug/m^3, carbon tetrachloride at 3.9 ug/m^3, trichloroethene at 2.8 ug/m^3, and tetrachloroethene at 28 ug/m^3. The concentrations of these VOCs in outdoor air samples were found to be consistent with background ranges. Due to the current use of these chemicals at the off-site buildings, exposures are considered occupational and Occupational Safety and Health Administration standards apply.

Based on the current use of the buildings on-and off-site, no actions are needed to address exposures related to soil vapor intrusion. However, the potential exists for the inhalation of site contaminants due to soil vapor intrusion for any future on-site development or if there is a change in use of the buildings.

Exhibit B

Description of Remedial Alternatives

The following alternatives were considered based on the remedial action objectives (see Section 6.5) to address the contaminated media identified at the site as described in Exhibit A.

Alternative #1: No Further Action

The No Further Action Alternative leaves the site in its present condition and does not provide any additional protection of the environment. The existing groundwater collection and treatment system would continue to operate and long-term monitoring of groundwater and surface water would continue. The existing cover system would be managed to restrict excavation below the existing cover system including pavement and buildings. Additionally, the following elements of the remedy in the March 2002 ROD would be eliminated: the off-site extraction well adjacent to the quarry; and the overburden groundwater interceptor trench on the southeast/south perimeter of the plant property.

Present Worth: *$4,996,000*
Capital Cost: *$0*
Annual Costs: *$325,000*

Alternative #2: Restoration to Pre-Disposal or Unrestricted Conditions

This alternative achieves all of the SCGs discussed in Section 6.1.1 and Exhibit A and soil meets the unrestricted soil clean objectives listed in Part 375-6.8 (a). This alternative would include: Complete demolition of the chemical plant, excavation and off-site disposal of all soils to bedrock (approximately 18-20 feet), drilling and blasting and off-site disposal of at least ten feet of the upper bedrock. The costs of this alternative were not considered because it is not practical and would cause shutdown of the plant.

Alternative #3: Horizontal Groundwater Extraction Wells and Existing Cover

This alternative would include enhancement of the existing groundwater extraction and treatment system by installing at least two horizontal groundwater extraction wells beneath the site. The groundwater extraction system will be designed and installed so that the capture zone is sufficient to intercept the contaminant source area and provide a barrier to off-site migration. The extraction system will enhance the existing depression of the water table so that contaminated groundwater is directed toward the extraction wells within the plume area. Groundwater will be extracted from the subsurface using approximately 800 feet of 6-inch diameter well screen that would be installed 5 feet below the top of bedrock (20-30 feet below ground surface) using horizontal drilling technologies as shown in Figure 7. Granular activated carbon (GAC) will be used to remove dissolved contaminants from extracted groundwater by adsorption. The GAC system will consist of one or more vessels filled with carbon connected in series and/or parallel. Following treatment, the groundwater will be discharged to the sanitary sewer. The existing GAC treatment system will need to be expanded to handle the increased groundwater recovery. Continued long-term groundwater and surface water monitoring would be included. Based on the diminished levels of chloropyridines entering the quarry and the enhancement of the on-site extraction system the following elements of the remedy in the March 2002 ROD would be eliminated: the off-site extraction well adjacent to the quarry; and the overburden groundwater interceptor trench on the southeast/south perimeter of the plant property. The existing cover system would be managed to restrict excavation below the existing cover system including pavement and buildings.

Present Worth:.. *$7,011,000*
Capital Cost:... *$1,094,000*
Annual Costs:.. *$452,000 years 1-20 and $97,000 years 21-30*

Alternative #4: Hydraulic Fracturing and Additional Groundwater Extraction Wells

This alternative would include enhancement of the existing groundwater extraction well system by fracturing bedrock (fracking) and installing additional extraction wells. Fracking uses pressurized fluid to open and develop fractures within bedrock to increase flow through the fractures. Fracking for this alternative would use water injected at low volumes and low pressures to further open and develop existing fractures in bedrock. Bedrock would be fracked along three alignments within the contaminant source area. Additional extraction wells would be installed within the fracking zones. The existing extraction and treatment system would be modified in a similar method as Alternative #3. Continued long-term groundwater and surface water monitoring would also be included. Additionally, the following elements of the remedy in the March 2002 ROD would be eliminated: the off-site extraction well adjacent to the quarry; and the overburden groundwater interceptor trench on the southeast/south perimeter of the plant property. The existing cover system would be managed to restrict excavation below the existing cover system including pavement and buildings.

Present Worth:.. *$4,805,000*
Capital Cost:... *$224,000*
Annual Costs:... *$325,000 years 1-25 $97,000 years 26-30*

Alternative #5: In-Situ Source Treatment – Chemical Oxidation

This alternative would include in-situ chemical oxidation to treat the contaminant source in groundwater. A chemical oxidant would be injected into the subsurface to destroy the contaminants within the source area as depicted in Figure 7 via injection wells within the overburden and shallow bedrock. The method and depth of injection would be determined during the remedial design. Continued operation of the existing groundwater extraction and treatment system and long-term monitoring would be included. Additionally, the following elements of the remedy in the March 2002 ROD would be eliminated: the off-site extraction well adjacent to the quarry; and the overburden groundwater interceptor trench on the southeast/south perimeter of the plant property. The existing cover system would be managed to restrict excavation below the existing cover system including pavement and buildings.

Present Worth:.. *$5,246,00*
Capital Cost:... *$250,000*
Annual Costs:.. *$325,000*

Exhibit C

Remedial Alternative Costs

Remedial Alternative	Capital Cost ($)	Annual Costs ($)	Total Present Worth ($)
Alternative #1 – No Further Action	0	325,000	$4,996,000
Alternative #2 – Restoration to Pre-disposal or Unrestricted conditions	-	-	-
Alternative #3 – Horizontal Groundwater Extraction Wells	$1,094,000	$452,000 years 1-20 $97,000 years 21-30	$7,011,000
Alternative #4 - Hydraulic Fracturing and Additional Groundwater Extraction Wells	$224,000	$325,000 years 1-25 $97,000 years 26-30	$4,805,000
Alternative #5: In-Situ Source Treatment – Chemical Oxidation	$250,000	$325,000	$5,246,000

Exhibit D

SUMMARY OF THE PROPOSED REMEDY

The Department is proposing Alternative #3, Horizontal Groundwater Extraction Wells as the remedy for this site. Alternative #3 would achieve the remediation goals for the site by enhancing groundwater recovery within the contaminant source area. The elements of this remedy are described in Section 7. The proposed remedy is depicted in Figure 7.

Basis for Selection

The proposed remedy is based on the results of the RI and the evaluation of alternatives in the Feasibility Study Addendum prepared in 2018. The criteria to which potential remedial alternatives are compared are defined in 6 NYCRR Part 375. A detailed discussion of the evaluation criteria and comparative analysis is included in the FS report.

The first two evaluation criteria are termed "threshold criteria" and must be satisfied in order for an alternative to be considered for selection.

1. Protection of Human Health and the Environment. This criterion is an overall evaluation of each alternative's ability to protect public health and the environment.

The proposed remedy, Alternative 3 (horizontal wells), would satisfy this criterion by controlling migration of groundwater contaminants from the source area and eliminating and controlling potential exposure pathways through removal and treatment of contaminated groundwater. This alternative is expected to mitigate contamination in the quarry by eliminating off-site migration of contaminants, and it is anticipated to achieve RAOs for groundwater in the long term. Alternative 1(NFA) would not completely control off-site migration; however, it has been successful mitigating off-site contamination. Alternatives 4(fracking) and 5 (ISCO) would satisfy this criterion by controlling off-site contaminant migration. Alternative 2 (pre-disposal) would eliminate all sources of contamination and meet this criterion.

2. Compliance with New York State Standards, Criteria, and Guidance (SCGs). Compliance with SCGs addresses whether a remedy will meet environmental laws, regulations, and other standards and criteria. In addition, this criterion includes the consideration of guidance which the Department has determined to be applicable on a case-specific basis.

Alternative 3(horizontal wells) complies with SCGs to the extent practicable. It addresses source areas of contamination and is expected to achieve SCGs within 20 years. Alternative 4(fracking) complies with SCGs; however, on-site pilot studies did not indicate a significant enhancement to bedrock groundwater recovery in the areas where fracking was conducted. Alternative 5(ISCO) would not address the source area contamination. While bench-scale studies indicated persulfate would be good reagent to oxidize contaminants, pilot-scale studies were unsuccessful. Contamination is within the rock matrix and groundwater flow rates did not provide adequate residence time to effectively oxidize contaminants. Alternative 1 (NFA) would not meet SCGs within a reasonable amount of time. Alternative 2 (pre-disposal) would meet SCGs because all contaminants would be removed.

The next six "primary balancing criteria" are used to compare the positive and negative aspects of each of the remedial strategies.

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

Alternative 3(horizontal wells) is expected to dramatically increase groundwater recovery rates and directly address contamination in the source area providing better control of off-site migration. In the long term (20 years) it is anticipated that SCGs would be achieved. Alternatives 1(NFA) and 4(fracking) would continue to control contaminant migration but would not be expected to achieve SCGs within a reasonable amount of time. Alternative 5(ISCO) would not be effective in the long term since the on-site pilot studies demonstrated that ISCO was not effective as described above. Alternative 2(pre-disposal) would meet this criterion because all contaminant would be removed.

4. Reduction of Toxicity, Mobility or Volume. Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility or volume of the wastes at the site.

Alternative 3(horizontal wells) provides for effective control of off-site migration of contaminants and actively remediates the source area thus meeting this criterion. Alternative 1(NFA) and 4(fracking) would continue to control off-site migration but do not adequately provide source area remediation. Alternative 5(ISCO) would not effectively remediate the source area as demonstrated by the on-site pilot studies described above. Alternative 2(pre-disposal) would meet this criterion because all contaminant would be removed.

5. Short-term Impacts and Effectiveness. The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation are evaluated. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives.

Alternatives 3(horizontal), 4(fracking), and 5(ISCO) all have short-term impacts which could easily be controlled. Alternative 3, would be the least disruptive to plant operations since horizonal wells would not need to be installed in the middle of an active chemical plant. Alternative 1(NFA) would not have any short-term impacts. Alternative 5(pre-disposal) would completely shut down the plant, require extensive engineering controls to prevent exposures and collapse of adjacent structures, would involve extreme levels of traffic, noise and potential air emissions, and it would have the largest carbon foot print of all the remedies.

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

Alternatives 1(NFA) would be the easiest to implement since no further actions are required. Alternatives 3(horizontal wells), 4(fracking) and 5(ISCO) are all favorable to implement with each having some technical issues. Alternative 2(pre-disposal) is completely impractical and would cause widespread disruptions to area business and effectively end operations at the chemical plant.

7. Cost-Effectiveness. Capital costs and annual operation, maintenance, and monitoring costs are estimated for

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

The costs of the alternatives that can be implemented range from between $5 million and $7 million. Costs to remediate the site to pre-disposal conditions were not calculated because that alternative is not technically feasible. Long-term monitoring and operations and maintenance for 30 years are the bulk of all the costs for alternatives 1,3,4 and 5. Of these four options, Alternative 3(horizontal wells) has the highest capital cost and alternative 1 (NFA) has no capital costs. The costs associated with Alternative 5(ISCO) would be wasteful since the pilot studies indicated that ISCO was not effective at treating the source area contaminants.

8. Land Use. When cleanup to pre-disposal conditions is determined to be infeasible, the Department may consider the current, intended, and reasonable anticipated future land use of the site and its surroundings in the selection of the soil remedy.

The site is located in an industrial park and the anticipated land use for the reasonably foreseeable future is industrial. All of the alternatives would allow for continued industrial use of the site. Alternative 2(predisposal) would not require any institutional controls; however, it is the least desirable of the proposed remedies. Alternatives 1,3,4 and 5 would require active engineering controls and institutional controls.

The final criterion, Community Acceptance, is considered a "modifying criterion" and is taken into account after evaluating those above. It is evaluated after public comments on the Proposed Remedial Action Plan have been received.

9. Community Acceptance. Concerns of the community regarding the investigation, the evaluation of alternatives, and the PRAP are evaluated. A responsiveness summary will be prepared that describes public comments received and the manner in which the Department will address the concerns raised. If the selected remedy differs significantly from the proposed remedy, notices to the public will be issued describing the differences and reasons for the changes.

Alternative #3 is being proposed because, as described above, it satisfies the threshold criteria and provides the best balance of the balancing criterion.

Arch Chemical Site 828018a
Site Location

Figure 1

Arch Chemical Site 828018a
Concentrations of VOCs iin Groundwater May 2018

Contour concentrations are in ug/L (ppb)

VOCs consist of Carbon tetrachloride, methylene chloride, chloroform, TCE, PCE, and chlorobenzene

Figure 2

Arch Chemical Site 828018a
Concentrations of Chloropyridines in Groundwater May 2018

0 125 250 500 750 1,000 Feet

Contour concentrations are in ug/L (ppb)

Chloropyridines consist of 2,6-dichloropyridine, 2-chloropyridine, 3-chloropyridine, 4-chloropyridine, and p-fluoroaniline.

Figure 3

Arch Chemical Site 828018a
Historic Surface Soil Sample Results Exceeding SCOs
Remedial Investigation Reports (1995-97)

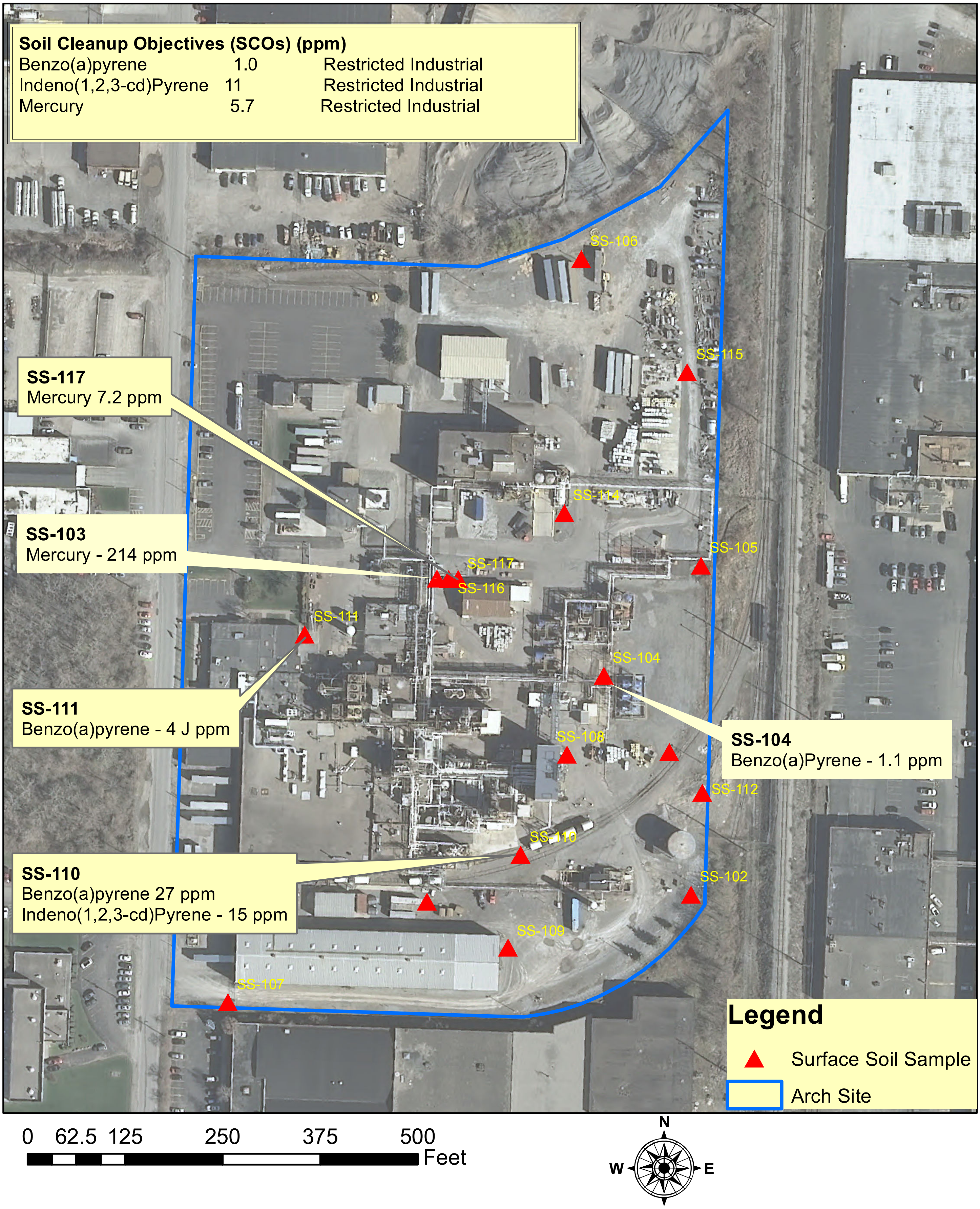


Figure 4

Arch Chemical Site 828018a
Historic Sub-Surface Soil Sample Results Exceeding SCOs
Remedial Investigation Reports (1995-97)

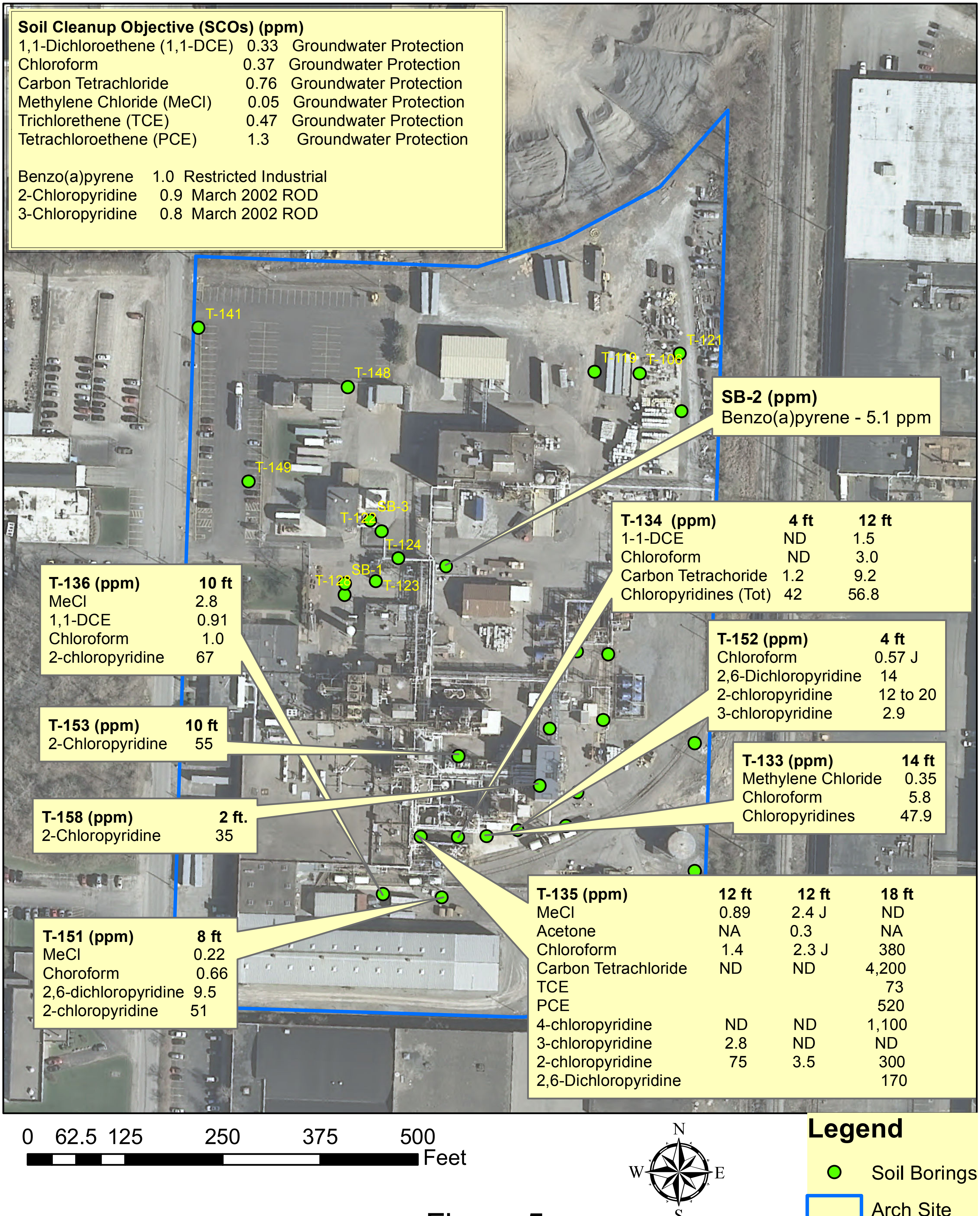


Figure 5

Arch Chemical Site 828018a
Current Groundwater and Surface Water Monitoring Points

Figure 6

Arch Chemical Site 828018a
Active Pumping Wells and Proposed Horizonal Well Locations

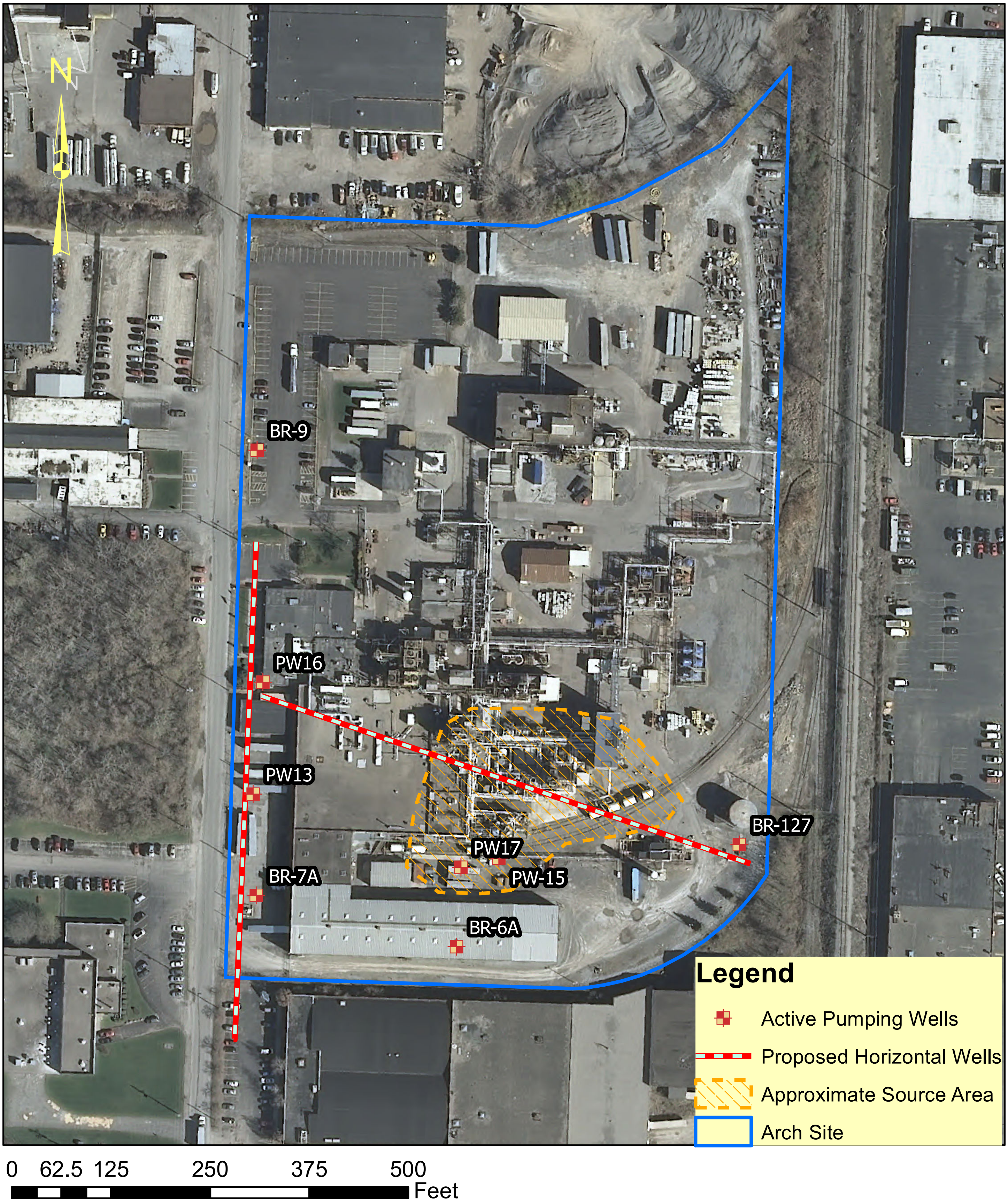
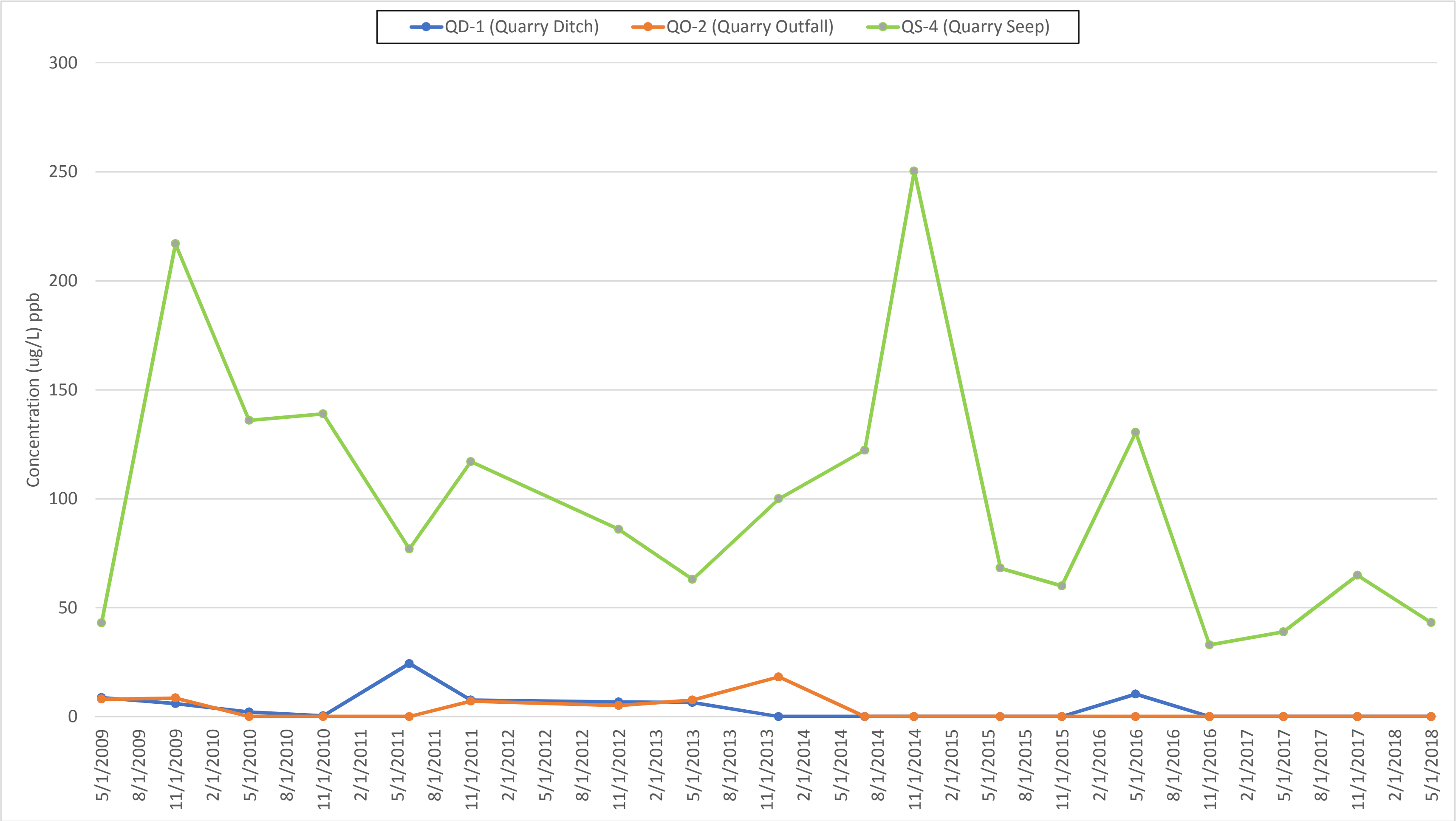


Figure 7

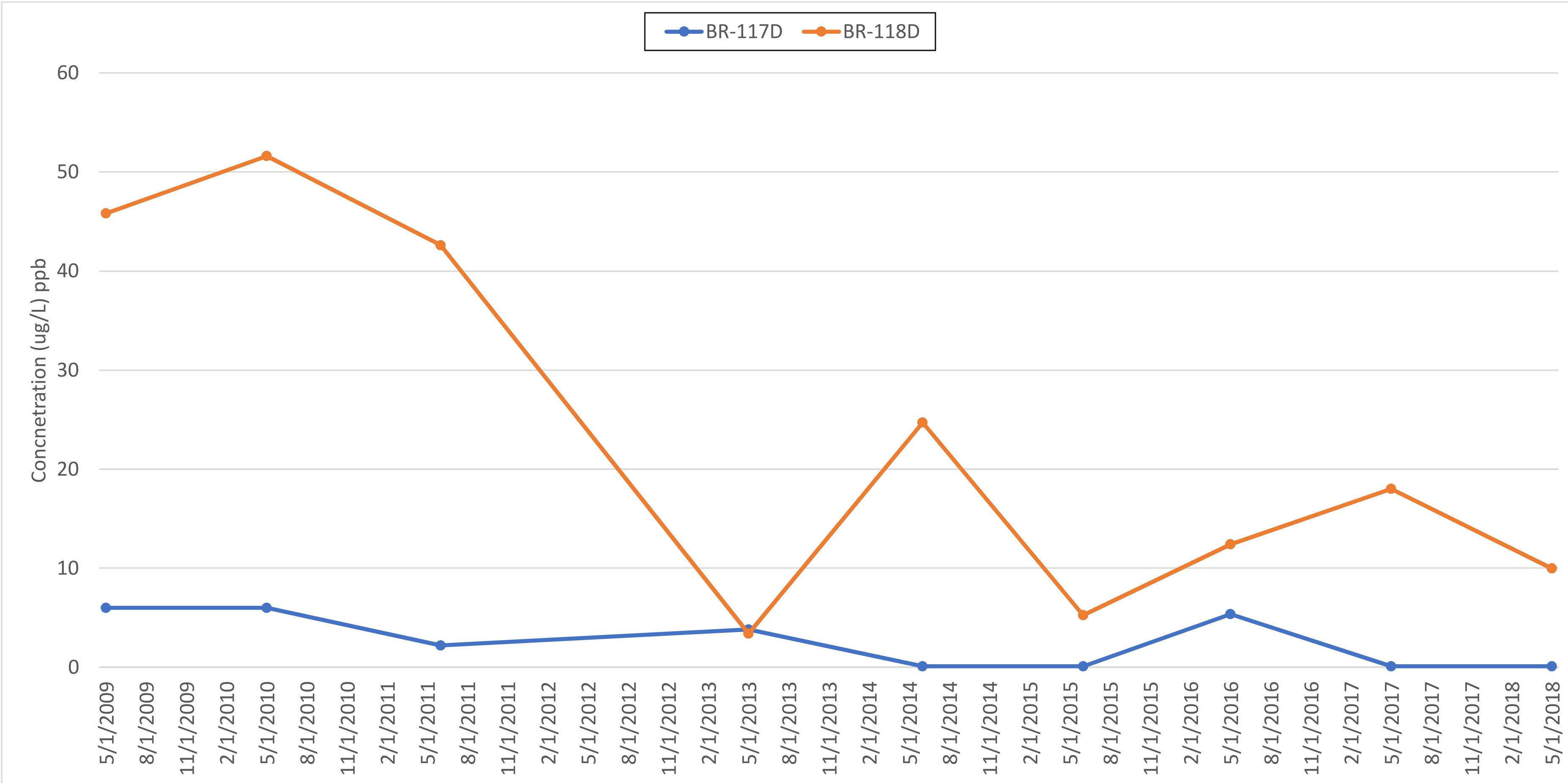
Figure 8
Total Chloropyridines in Surface Water at Quarry (2009-2018)



See Figure 6 for sampling locations

Total chloropyridines inclue 2,6 dichloropyridine, 2-chloropyridine, 3-chloropyridine, 4-chloropyridine, and p-fluroroanaline.

Figure 9
Total Chloropyridines in Deep Bedrock Wells at Quarry
(2009-2018)



See Figure 6 for sampling locations

Total chloropyridines inclue 2,6 dichloropyridine, 2-chloropyridine, 3-chloropyridine, 4-chloropyridine, and p-fluroroanaline.