THIRD FIVE-YEAR REVIEW REPORT
MACKENZIE CHEMICAL WORKS SUPERFUND SITE
SUFFOLK COUNTY, NEW YORK

Prepared by

U.S. Environmental Protection Agency
Region 2
New York, New York

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List of Abbreviations & Acronyms

1,2,3-TCP	1,2,3-Trichloropropane
bgs	below ground surface
CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
FS	Feasibility Study
FYR	Five-Year Review
ICs	Institutional Controls
ISCO	*In-situ* Chemical Oxidation
ISVE	*In-situ* Vapor Extraction
MCL	Maximum Contaminant Level
MCW	MacKenzie Chemical Works
MEK	Methyl Ethyl Ketone
µg/l	micrograms per liter
µg/m^3	micrograms per cubic meter
mg/kg	milligrams per kilogram
MW	Monitoring Well
ND	Not Detected
NPL	National Priorities List
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OU	Operable Unit
PFAS	Polyfluoroalkyl substances
PFOA	Perfluorooctanoic acid
RAO	Remedial Action Objectives
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
SCDHS	Suffolk County Department of Health Services
SCWA	Suffolk County Water Authority
TCP	Trichloropropane
SVOCs	Semi-Volatile Organic Compounds
TAGM	Technical and Administrative Guidance Memorandum
VOC	Volatile Organic Compound

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

This is the third FYR for the MacKenzie Chemical Works Inc. (MCW) site. The triggering action for this FYR is the signature date of the last review. The approval date of the last review was May 10, 2017.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act Section 121, consistent with the National Contingency Plan (40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

The work at the site is being conducted as a single operable unit that covers on-property surface and subsurface soil and on- and off-property groundwater. The FYR has been prepared because, while the remedial action will not leave hazardous substances, pollutants, or contaminants on-site above levels that allow for unlimited use and unrestricted exposure, the remedy requires five or more years to complete.

The third FYR for the site was led by Mark Granger, the EPA Remedial Project Manager (RPM). Participants included David Edgerton (EPA hydrogeologist), Chuck Nace (EPA human-health and ecological risk assessor), and Shereen Kandil (EPA community involvement coordinator). The FYR began on April 28, 2021.

Site Background

The 1.4-acre MCW site is located in a residential/light commercial area. The property originally contained numerous buildings and structures, including three one-story block buildings (a former manufacturing building and two warehouses) and a two-story block building (a former laboratory/warehouse), all of which were removed between 2004 and 2006. The property is bounded to the north by the Long Island Rail Road and commercial properties, to the east by a residential property and an abandoned parking lot, to the south by residential properties, and to the west by Cordello Avenue and an outdoor-furniture warehouse. **Figure 1** (see Appendix A, attached) presents the site layout.

The property is presently zoned industrial. According to the Town of Islip Department of Planning and Development, it is not anticipated that the land use will change in the future.

The property was used from approximately 1948 to 1987 for the manufacture of various chemical products by MCW, including fuel additives and metal acetylacetonates. Over the years of operation, the Suffolk County Department of Health Services (SCDHS) and the Suffolk County Fire Department documented poor housekeeping and operational procedures at MCW. According

to SCDHS, MCW stored 1,2,3-trichloropropane (1,2,3-TCP) in three 10,000-gallon tanks on the property. Other potential historical waste sources include other storage tanks[1], leaking drums, two waste lagoons, a cesspool, and storm-water drywells.

Appendix B, attached, summarizes the documents utilized to prepare this FYR.

Appendix C, attached, summarizes the site's topography and geology/hydrogeology. For more detail related to background, physical characteristics, geology/hydrogeology, land/resource use, and history related to the site, please refer to www.epa.gov/superfund/mackenzie-chemical.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: MacKenzie Chemical Works Superfund Site		
EPA ID: NYD980753420		
Region: 2	**State:** NY	**City/County:** Central Islip/Suffolk County
SITE STATUS		
NPL Status: Final		
Multiple OUs? No	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: EPA ***[If "Other Federal Agency", enter Agency name]*:**		
Author name (Federal or State Project Manager): Mark Granger		
Author affiliation: EPA		
Review period: 05/11/2017 – 01/15/2022		
Date of site inspection: 7/27/2021		
Type of review: Policy		
Review number: 3		
Triggering action date: 5/10/2017		
Due date *(five years after triggering action date)*: 5/10/2022		

[1] The tanks associated with MCW operations were decommissioned and scrapped in the 1990s.

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

Spills, explosions, and fires occurred at the facility, including a methyl ethyl ketone (MEK) spill in 1977, a nitrous oxide release in 1978, and an MEK fire in 1979. Based on these and other events, SCDHS ordered MCW to perform a general property cleanup, including the excavation and drumming of stained surface soils. This effort was completed in 1979.

Based on a 1983 assessment conducted by EPA, MCW arranged for the disposal of thirty-three drums of stained surface soils (from the 1979 cleanup effort) and twenty-two drums of liquid wastes. MCW operations at the property ceased in 1987. In 1993, SCDHS installed nine downgradient temporary well points to assess the horizontal and vertical extent of groundwater contamination. The results of the SCDHS effort indicated the presence of elevated levels of 1,2,3-TCP in downgradient groundwater. In 1993, the New York State Department of Environmental Conservation (NYSDEC) completed an investigation of the property. The results of the NYSDEC effort indicated the presence of elevated levels of 1,2,3-TCP in on-site soils and groundwater. Semivolatile organic compounds (SVOCs) were also detected in on-site soils.

In 1998, NYSDEC commenced a remedial investigation and feasibility study (RI/FS) to determine the nature and extent of contamination at and emanating from the property and to identify and evaluate remedial alternatives. Concurrent with this investigation, NYSDEC removed all soil and sludge materials from the two waste lagoons and backfilled them with clean soil. The excavated material was disposed of at an approved off-site disposal facility.

In 1999, based on the preliminary findings of the RI, NYSDEC requested that EPA take a response action at the property. EPA collected groundwater samples from off-property monitoring wells, two municipal supply wells, and one private well in 2000. Based upon the results of this investigation, EPA concluded that immediate actions were not required, but that remedial actions should be considered to address potential long-term threats. NYSDEC completed the RI/FS in 2000.

The site was proposed for inclusion on the National Priorities List (NPL) in June 2001; it was listed on the NPL in September 2001.

Because a number of subsequent occupants had reworked the surface of the property since MCW's operations ceased, EPA undertook surface soil sampling in 2002. Based upon the sample results, an RI/FS-report addendum was completed by EPA in 2003. The RI/FS report and RI/FS-report addendum indicated the presence of elevated levels of 1,2,3-TCP in site soils and groundwater. SVOCs were also detected in site soils. It was also determined that an approximately 1,500-foot long, 300-foot wide, and 140-foot-deep groundwater volatile-organic compound (VOC) plume extended in a southeasterly direction from the western portion of the property.

The results of the risk assessment indicated that ingestion of and dermal contact with on-property subsurface soils by future on-property construction and utility workers, ingestion and inhalation

of groundwater by hypothetical on-property workers and hypothetical off-property adult and child residents, and inhalation of on-property soil gas by future on property workers posed unacceptable excess cancer risks. The total estimated Hazard Index values for future on-property construction and utility workers exposed to subsurface soil and ingestion and inhalation of groundwater by hypothetical on-property workers and hypothetical off-property adult and child residents posed a chronic adverse noncancer health risk to such receptors. While the presence of other low-level constituents was documented, the risk was predominantly driven by the presence of 1,2,3-TCP in soils and groundwater. Further, by addressing the pervasive presence of 1,2,3-TCP in these media, the other low-level constituents are likewise addressed.

EPA conducted a screening of ecological risks and concluded that property conditions did not necessitate a quantitative ecological risk assessment.

Response Actions

Following the completion of the RI/FS, a Record of Decision (ROD) was signed in 2003. The remedial action objectives (RAOs) specified in the ROD were:

- Restore groundwater to levels which meet state and federal standards within a reasonable time frame;
- Mitigate the potential for contaminants to migrate from soils and drainage structures on the property into groundwater;
- Mitigate the migration of the affected groundwater; and
- Reduce or eliminate any direct contact, ingestion, or inhalation threat associated with contaminated soil on the property.

The ROD remedy included:

- Treatment of the unsaturated soils using thermally-enhanced *in-situ* soil vapor extraction (ISVE) in on-property source areas which exceed New York State Technical and Administrative Guidance Memorandum No. 94-HWR-4046 (TAGM) levels for VOCs. Post-treatment confirmatory samples will be collected to ensure that all source areas have been effectively treated to the cleanup levels. Off-gases from the ISVE system may need to be treated to meet air-discharge requirements. Soil-vapor monitoring in the treatment areas and in adjacent residential areas will also be conducted, as necessary. Should this monitoring indicate a potential vapor intrusion problem with respect to residences, appropriate actions will be taken.
- Excavation and off-site disposal of approximately 100 cubic yards of SVOC-contaminated soils which exceed TAGM levels for SVOCs. In addition, any contaminated drywell structures, cesspools, and associated piping will also be excavated and disposed of off-site. Confirmatory sampling will be conducted to ensure that all SVOC-contaminated soils above the cleanup levels have been removed. The excavation will be backfilled with certified clean fill.
- Demolition of the laboratory building. The building debris, after decontamination if necessary, will be disposed of off-site.

- Treatment of the contaminated groundwater using air sparging with ozone injection. The exact configuration and number of injection wells will be determined during the design phase. The system will be operated until state and federal groundwater standards are attained. Soil-vapor monitoring will be conducted in the treatment areas, as necessary. Should this monitoring indicate a potential vapor intrusion problem, appropriate actions will be taken.
- Long-term groundwater monitoring in order to verify that the concentrations and the extent of groundwater contaminants are declining, that the remedy remains effective, and that public water supplies are protected. The exact frequency and parameters of sampling and the location of any additional monitoring wells will be determined during the design phase.
- Institutional control (IC) restricting the installation and use of groundwater wells at and downgradient of the property until groundwater quality has been restored. The IC will be in the form of existing restrictions limiting the use of groundwater as a potable or process water, as required by the Suffolk County Department of Health Services and/or NYSDEC.
- Engineering controls, such as fencing and signs, in order to protect the integrity of the remedy and to limit property access until cleanup levels have been attained.

The ROD also identified a contingency remedy for the soil (excavation and off-site treatment/disposal of the contaminated soils) and a contingency remedy for the groundwater (treatment using a permeable reactive barrier) should treatability studies show that the selected remedies would not be effective.

An Explanation of Significant Differences (ESD) in 2011 documented the elimination of thermal enhancement of the ISVE system and the use of an alternative oxidation technology and a 2020 ESD documented EPA's decision to address the VOC-contaminated soils that were not treated through the operation of the ISVE system by excavation and disposal off-site, consistent with the contingent remedy. The basis for the ESDs are presented below in the "Response Action Implementation" section.

Response Action Implementation

Building Demolition

In 2004, EPA's contractor, Earth Tech Inc., demolished the laboratory building. Because the structural integrity of the remaining buildings was questionable, installing ISVE system wells to address the contaminated soils under the slabs would have presented safety risks to the remediation workers. Therefore, the remaining buildings were demolished in 2006. Metal from the buildings was recycled. Wood and rubble were disposed of in an EPA-approved facility in Suffolk County. None of the debris required decontamination.

Semi-Volatile Organic Compound-Contaminated Soil Excavation

In 2006, Earth Tech excavated approximately 20 cubic yards of SVOC-contaminated soils that exceeded the protection of groundwater TAGM cleanup objectives for SVOCs. The excavated soils were stockpiled and subsequently removed from the site to an EPA-approved facility in Suffolk County.

Soil Remediation

In 2003, Earth Tech, Inc. commenced treatability studies related to the ISVE remedy. During the treatability studies, which were completed in 2004, it was determined that thermal enhancement of the ISVE system was not necessary.[2] Full-scale operation commenced following the successful completion of the treatability studies. The ISVE system was expanded in 2006 to include contaminated soils around and underlying the slabs of two former on-site buildings (the buildings had been demolished, leaving only the slabs). The ISVE system ran continuously until 2010. Thereafter, until August 2020, the system operated on a part-time basis (6:00 pm – 6:00 am) as part of an optimization strategy that integrated more efficient contaminant recovery with energy conservation, while taking advantage of discounted night-time electricity rates.

While the ISVE system was highly effective in removing VOCs from the sandy soils located from 3 to 5 feet (ft) below ground surface (bgs) to the water table (approximately 50 ft), it was not as effective in treating the tighter soils located from the surface down to 3 to 5 ft bgs. These soils, which were less permeable than the soils at depth, were likely fill material. A September 2020 ESD documented EPA's decision to address the VOC-contaminated soils that were not treated through the operation of the ISVE system by excavation and disposed off-site, consistent with the contingent remedy.

From August to September 2020, Environmental Restoration LLC excavated approximately 2,000 cubic yards of 1,2,3-TCP-contaminated soils that exceeded the 0.4 milligram per kilogram (mg/kg) TAGM cleanup objective. The excavated soils were stockpiled and subsequently removed from the site to an EPA-approved facility in Suffolk County.

Groundwater Remediation

In 2003, Earth Tech commenced field-scale treatability studies related to air sparging with ozone injection. Based on the results of the treatability studies, it was concluded that this particular oxidation technology was insufficient to effectively remediate the groundwater. As a result, laboratory and field testing of an alternative oxidation technology, *in-situ* chemical oxidation (ISCO), using base-activated sodium persulfate as the oxidant, was performed. Following the successful field and lab studies, full-scale deployment followed in 2006, when approximately 17,000 gallons of sodium persulfate were injected using a network of installed multiple-depth injection points in the source area.[3]

Based on follow-up groundwater data, a second ISCO-injection event took place in 2006. At that time, approximately 17,000 gallons of sodium-persulfate solution were injected into the injection-point network, several additional Geoprobe injection locations, and several downgradient monitoring wells. A third ISCO injection event took place in November 2008, at which time approximately 12,000 gallons of sodium-persulfate solution was injected using the source-area injection-point network. A fourth ISCO injection event occurred in January 2012; during this event, which utilized Geoprobes, 20,000 gallons of sodium-persulfate solution were injected in the source area. In September 2016, to address residual groundwater contamination downgradient of

[2] The noted change to the remedy was documented in a September 2011 ESD.
[3] The noted change to the remedy was documented in the September 2011 ESD.

the source area, 1,500 gallons of sodium-persulfate solution were injected (the fifth injection event) in three of the monitoring wells in the groundwater monitoring-well network (EPA-MW-1, EPA-MW-5, and OS-7S).

Institutional Controls

The ROD called for the use of an IC in the form of existing restrictions limiting the use of groundwater as a potable or process water (as required by the SCDHS and/or NYSDEC) to restrict the installation and use of groundwater wells at and downgradient of the property until groundwater quality has been restored.

Existing SCDHS regulations require new residences and businesses to connect to public water supplies whenever public water mains are reasonably available. Where such mains are not available, the SCDHS regulations require proposed wells for new residences and businesses to be tested for water quality prior to use. For certain contaminant ranges, appropriate treatment is to be provided. Drinking water is available from public supplies for the entire area at and downgradient of the site property. Therefore, the IC to restrict the installation and use of groundwater wells at and downgradient of the property until groundwater quality has been restored are in place in the form of existing regulations.

Table 1, below, summarizes the status of the IC.

Table 1: **Summary of Implemented Institutional Control**

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs needed?	ICs called for in the decision documents?	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Groundwater	Yes	Yes	Site property and areas downgradient of the site property.	Restrict installation and use of groundwater wells at and downgradient of the site property.	SCDHS regulations

Systems Operation/Operation & Maintenance

The site is inspected at least annually as follows:

- Fencing and gates to ensure that secure conditions are maintained; and
- Groundwater monitoring wells for ease of locating, functionality, damage/vandalism, and the condition of the surface seals[4].

[4] The ISVE system was inspected annually until it was decommissioned in 2020.

Nine monitoring wells were installed on the site property and eight monitoring well clusters (shallow, intermediate, and deep) were installed off-property to monitor the groundwater plume. The depth-to-groundwater is approximately 50 ft bgs and groundwater flow is generally to the southeast. All the wells are sampled periodically, generally every other year. **Figure 2** in Appendix A illustrates the full monitoring well layout.

With respect to the ISVE component of the remedy, the system influent and effluent was evaluated regularly using standard field-screening instrumentation. Full lab-scale VOC analysis (using method TO-15) of the ISVE system (influent, effluent, and individual ISVE extraction wells) was generally performed every two years. The system was decommissioned in August 2020.

Potential impacts on the site from climate change were assessed. The performance of the remedy is currently not at risk due to the expected effects of climate change in the region near the site.

III. PROGRESS SINCE THE LAST REVIEW

The protectiveness determinations from the last FYR are summarized in **Table 2**, below. The current status of recommendations and suggestions from the last FYR are summarized in **Tables 3 and 4**, respectively, below.

Table 2: **Protectiveness Determinations/Statements From 2017 FYR**

Operable Unit (OU)	Protectiveness Determination	Protectiveness Statement
01	Short-term Protective	The **remedy for OU1** is protective of human health and the environment in the short-term because all exposure pathways have been addressed. However, in order for the remedy to be protective in the long-term, residual soil contamination needs to be addressed.
Sitewide	Short-term Protective	The **sitewide remedy** is protective of human health and the environment in the short-term because all exposure pathways have been addressed. However, in order for the remedy to be protective in the long-term, residual soil contamination needs to be addressed.

Table 3: **Status of Recommendations from 2017 FYR**

OU(s)	Issue	Recommendations	Current Status	Current Implementation Status Description
01	Residual soil contamination remains in the source area.	Evaluate alternatives for addressing residual soil contamination.	Completed	Excavation of residually contaminated (*i.e.,* above the 0.4 mg/kg TAGM cleanup objective) shallow-fill unit soils (0 to 5 ft. bgs) was completed in September 2020.

Table 4: Status of Suggestions from 2017 FYR

Suggestion	Status
While not affecting current and/or future protectiveness, continuing to utilize a method detection limit for 1,2,3-TCP that is below the 0.04 µg/l state groundwater standard may improve evaluation of the remedy.	The detection limit for 1,2,3-TCP was adjusted from 0.5 ug/L to 0.03 ug/L to more accurately reflect the NYSDEC Class GA groundwater cleanup goal of 0.04 ug/L.

IV. FIVE-YEAR REVIEW PROCESS

Community Notification & Involvement

On August 6, 2021, EPA Region 2 posted a notice on its website indicating that it would be reviewing site cleanups and remedies at Superfund sites in New York, New Jersey, Puerto Rico and the U.S. Virgin Islands including the MacKenzie Chemical Works site. The announcement can be found at the following web address: https://www.epa.gov/superfund/R2-fiveyearreviews.

In addition to this notification, EPA posted a public notice about the start of the FYR on EPA Region 2's website. EPA also sent the notice to the Town of Islip and the notice was posted on the Town's website on January 20, 2022. The purpose of the public notice was to inform the community that EPA would be conducting a FYR to ensure that the remedy implemented at the site remains protective of public health and is functioning as designed. In addition, the notice included contact information, including addresses and telephone numbers, for questions related to the FYR process. Once the FYR is completed, the results will be made available at the site information repositories and on the site website: https://www.epa.gov/superfund/mackenzie-chemical. The site repositories are located at EPA, 290 Broadway, 18th Floor, New York, New York and at the Central Islip Public Library, 33 Hawthorne Avenue, Central Islip, New York.

Data Review

The effectiveness of the source treatment (*i.e.,* ISVE for soil and ISCO for groundwater) was first evaluated in July 2011 by comparing baseline- and treated-soil sampling results. Baseline-soil sampling was performed in 2004 and treated-soil sampling was performed in 2009. The treated-soil sampling evaluation at that time indicated that the ISVE and ISCO source treatment had reduced the overall contaminant mass within the source area by greater than 92 percent. Specifically, the data showed substantial reductions of 1,2,3-TCP concentrations throughout the source area. In the 2004 soil-sampling data set, levels of 1,2,3-TCP greater than 5 mg/kg were common and were encountered as high as 530 mg/kg. In 2009, only one sample collected within the source area had levels of 1,2,3-TCP above 5 mg/kg and that sample was collected at a depth of 20 to 24 ft. bgs. Further, ISVE-related soil-vapor data showed a significant drop in 1,2,3-TCP concentrations in the ISVE wells. For example, in 2004, extraction well SVE-3 was shown to have a 1,2,3-TCP concentration of 460,000 micrograms per cubic meter (µg/m³); this concentration had fallen to 2,300 µg/m³ by 2009. The 1,2,3-TCP concentration in this well in 2017 (the last year for which data is available) was reported at 320 µg/m³. Similarly, concentrations in extraction well SVE-5 decreased from 4,510 µg/m³ in 2009 to 131 µg/m³ in 2012; the concentration of 1,2,3-TCP

in this well in 2017 was 3 µg/m³. These wells were directly in the contaminant source zone. See **Figure 3** in Appendix A for a layout of the ISVE system.

Following the 2012 ISCO persulfate-injection event, comprehensive source-area soil sampling was conducted in January 2013. Samples were collected at multiple locations and multiple depths from the ground surface down to the water table (approximately 50 ft. bgs). As noted above, the 1,2,3-TCP TAGM cleanup objective for the site is 0.4 mg/kg. With one exception, samples collected from the sandy vadose-zone source-area unit (5 to 50 ft. bgs) were either not detected (ND) or were below the 0.4 mg/kg TAGM cleanup objective; the lone exception was a concentration of 0.48 mg/kg for 1,2,3-TCP at 14 ft. bgs. Focused ISVE in the area of this elevated concentration subsequently reduced this 1,2,3-TCP concentration to below the soil cleanup objective.

In the shallow-fill unit (0 to 5 ft. bgs), seven of 12 locations were below the 0.4 mg/kg TAGM cleanup objective. The range of concentrations of 1,2,3-TCP in the remaining five shallow locations was 0.57 to 14 mg/kg. See **Figure 4a** in Appendix A for a layout of the 2013 soil borings and the soil-sampling results. While the ISVE system was highly effective in removing VOCs from the sandy vadose-zone source-area unit (5 to 50 ft. bgs), it was not as effective in treating the soils located from 0 to 5 ft. bgs. These soils, which were much less permeable than the deeper sandy soils, likely constituted a shallow-fill unit (0 to 5 ft. bgs). A September 2020 ESD documented EPA's decision to address these shallow soils by excavation and disposal off-site (consistent with the contingent remedy described in the ROD). As a result of the ISVE and the 2020 supplemental shallow-fill unit (0 to 5 ft. bgs) excavation, all concentrations in the sandy vadose source-area soil (5 to 50 ft. bgs) and the shallow-fill unit soil (0 to 5 ft. bgs) were confirmed to be below the 0.4 mg/kg TAGM cleanup objective. See **Figure 4b** in Appendix A for the pre-excavation and post-excavation final soil-sampling results relative to the 2020 shallow-unit soil excavation.

Drinking water is supplied to nearby residents by Suffolk County, with the exception of a nearby residential property immediately to the east of the MCW property, where there is a private well (sidegradient) used for potable purposes. This well has been sampled for VOCs, including 1,2,3-TCP, periodically since 2009. With a 5 µg/l New York State Department of Health (NYSDOH) maximum contaminant level (MCL) for 1,2,3-TCP, the drinking-water analytical method utilized (524.2) through 2014 had a detection limit of 0.5 µg/l; using this detection limit, VOCs, including 1,2,3-TCP, in this private well were not detected through 2014. Thereafter, as noted above, a lower detection level (0.03 µg/l) was used to more accurately reflect the ROD-specified groundwater cleanup goal of 0.04 µg/l (the NYSDEC Class GA standard). A single detection of 0.005 µg/l for 1,2,3-TCP was reported in the 2018 sampling event.

With respect to groundwater, monitoring wells have been grouped for evaluation purposes: Group 1 comprises source area wells; Group 2 are the downgradient fence-line wells located in the eastern portion of the property; Group 3 are the shallow wells along Brightside Avenue and Group 4 are the intermediate and deep wells along Brightside; and Group 5 are the shallow, intermediate, and deep wells tracking the plume downgradient from Brightside Avenue. Discussion of data relative to these groups is presented in more detail below. **Figure 5** presents the data for 1,2,3-TCP

concentrations in groundwater from 2009 to 2021. See **Figures 1 and 2** for monitoring well locations. **Figures 6 through 10** present data trends for each of these groups.

Concentrations of 1,2,3-TCP in the source-area groundwater (**Group 1 wells**) have also dropped significantly since the start of the ISVE system and the ISCO-injections. The two most heavily-contaminated groundwater monitoring wells in 2004 were EPA-MW-1 and EPA-MW-2 (both within the source area). With the exception of a lone detection of 13 µg/l in 2018, the 1,2,3-TCP levels in monitoring well EPA-MW-1 fell from 91,000 µg/l in July 2004 down to ND for all rounds up to the end of this review period. The 2018 concentration of 13 µg/l is likely due to the curtailing of ISVE efforts in the source area. 1,2,3-TCP levels in monitoring well EPA-MW-2 fell from 59,000 µg/l in July 2004 to 1.7 µg/l in November 2018. There was an increase in concentration to 8.5 µg/l in 2021 for this well, along with similarly modest concentrations present in EPA-MW-3 and EPA-MW-7, likely due to the shallow source-area excavation effort completed in September 2020. Contaminant levels during the review period in the monitoring wells further sidegradient of the source area (*i.e.,* **Group 2 wells**, along the eastern fence line) show 1,2,3-TCP concentrations to be stable and generally fluctuating between 3 and 13 µg/l. Please see **Figure 1** in Appendix A for monitoring-well locations. Please refer to **Figures 6 and 7** in Appendix A for illustrations of the groundwater trends in these monitoring wells from 2009 to 2021.

For downgradient monitoring wells, concentrations of 1,2,3-TCP have generally demonstrated declining trends over time. Shallow off-property wells immediately downgradient from the source area (**Group 3 wells**, monitoring wells OS-3S, OS-6S, and OS-7S) have historically reported 1,2,3-TCP concentrations to be present at concentrations below the 5 µg/l MCL. There was a reported concentration of 9.5 µg/l in 2021 for well OS-3S in September 2021, again likely due to the shallow source-area excavation effort completed in September 2020. Concentrations of 1,2,3-TCP during the review period in the eight intermediate (I series) and deep (D series) wells immediately downgradient from the source area (**Group 4 wells**, monitoring wells OS-3I, OS-3D, OS-3DR, OS-6I, OS-7I, OS-7D, OS-8I and OS-8D) are consistently reported at levels below 0.1 µg/l. The high concentration for all eight of these monitoring wells was 0.076 µg/l at OS-7D in 2018. Please see **Figure 1** in Appendix A for monitoring-well locations. Please refer to **Figures 8 and 9** in Appendix A for illustrations of the groundwater trends in these monitoring wells.

There are three monitoring well locations defining the downgradient plume south of Brightside Avenue: monitoring wells OS-2S/2I/2D; OS-4D; and OS-1D (**Group 5 wells**), respectively, in order of distance from the property (see **Figure 2** in Appendix A for downgradient monitoring-well locations). Since 2009, with few exceptions, the highest concentrations of 1,2,3-TCP in any on- or off-property well has been reported at off-property monitoring well OS-2D. In 2009 the reported concentration for 1,2,3-TCP for this well was 170 µg/l. During the review period the 1,2,3-TCP concentration in this well declined from 24 µg/l in 2016 to 6.8 µg/l in 2018 to 2.5 µg/l in 2021. The 1,2,3-TCP concentrations in the shallow and intermediate wells at this location are consistently negligible. This generally declining 1,2,3-TCP trend at monitoring well OS-2D apparently reflects the passing and subsiding of the downgradient plume which is likely reflected in a slight increase in concentration at further-downgradient and similarly-screened monitoring well OS-4D; specifically, after years of negligible concentrations, the concentration in this well increased from 0.095 µg/l in 2018 to 2.6 µg/l in 2021. Concentrations in monitoring well OS-1D, the well reflecting the leading edge of the plume and located further-downgradient from and

similarly-screened to OS-4D, remained consistently negligible for the review period. Please refer to **Figure 10** in Appendix A for an illustration of the groundwater trends in these monitoring wells from 2009 to 2021.

In summary, many wells reporting 1,2,3-TCP concentrations below the 5 µg/l NYSDOH MCL remain above the NYSDEC 0.04 µg/l Class GA standard. Although contamination remains, the plume is contained and, as a result of aggressive and successful source-area treatment, appears to be shrinking over time. The need for additional ISCO injections will be evaluated going forward.

Emerging Contaminants

Emerging contaminants 1,4-dioxane and per- and polyfluoroalkyl substances (PFAS) were analyzed by NYSDEC in groundwater samples collected during the review period. This sampling was conducted in November 2018. All concentrations of 1,4-dioxane were below the NYSDEC drinking water standard of 1 µg/L.[5] 1,4-dioxane was not detected in upgradient monitoring well MCMW-1, was present at less than 0.1 µg/L in three monitoring wells on or near the site (EPA-MW-8, OS-3S, and OS-7S), and was higher in further downgradient monitoring wells OS-2D (0.39 µg/L) and OS-1D (0.15 µg/L).

Several PFAS compounds were detected in upgradient, on-property, and downgradient monitoring wells at levels that exceed New York State's drinking water standard of 10 nanograms per liter (ng/L). Notably, perfluorooctanoic acid (PFOA) was present in all six monitoring wells sampled at levels above 10 ng/L; PFOA concentrations generally ranged from 11.0 to 14.5 ng/L, the exception being a concentration of 29.0 ng/L in the sample from monitoring well OS-3S.

As noted above, there is a private residential well located immediately sidegradient to the east. In a January 2021 sampling event, there were three PFAS compounds detected above 10 ng/L. As a result, NYSDEC provided a treatment system to the residence shortly thereafter. There are no other site-related contaminants at this well above drinking water standards. EPA will continue to work with NYSDEC to determine future sampling needs.

Site Inspection

An inspection of the site was conducted on September 23, 2020. In attendance were Mr. Granger, EPA On-Scene Coordinator Louis DiGuardia, and NYSDEC RPM Jared Donaldson. The property, roadways, monitoring wells, fencing, gates, and other site-related facilities were all in good repair at the time of the inspection.

A follow-up inspection was conducted on July 27, 2021. In attendance were Mr. Granger and Mr. Donaldson. The above-referenced components were similarly in good repair at the time of the inspection.

[5] Note that the NYSDEC cleanup goal is not specified in the ROD.

V. TECHNICAL ASSESSMENT

QUESTION A: *Is the remedy functioning as intended by the decision documents?*

The remedy is functioning as intended by the ROD (as modified by the ESDs) and exposures from groundwater consumption are addressed by existing SCDHS restrictions.

The ROD, as modified by the ESD, called for, among other things, the ISVE treatment of the source-area VOC-contaminated soils; excavation and off-site disposal of approximately 100 cubic yards of SVOC-contaminated soils; demolition, decontamination as necessary, and off-site disposal of the laboratory building; ISCO treatment of the contaminated groundwater; long-term groundwater monitoring; institutional controls restricting the installation and use of groundwater wells at and downgradient of the property until groundwater quality has been restored; and engineering controls, such as fencing and signs, in order to protect the integrity of the remedy and to limit property access until cleanup levels have been attained. The purpose of the soil component of the remedy is to reduce or eliminate direct contact, ingestion, or inhalation threats associated with contaminated soil and to reduce the risk to human health and the environment due to contaminants leaching from the soil into the groundwater. The purpose of the groundwater treatment is to control groundwater migration and assure that the downgradient groundwater meets cleanup goals in a reasonable time frame. The implemented remedy continues to operate as intended and there are no complete exposure pathways.

As a result of the ISVE and the 2020 supplemental shallow-fill unit (0 to 5 ft. bgs) excavation, all concentrations in the sandy vadose source-area soil (5 to 50 ft. bgs) and the shallow-fill unit soil (0 to 5 ft. bgs) are below the 0.4 mg/kg TAGM cleanup objective. Low-level contamination does remain in groundwater, however, in some sidegradient and downgradient wells somewhat above the 5 µg/l MCL. Concentrations of 1,2,3-TCP in groundwater in the source area have dropped precipitously from baseline conditions and have been generally stable below or slightly above the MCL. A modest increase in concentration in these wells in September 2021 appears attributable to the supplemental shallow-fill unit excavation completed in September 2020.

As noted above, while the NYSDOH MCL of 5 µg/l for 1,2,3-TCP informs the discussion of groundwater, the ROD-specified groundwater cleanup goal is the NYSDEC Class GA standard of 0.04 µg/l. Many wells reporting 1,2,3-TCP concentrations below the 5 µg/l NYSDOH MCL remain above the NYSDEC 0.04 µg/l Class GA standard. Although contamination remains, the plume is contained and, as a result of aggressive and successful source-area treatment, appears to be shrinking over time. The need for additional ISCO injections will be evaluated going forward.

As noted above, ICs to restrict the installation and use of groundwater wells at and downgradient of the property are in place in the form of existing regulations.

QUESTION B: *Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?*

The human-health risk assessment conducted for the site evaluated exposure to soil from ingestion, inhalation (vapors and dust), and dermal contact, as well as exposure to groundwater from ingestion, dermal contact, and inhalation of vapors for both on-property adult workers, trespassers and construction workers, and off-property residents (adult and child). The exposure assumptions and exposure pathways that were used in the risk assessment were reviewed and remain valid at this time.

Although the risk assessment process has been updated and specific parameters and toxicity values may have changed, the risk-assessment process that was used is still consistent with current practice and the need to implement a remedial action remains valid. In the first FYR (2011), the toxicity value for the primary contaminant of concern, 1,2,3-TCP, was identified as being more stringent than at the time of the ROD, and the toxicity value of 1,2,3-TCP has not changed since the 2011 FYR.

The cleanup goals that were identified in the ROD were identified as the NYSDEC TAGM cleanup objectives for soil and the federal and state MCLs or NYSDEC Class GA Groundwater Quality Standards for groundwater. These values are still valid as they are within EPA's acceptable risk range.

EPA conducted soil vapor intrusion evaluations of sixteen residential properties in 2005 and 2006. 1,2,3-TCP was not detected in the subslab soil vapor or indoor air of any of the properties sampled. The last FYR (2017) concluded that vapor intrusion is not associated with the site, and this information remains valid.

EPA conducted a screening of ecological risks and concluded that property conditions did not require a quantitative ecological risk assessment. A qualitative ecological evaluation concluded that contamination in the surface soil posed a potential unacceptable risk to burrowing animals that may come into contact with these soils. However, the exposure pathways, specifically exposure to contaminated soil, associated with these ecological receptors were addressed by the remedial actions that have already been taken at the site. Thus, the site no longer poses an ecological risk.

In summary, the exposure assumptions, toxicity data, cleanup levels, and RAOs that were used at the time of the remedy remain valid.

QUESTION C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

There is no other information or issues related to the site that would change the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

As can be seen in **Table 5**, below, there are no recommendations for this FYR.

Table 5: Issues and Recommendations

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
01

OTHER FINDINGS

None.

VII. PROTECTIVENESS STATEMENT

Table 6, below, presents the operable unit and sitewide protectiveness statements.

Table 6: Protectiveness Statements

Protectiveness Statement(s)	
Operable Unit:	*Protectiveness Determination:*
OU1 (Groundwater and Soil)	**Protective**
Protectiveness Statement:	
The **remedy for OU1** is protective of human health and the environment	
Sitewide Protectiveness Statement	
Protectiveness Determination:	
Protective	
Protectiveness Statement:	
The **sitewide remedy** is protective of human health and the environment.	

VIII. NEXT REVIEW

The next FYR report for the MacKenzie Chemical Works site is required five years from the completion date of this review.

APPENDIX A: FIGURES

Figure 1: MacKenzie Chemical Works – Site Layout with Nearby Monitoring Wells

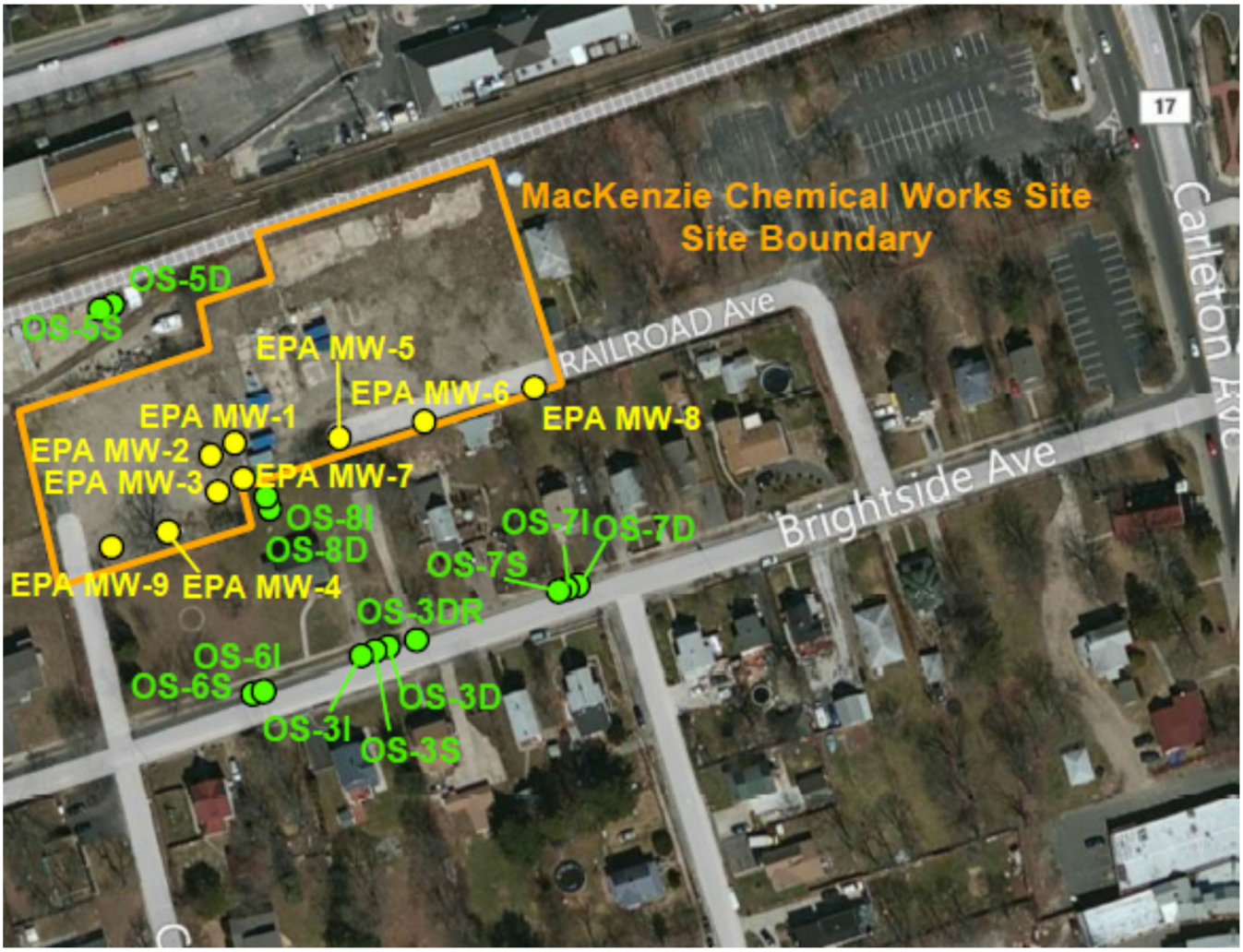


Figure 2: MacKenzie Chemical Works – Full Monitoring Well Network

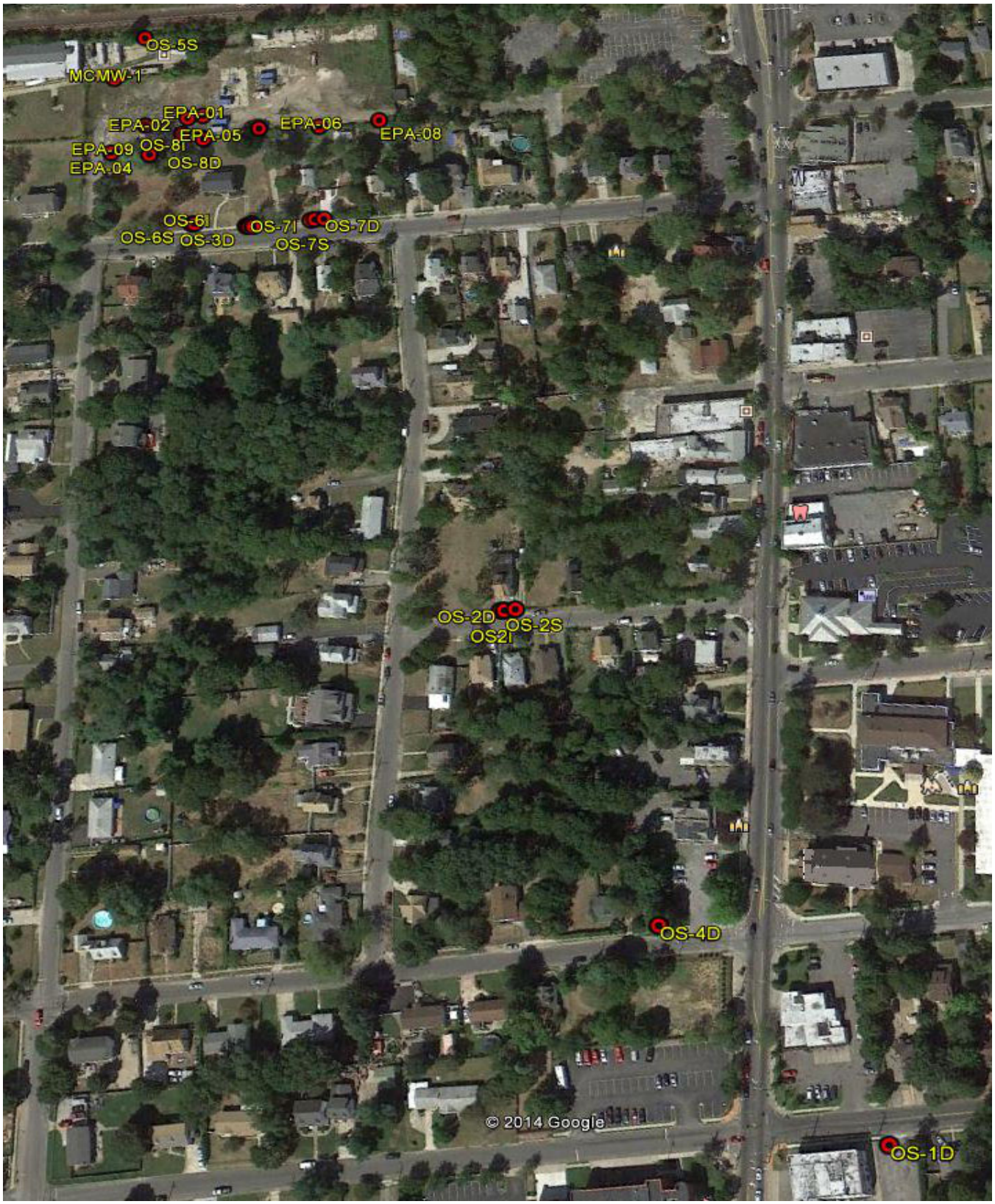


Figure 3: MacKenzie Chemical Works – *In-situ* Soil-Vapor Extraction System Layout

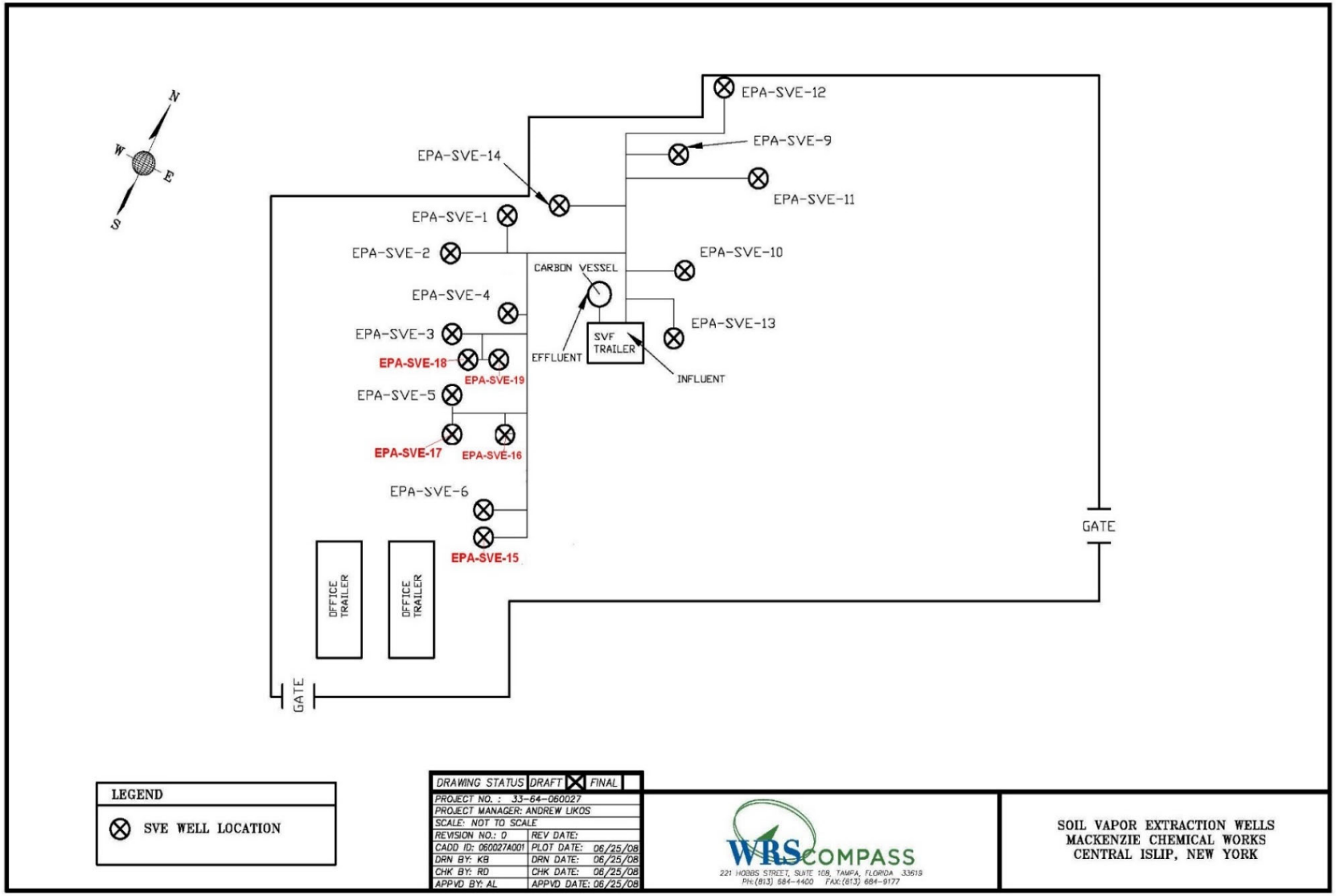


Figure 4a: MacKenzie Chemical Works – February 2013 Post-ISCO Soil Sampling Data

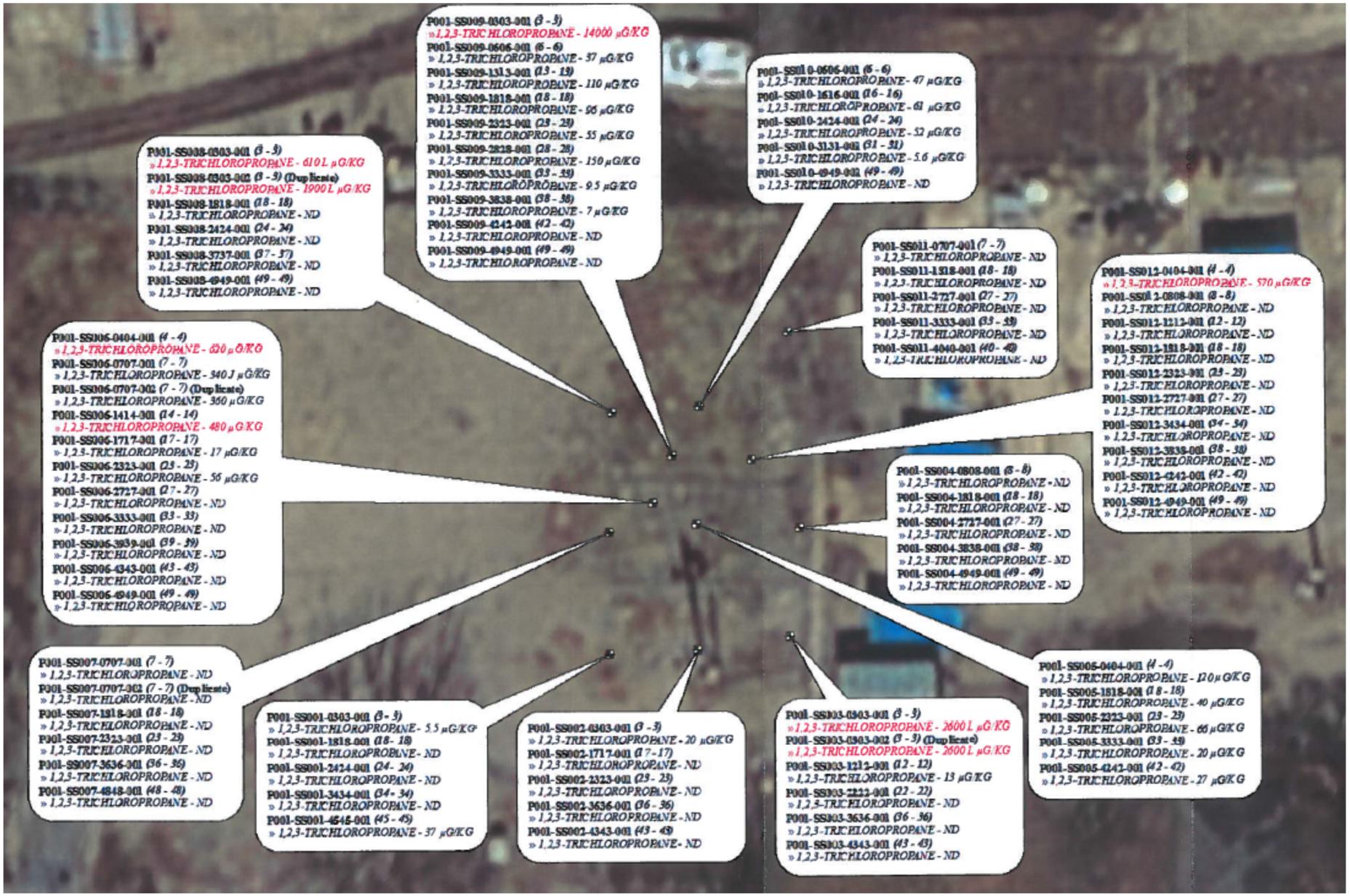


Figure 4b: MacKenzie Chemical Works – September 2020 Post-Excavation Soil Sampling Data

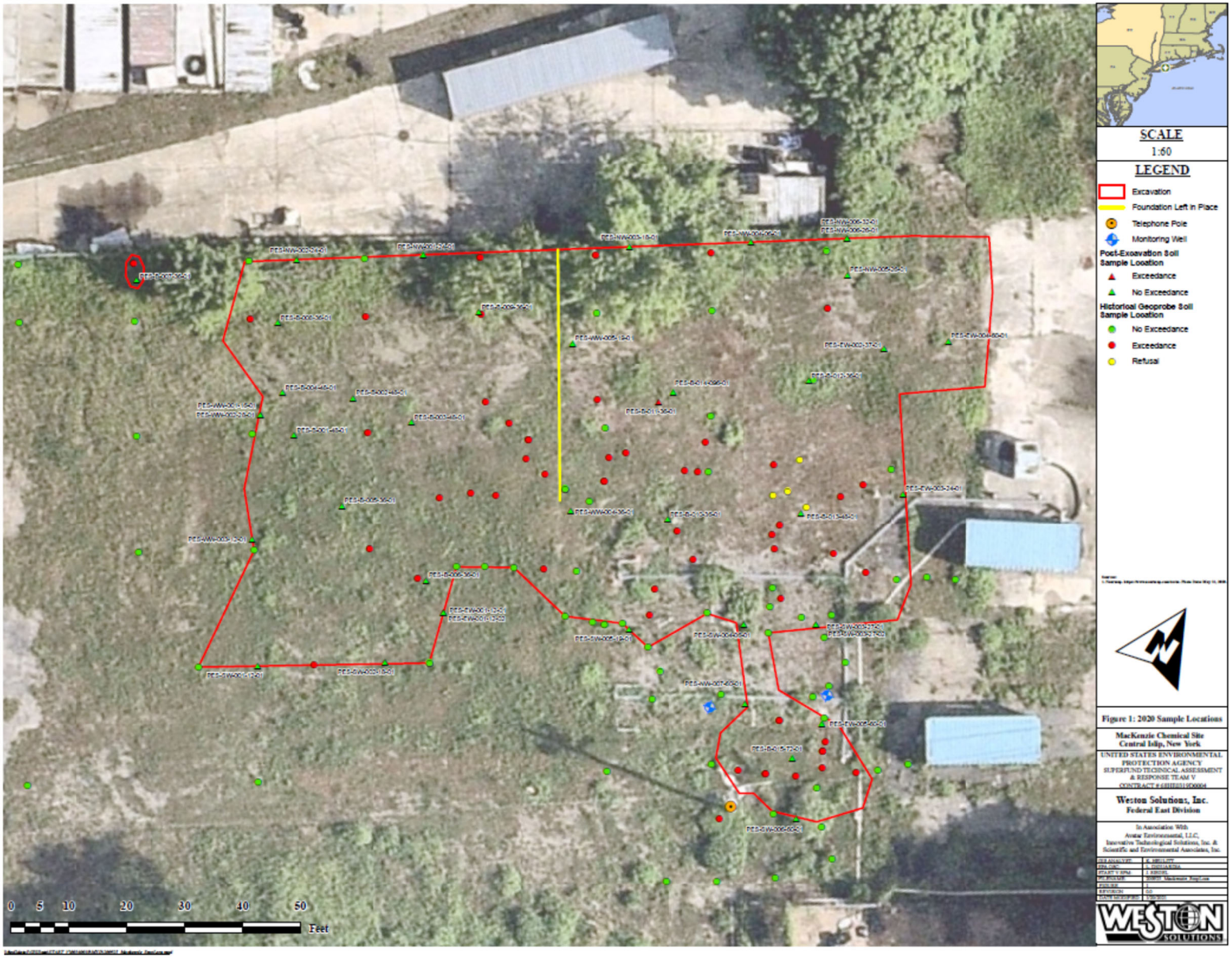


Figure 5: MacKenzie Chemical Works – 1,2,3-TCP in Groundwater: 2009 to 2021

DATE	Group 1								Group 2						Group 3						Groups 4			
	EPA-1	Q	EPA-2	Q	EPA-3	Q	EPA-7	Q	EPA-5	Q	EPA-6	Q	EPA-8	Q	OS-6S	Q	OS-3S	Q	OS-7S		OS-6I	Q	OS-3I	Q
April-09			0.03	U	0.03	U	0.03	U	**94**						0.03	U	0.03	U	**14**		0.03	U	0.03	U
June-10			**2.9**		0.03	U	**140**		0.03	U					0.03	U	0.03	U	**2.8**		0.03	U	0.03	U
May-11			0.03	U	0.03	U	**3.0**		**1.8**						0.03	U	0.03	U	0.03	U	0.03	U	0.03	U
August-12	0.03	U	0.03	U	8.5		**2.8**		0.03	U	**5**		**26**		0.03	U	**1.5**		0.03	U	0.03	U	**0.81**	
July-13	0.03	U	0.03	U	0.03	U	**3.5**		**1.5**		**11**		**14**		0.03	U	0.03	U	**0.72**		0.03	U	0.03	U
June-14	0.03	U	**2.0**		**3.3**		**1.9**		**1.9**		0.03	U	**20**		0.03	U	0.03	U	**0.85**		0.03	U	0.03	U
August-15	0.03	U	**2.0**		**4.4**		**3.4**		**8.0**		**3.1**		**3.1**		0.03	U	**2.4**		**4.2**		0.10		0.03	U
August-16	0.03	U	**1.4**		**1.2**		**0.75**		**3.3**		**3.9**		**12**		0.03	U	**0.83**		**4.1**		0.03	U	0.03	U
November-18	**13**		**1.7**		**11**		**4.6**		**13**		**2.9**		**6.6**		0.021	J	**2.8**		**0.51**		0.21		0.03	U
September-21	**0.03**	U	**8.5**		**7.7**		**15**		**9**		**4.2**		**4.3**		0.03	U	**9.5**		**0.83**		0.03	U		

DATE	Group 4												Group 5									
	OS-3D	Q	OS-3DR	Q	OS-7I	Q	OS-7D	Q	OS-8I	Q	OS-8D	Q	OS-2S	Q	OS-2I	Q	OS-2D	Q	OS-4D	Q	OS-1D	Q
April-09	0.03	U	0.03	U	0.03	U	0.03	U	**14**		0.03	U	0.03	U	**1.5**		**170**					
June-10	**0.85**		0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	**110**					
May-11	0.03	U	**0.54**		0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	**71**		**0.54**			
August-12	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	**32**		0.03	U	0.03	U	0.03	U	**0.7**	
July-13	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	**36**		**0.59**		**1.1**	
June-14	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	**33**		0.03	U	0.03	U
August-15	**0.046**		0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	**0.22**		**15**		**0.31**		**0.11**	
August-16	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	**0.58**		**24**		0.03	U	0.03	U
November-18			0.0096	J	0.03	U	**0.076**		**0.048**		**0.071**		**0.15**		**0.21**		**6.8**		**0.095**		**0.044**	
September-21	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	**2.5**		0.03	U	**2.5**		**2.6**		0.03	U

Figure 6 (2009-21): Group 1 - On-site Source-Area Wells (plus MWs 8I & 8D)

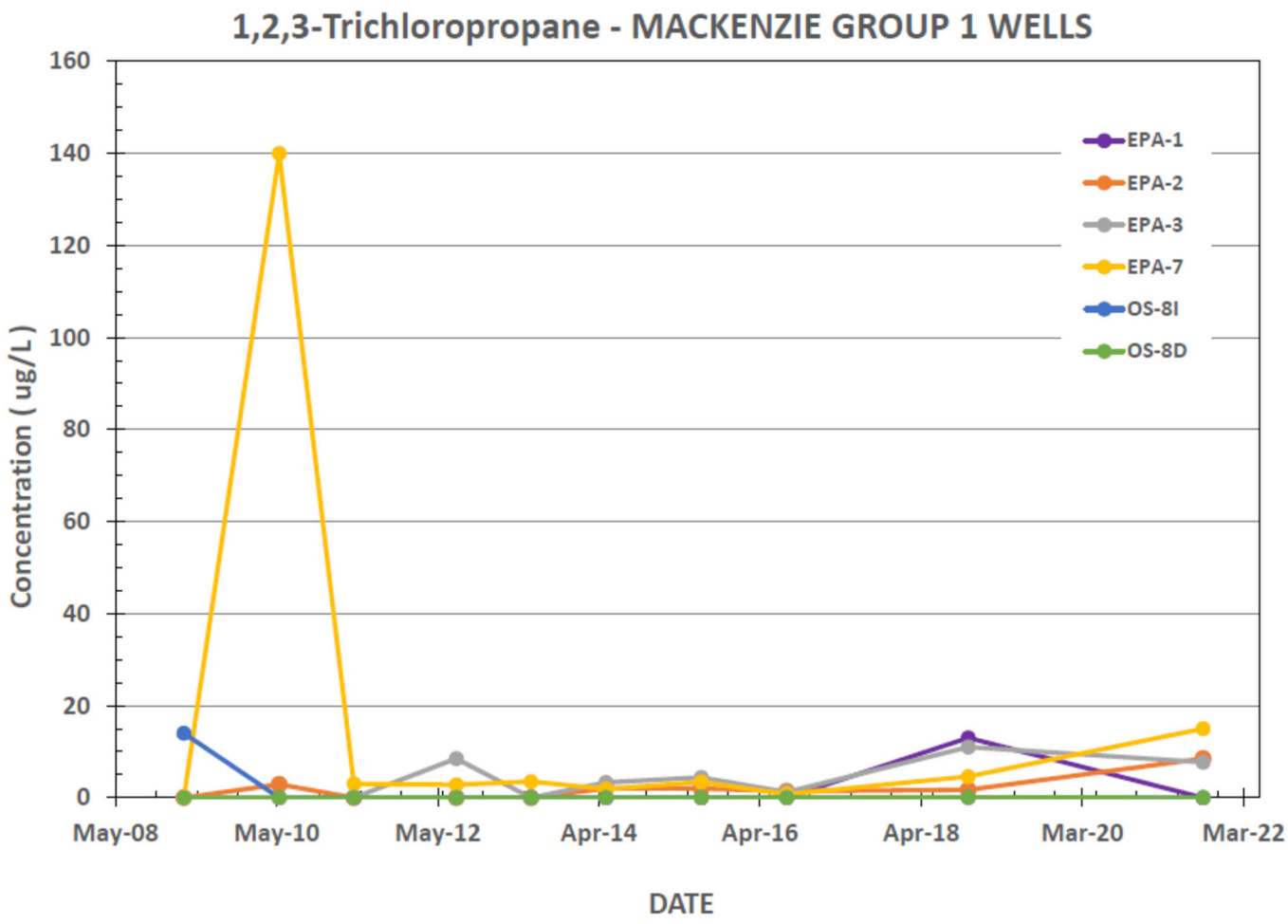


Figure 7 (2009-21): Group 2 - MacKenzie-East Fence Line Wells

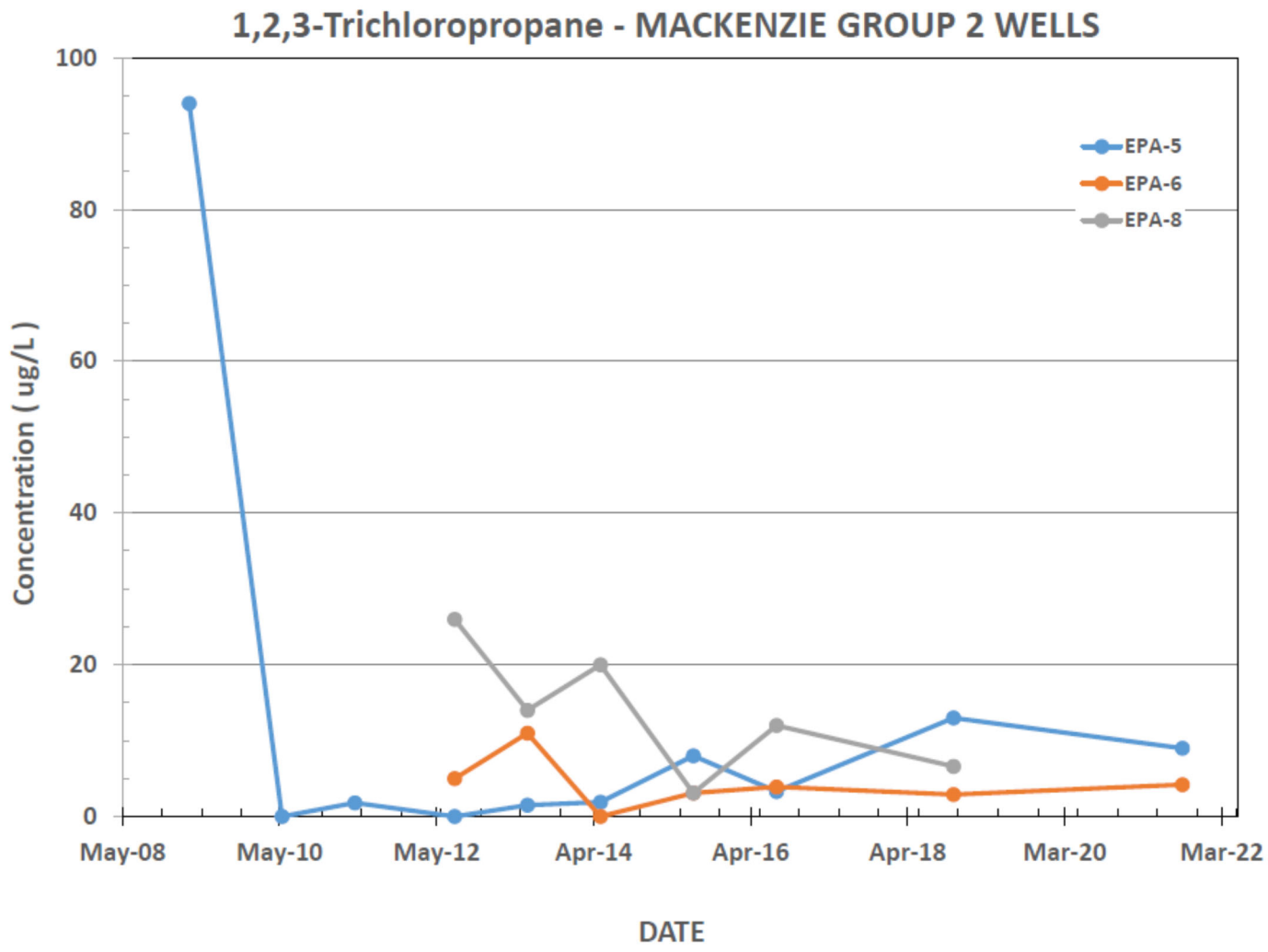


Figure 8 (2009-21): Group 3 - Brightside Avenue Cross Section (Shallow S-series Wells)

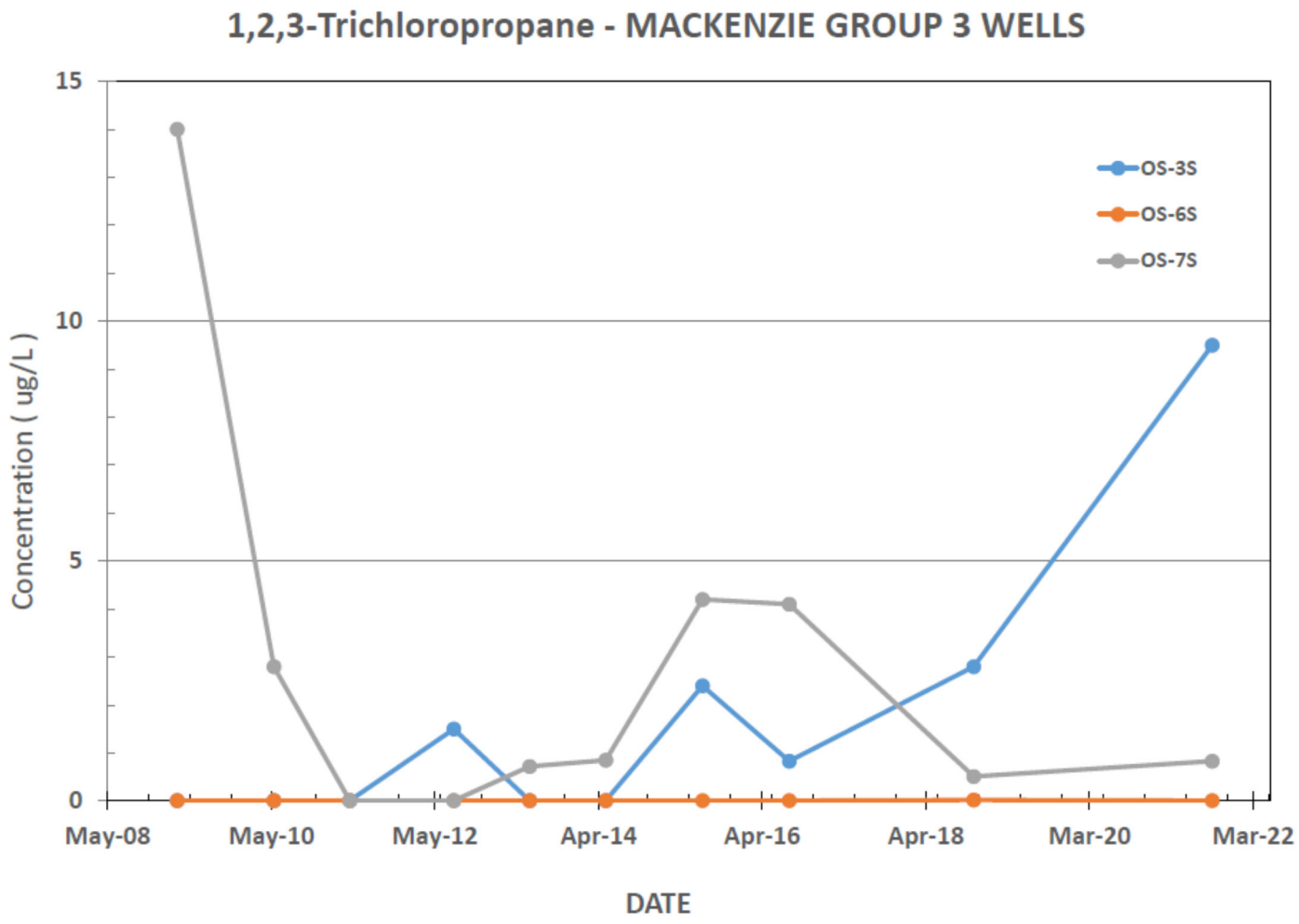


Figure 9 (2009-21): Group 4 - Brightside Avenue Cross Section (I- & D-series Wells)

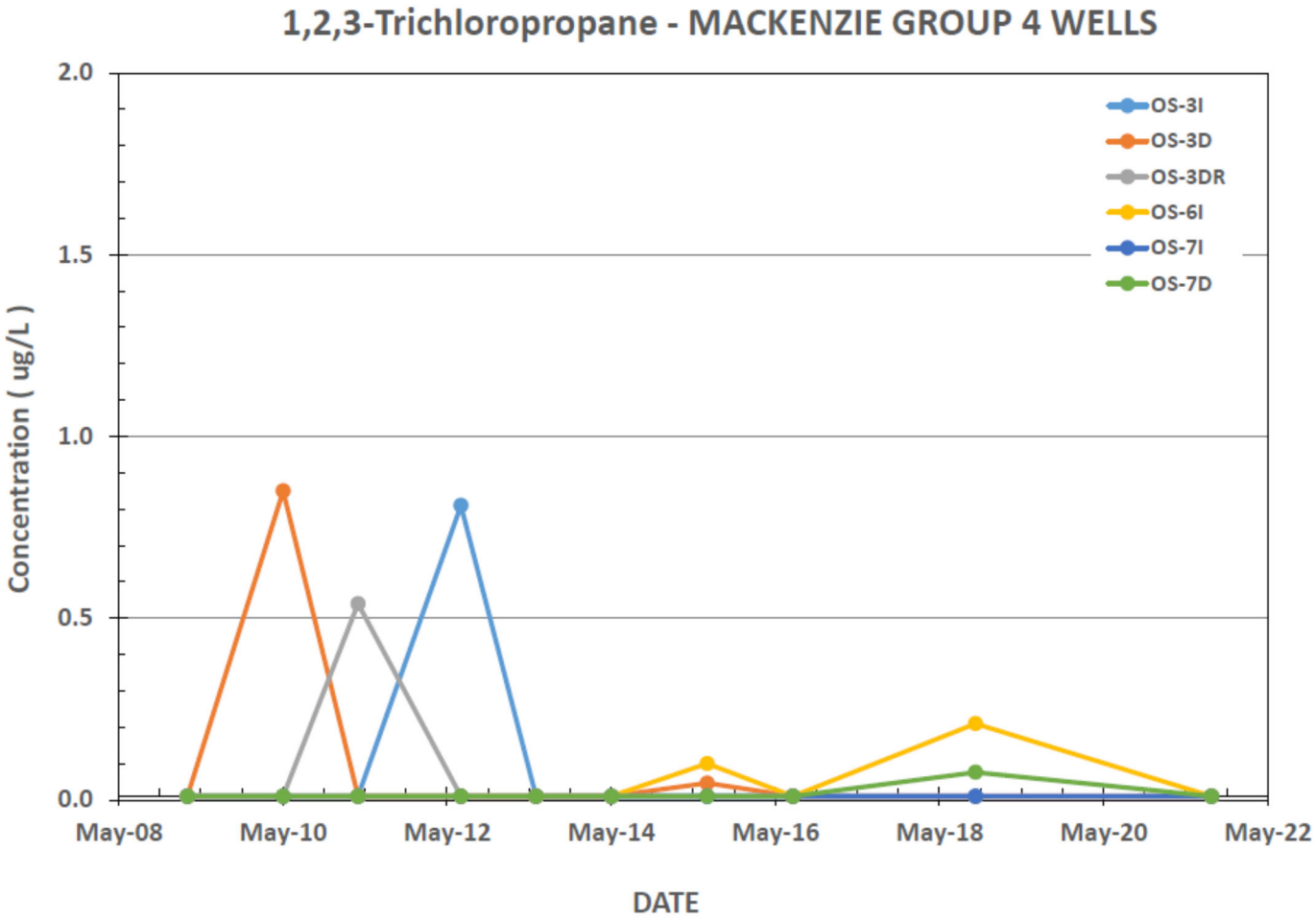
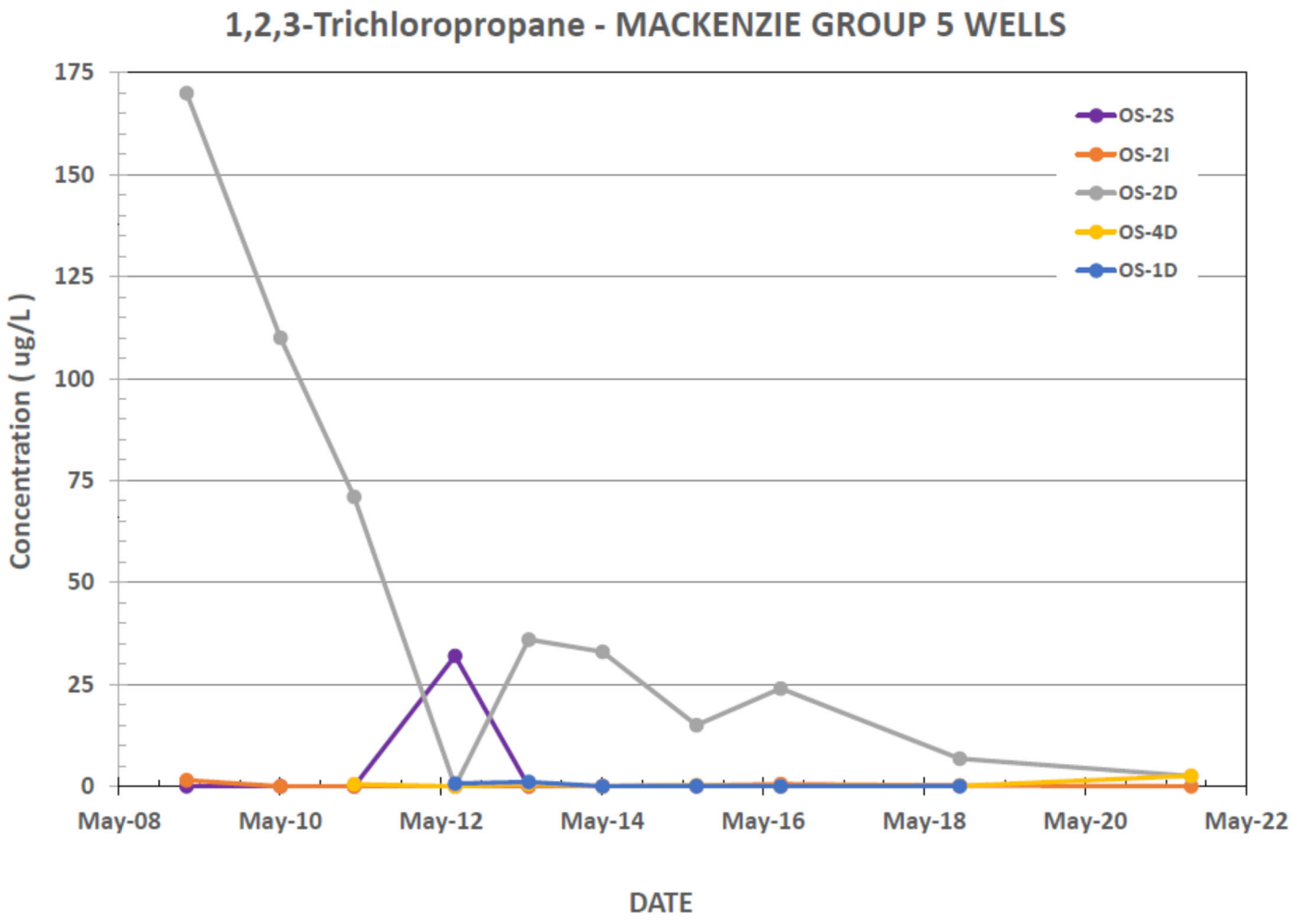


Figure 10 (2009-21): Group 5 – Downgradient-Plume Wells



APPENDIX B: REFERENCES

2012 Annual Groundwater Monitoring Report, MacKenzie Chemical Works Site, Central Islip, New York, USEPA, November 2012.

2013 Annual Groundwater Monitoring Report, MacKenzie Chemical Works Site, Central Islip, New York, USEPA, December 2013.

2014 Annual Groundwater Monitoring Report, MacKenzie Chemical Works Site, Central Islip, New York, USEPA, September 2014.

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2016 Annual Groundwater Monitoring Report, MacKenzie Chemical Works Site, Central Islip, New York, USEPA, October 2016.

2018 Groundwater Monitoring Report, MacKenzie Chemical Works Site, Central Islip, New York, NYSDEC, November 2018.

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Explanation of Significant Differences, MacKenzie Chemical Works Site, Central Islip, New York, USEPA, September 2011.

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Interim Remedial Action Report for Groundwater Remediation, MacKenzie Chemical Works Site, Central Islip, New York, USEPA, September 2006.

MacKenzie Chemical Works Site Data Visualization, MacKenzie Chemical Works Site, Central Islip, New York, USEPA, August 2015.

MacKenzie Chemical Works Site Data Visualization Update, MacKenzie Chemical Works Site, Central Islip, New York, USEPA/NYSDEC, October 2021.

Record of Decision, MacKenzie Chemical Works Site, Central Islip, New York, USEPA, March 2003.

Remedial Action Report, MacKenzie Chemical Works Site, Central Islip, New York, USEPA, September 2020.

APPENDIX C: TOPOGRAPHY AND SITE GEOLOGY/HYDROGEOLOGY

The local topography surrounding the site consists of relatively flat terrain with a very slight southerly downward slope (*i.e.*, a difference in elevation of approximately 70 ft. over several miles). Subsurface features reportedly included two former concrete-lined waste lagoons (backfilled with clean soils), at least one cesspool, and at least nine storm-water drywells.

Surficial geology is comprised of one to two ft. of topsoil/fill underlain by the sand and gravel of the upper geologic unit. Depth to groundwater is approximately 50 ft. below ground surface (bgs). Local groundwater flow at the site moves south to southeast. No surface water bodies exist at or near the site. There are no streams or stream-cut channels at or near the property. The nearest surface water bodies are Champlin Creek, which is located over a mile south of the property, and the Connetquot River, which is located approximately two miles east of the property.

There are three primary water-bearing aquifers underlying Suffolk County, comprising a federally-designated sole source of drinking water for Long Island. Therefore, groundwater in the vicinity of the site is a potential source of drinking water. The only known private well near or downgradient of the property is located on a residential property that is hydrologically sidegradient to the east. Annual sampling of this well has shown that it is not impacted by site-related contaminants. The nearest municipal drinking water supply well is located approximately 3,500 ft. southeast of the property (well beyond the contaminant plume) and is screened at a depth of 710 ft. bgs. A review of Suffolk County Water Authority (SCWA) data for this well has shown that it is not impacted by site-related contaminants.