SECOND 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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Date

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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/kg	micrograms per kilogram
µg/l	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
MW	Monitoring Well
ND	Not Detected
NPL	National Priorities List
NYSDEC	New York State Department of Environmental Conservation
OU	Operable Unit
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 in order 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.

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.

This is the second FYR for the MacKenzie Chemical Works Inc. (MCW) site. The triggering action for a subsequent FYR is the signature date of the last review. The approval date of the last review was October 3, 2011.

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 site's second FYR team was led by Mark Granger, the EPA Remedial Project Manager (RPM). Participants included Sharissa Singh (EPA hydrogeologist), Chuck Nace (EPA human-health and ecological risk assessor), and Cecilia Echols (EPA community involvement coordinator). The FYR began on May 25, 2016.

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, which was used for industrial/commercial purposes from 1948 to 1987, 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. 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 in order 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. Semi-volatile organic compounds (SVOCs) were also detected in on-site soils.

In January 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 emptied the two waste lagoons of all soil and sludge materials and backfilled them with clean soils. The excavated material was disposed of at an approved off-site waste disposal facility.

Appendix B (References), 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

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

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: 10/04/2011 - 05/05/2017		
Date of site inspection: 8/17/2016		
Type of review: Policy		
Review number: 2		
Triggering action date: 10/3/2011		
Due date *(five years after triggering action date)*: 10/3/2016		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

In June 1999, based on the preliminary findings of the RI, NYSDEC requested that EPA take a response action at the property. In response to NYSDEC's request, EPA collected groundwater samples from off-property monitoring wells, two municipal supply wells, and one private well in April 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 August 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 sampling in July 2002 in order to assess the conditions related to on-property surface soil. Based upon these sample results, an RI/FS-report addendum was completed by EPA in January 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.

Based upon the groundwater sampling results, it was 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.

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 March 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 2003 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 controls (ICs) restricting the installation and use of groundwater wells at and downgradient of the property until groundwater quality has been restored. ICs 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.

Response Action Implementation

Building Demolition

In August 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 August 2006. Metal

from the buildings was recycled. Wood and rubble was disposed of in an EPA-approved facility in Suffolk County. None of the debris required decontamination.

Soil Excavation

In August 2006, Earth Tech excavated approximately 20 cubic yards of SVOC-contaminated soils that exceeded the TAGM 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 October 2003, Earth Tech, Inc. commenced treatability studies related to the ISVE remedy. During the treatability studies, which were completed in December 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 the summer of 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 expanded system was brought on line in September 2006. There are seventeen soil-vapor extraction wells over a 0.5-acre area. Soil vapors from the ISVE system are piped through a carbon vessel that is filled with 2,000 pounds of vapor-phase activated carbon before being released to the atmosphere. A second carbon vessel, also filled with activated carbon, acts as a spare unit. Once one vessel is spent (*i.e.*, monitoring results detect breakthrough), the effluent piping is attached to the spare. Carbon change-outs occur approximately every 1.5 to 2 years. ISVE vacuum, flow, VOC, and other readings are collected regularly. VOC, oxygen, carbon monoxide, hydrogen sulfide, and lower explosive limit readings are measured directly from the ISVE wells. Total influent flow rates average approximately 480 cubic feet per minute. Individual well flows have varied depending on the total number of wells open. The system is shut down occasionally for general maintenance, during post-ISCO injection periods, and during holiday periods.

The ISVE system ran continuously from its full-scale deployment in 2004 until February 2010. Since that time, the system has been operating on a part-time basis (night-time on weekdays) as part of an optimization strategy that integrates more efficient contaminant recovery with energy conservation, while taking advantage of discounted night-time electricity rates.

Groundwater Remediation

In October 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, or ISCO, using base-activated sodium persulfate as the oxidant) was performed. Following the successful field and lab studies, full-scale deployment followed in March 2006, when

[2] The noted change to the remedy was documented in a September 2011 Explanation of Significant Differences
(ESD).

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 the follow-up groundwater data, a second ISCO-injection event took place in August 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 was Geoprobe based, 20,000 gallons of sodium-persulfate solution were injected in the source area. In September 2016, in order to address residual groundwater contamination downgradient of 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 ICs 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) in order 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 ICs 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 summarizes the status of the ICs.

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

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

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 annually as follows:

- fencing and gates to ensure that secure conditions are maintained;
- groundwater monitoring wells for ease of locating, functionality, damage/vandalism, and the condition of the surface seals; and
- all facilities (ISVE system, *etc*.) to ensure that they are in proper working order.

Nine monitoring wells have been installed on-site and eight monitoring well clusters (shallow, intermediate, and deep) have been installed off-site to monitor the groundwater plume. The depth-to- groundwater is approximately 50 feet below ground surface (bgs) and groundwater flow is generally to the southeast. All of the wells are sampled annually. **Figure 2** in Appendix A illustrates the monitoring well layout.

With respect to the ISVE component of the remedy, the system influent and effluent is 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) is generally performed every two years.

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. While the previous FYR had no recommendations, there were some suggestions. The current status of the suggestions are summarized in **Table 3**, below.

Table 2: **Protectiveness Determinations/Statements From 2011 Five-Year Review**

Operable Unit (OU)	Protectiveness Determination	Protectiveness Statement
1	Protective	The soil and groundwater remedy at the MacKenzie Chemical Works site is expected to be protective upon completion of the remedy. In the interim, exposure pathways that could result in unacceptable risks are being controlled.
Sitewide	Protective	The soil and groundwater remedy at the MacKenzie Chemical Works site is expected to be protective upon completion of the remedy. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

Table 3: Suggestions from 2011 Five-Year Review

Suggestion	Status
Wells OS-4D and OS-1D will be considered for inclusion in the regularly-scheduled sampling.	These wells were subsequently reintroduced into the annual groundwater- monitoring effort.
Consideration will be given to adjusting the detection limit downward at the appropriate time to more accurately reflect the groundwater contaminant level for 1,2,3-TCP.	The detection limit for 1,2,3-TCP was adjusted from 0.5 ug/L to 0.03 ug/L in 2015 to more accurately reflect the groundwater cleanup goal of 0.04 ug/L.

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

On November 14, 2016, EPA Region 2 posted a notice on its website indicating that it would be reviewing site cleanups and remedies at 38 Superfund sites in New York and New Jersey, including the MacKenzie Chemical Works site. The announcement can be found at the following web address:

https://www.epa.gov/sites/production/files/2016-11/documents/five_year_reviews_fy2017_final.pdf

In addition to this notification, a notice of the commencement of the FYR was posted on EPA Region 2's website and sent to local public officials. The notice was provided to the Town of Islip and was posted on the Town's website on February 22, 2017. 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. 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 2006 and treated-soil sampling was performed in 2009. The evaluation at that time indicated that the 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 5,000 micrograms per kilogram (µg/kg) were common and were encountered as high as 530,000 µg/kg. In 2009, only one sample collected within the source area had levels of 1,2,3-TCP above 5,000 µg/kg and that sample was collected at a depth of 20 to 24 feet bgs.

Comprehensive source-area soil sampling was conducted following the 2012 persulfate-injection event in January 2013. Samples were collected at multiple locations and multiple depths from the ground surface down to the water table (approximately 50 feet bgs). The 1,2,3-TCP soil cleanup objective for the site is 400 µg/kg. With one exception, samples collected from the sandy vadose-zone source-area unit (5 to 50 feet bgs) were either not detected (ND) or were below the 400 µg/kg cleanup goal; the lone exception was a concentration of 480 µg/kg for 1,2,3-TCP at 14 feet bgs. In the shallow -fill unit (0 to 5 foot bgs), seven of 12 locations were below the 400 µg/kg cleanup goal. The range of concentrations of 1,2,3-TCP in the remaining five shallow locations was 570 to 14,000 µg/kg. See **Figure 3** in Appendix A for a layout of the 2013 soil borings and the soil-sampling results.

ISVE-related soil-vapor data has shown 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 most recent data from this well (2014) reported 1,2,3-TCP at 159 µg/m³. Concentrations in extraction well SVE-4 decreased from 120,000 µg/m³ in 2004 to 586 µg/m³ in 2009. 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 2014 was 78 µg/m³. These wells are directly in the contaminant source zone. See **Figure 4** in Appendix A for a layout of the ISVE system.

Drinking water is supplied to nearby residents by Suffolk County, with the exception of a nearby residential property to the east, where there is a private well used for potable purposes. This well is sampled annually. This well is not impacted by site-related contamination. Specifically, 1,2,3-TCP has never been reported above the standard drinking-water-method detection limit of 0.5

micrograms per liter (µg/l); more importantly 1,2,3-TCP was ND in the analysis performed in 2015 at the lower 0.03 µg/l detection limit.

Concentrations of 1,2,3-TCP in the source-area groundwater have also dropped significantly since the start of the ISVE system and the ISCO-injection events. The two most heavily-contaminated groundwater monitoring wells in 2004 were EPA-MW-1 and EPA-MW-2 (both within the source area). The 1,2,3-TCP levels in monitoring well EPA-MW-1 have fallen from 91,000 µg/l in July 2004 to ND for the five rounds during this review period, including at a detection level of 0.03 µg/l (*i.e.,* below the groundwater cleanup value of 0.04 µg/l) in 2015. 1,2,3-TCP levels in monitoring well EPA-MW-2 fell from 59,000 µg/l in July 2004 to 1.4 µg/l in August 2016. Contaminant levels in the monitoring wells further sidegradient of the source area (*i.e.,* along the eastern fence line) show 1,2,3-TCP concentrations to be generally fluctuating between 0.5 and 10 µg/l. Please see **Figure 1** in Appendix A for monitoring-well locations. Please refer to **Figures 5a and 6a** in Appendix A for illustrations of the groundwater trends in these monitoring wells from 2009 to 2016. **Figures 5b and 6b** in Appendix A present scale-adjusted illustrations of the groundwater trends from 2012 to 2016.

For downgradient monitoring wells, concentrations of 1,2,3-TCP have, generally, demonstrated declining trends over time. Shallow off-site wells immediately downgradient from the source area (monitoring wells OS-3S, OS-6S, and OS-7S) show 1,2,3-TCP concentrations to be present at concentrations similar to the shallow on-site source-area wells (*i.e.,* monitoring wells EPA-MW-1, EPA-MW-2, EPA-MW-3, and EPA-MW-7). While monitoring well OS-7S demonstrates a declining trend over time, levels of 1,2,3-TCP in this well during the review period, similar to the eastern fence-line wells, fluctuated between 0.5 and 5 µg/l. Concentrations of 1,2,3-TCP in the intermediate (I series) and deep (D series) wells immediately downgradient from the source area were either reported at ND levels (at a 0.03 µg/l detection level) or below 0.1 µg/l in 2015 (*i.e.,* slightly above the groundwater cleanup value of 0.04 µg/l). Please see **Figure 1** in Appendix A for monitoring-well locations. Please refer to **Figures 7 and 8** in Appendix A for illustrations of the groundwater trends in these monitoring wells.

There are three monitoring well locations defining the plume further downgradient of the site: monitoring wells OS-2S/2I/2D, OS-4D, and OS-1D, respectively, in order of distance from the site (see **Figure 2** in Appendix A for downgradient monitoring-well locations). The highest concentrations of 1,2,3-TCP in any on- or off-site well is consistently reported at off-site monitoring well OS-2D. The 1,2,3-TCP concentration in this well in 2016 was 24 µg/l. While this well consistently reflects the highest concentrations, it is important to note that there is, nevertheless, a generally declining trend over time; annual sampling shows that the levels of 1,2,3-TCP have steadily decreased since 2009 when the reported concentration was 170 µg/l. The 1,2,3-TCP concentrations in the shallow and intermediate wells at this location are consistently negligible (in 2015: ND in monitoring well OS-2S and 0.23 µg/l in monitoring well OS-2I). Further downgradient from monitoring well OS-2D, concentrations in the deep wells, screened similarly to OS-2D, are likewise consistently negligible (in 2015: 0.31 µg/l for OS-4D and 0.11 µg/l for OS-1D). Please refer to **Figure 9a** for an illustration of the groundwater trends in these monitoring wells. **Figure 9b** in Appendix A presents a scale-adjusted illustration of the groundwater trends from 2012 to 2016.

Site Inspection

An inspection of the site was conducted on August 17, 2016. In attendance were RPM Mark Granger, EPA On-Scene Coordinator Louis DiGuardia, and NYSDEC RPM Steve Malsan. A follow-up inspection was conducted on December 8, 2016 with Mark Granger, Sharissa Singh, and Chuck Nace. The property, treatment equipment, roadways, monitoring wells, fencing, gates, and other site-related facilities were all in good repair at the time of the inspection.

V. TECHNICAL ASSESSMENT

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

It has been concluded that the remedy is functioning as intended by the ROD (as modified by the ESD) and that groundwater consumption is 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.

Concentrations of 1,2,3-TCP in groundwater and soil in the source area have dropped precipitously; in fact, concentrations of 1,2,3-TCP have declined to below the State drinking-water maximum contaminant level (MCL) of 5 µg/l in the source-area monitoring wells and almost all of the sandy vadose source-area soil data (5 to 50 feet bgs) is below the 400 µg/kg cleanup goal. Low-level contamination does remain, however, in a few sidegradient and downgradient wells somewhat above the MCL. Although contamination remains, the plume is contained and is not impacting any residential wells. With respect to soil contamination, while concentrations have substantially dropped in the sandy vadose source-area soils, the comprehensive 2013 soil-sampling event also determined that the shallow-fill unit (0 to 5 feet bgs) contains 1,2,3-TCP above the 400 µg/kg cleanup goal in five of the twelve soil-sampling locations (ranging from 570 to 14,000 µg/kg).

The need for operation of the ISVE system and ISCO injections, along with potential excavation of some areas of the shallow-fill zone (0 to 5 feet bgs), 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 first FYR (2011) indicated that exposure pathways, receptors and exposure assumptions were valid. This information was reviewed during this evaluation and it remains valid at this time, including the conclusion that vapor intrusion is not associated with the site.

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 last FYR, the toxicity value for 1,2,3-TCP was identified as being more stringent than at the time of the ROD. The toxicity value has not changed since the 2011FYR; that FYR noted that the impact of having a more stringent toxicity value would not alter the actions taken nor the protectiveness of the remedy. There have been no physical changes to the site that would adversely affect the protectiveness of the remedy. The cleanup values chosen in the ROD (NYSDEC TAGM values for soils; Federal/State MCLs and NYSDEC Class GA Groundwater Quality Standards) are also still valid as they either have not changed or they are within EPA's risk range. The RAOs (see "Response Actions" section, above) also remain valid.

EPA conducted soil vapor intrusion evaluations of sixteen residential properties in 2005 and 2006. No 1,2,3-TCP was detected in the subslab soil vapor or indoor air of any of the properties sampled. The vapor intrusion pathway is not an issue at this site.

The exposure pathways associated with ecological receptors, specifically exposure to contaminated soil, were addressed by the remedial actions that have already been taken at the site. Thus the remedy is protective for ecological receptors.

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

Table 4: Issues and Recommendations

Issues and Recommendations Identified in the Five-Year Review:				
OU(s): 1	**Issue Category:** Remedy Performance			
	Issue: Residual soil contamination remains in the source area			
	Recommendation: Evaluate alternatives for addressing residual soil contamination			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	9/30/2017

Other Findings

In addition, 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.

VII. PROTECTIVENESS STATEMENT

Table 5: Protectiveness Statements

Protectiveness Statement(s)	
Operable Unit:	*Protectiveness Determination:*
OU1 (Groundwater and Soil)	**Short-term Protective**
Protectiveness Statement: 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 Protectiveness Statement	
Protectiveness Determination: **Short-term Protective**	
Protectiveness Statement: 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.	

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

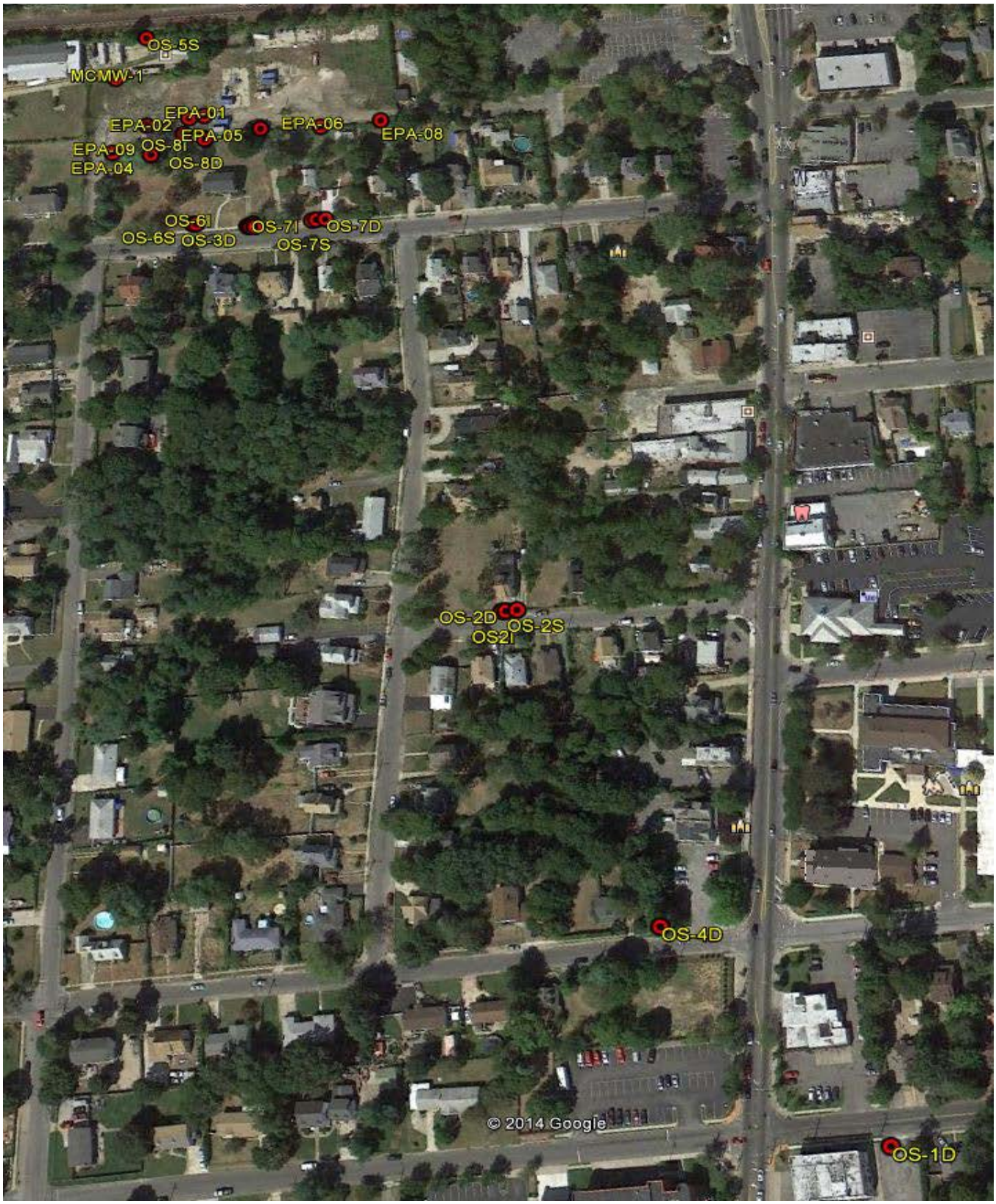


Figure 3: MacKenzie Chemical Works – February 2013 Post-ISCO Soil Sampling Data

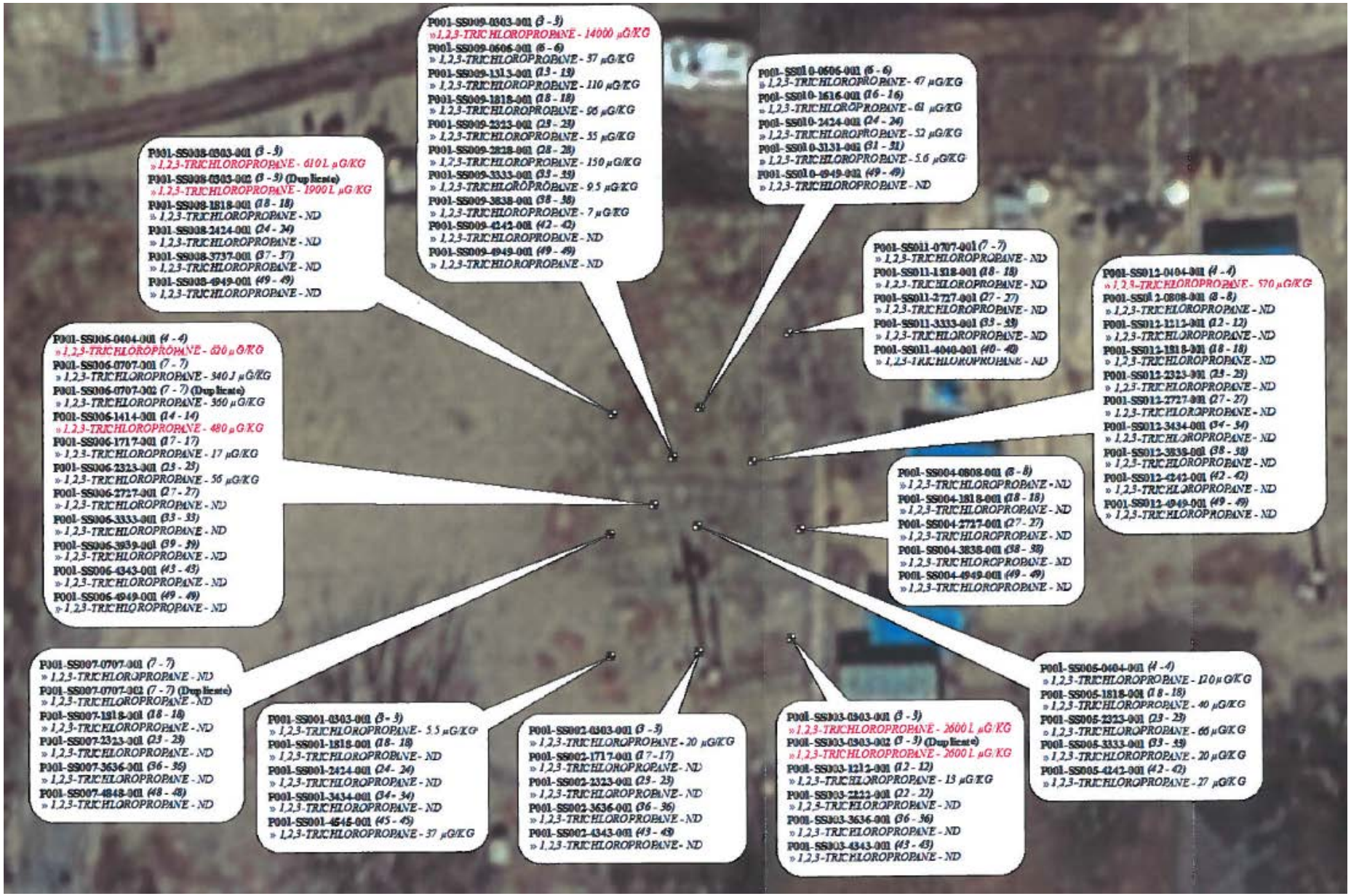


Figure 4: MacKenzie Chemical Works – *In-situ* Soil-Vapor Extraction System Layout

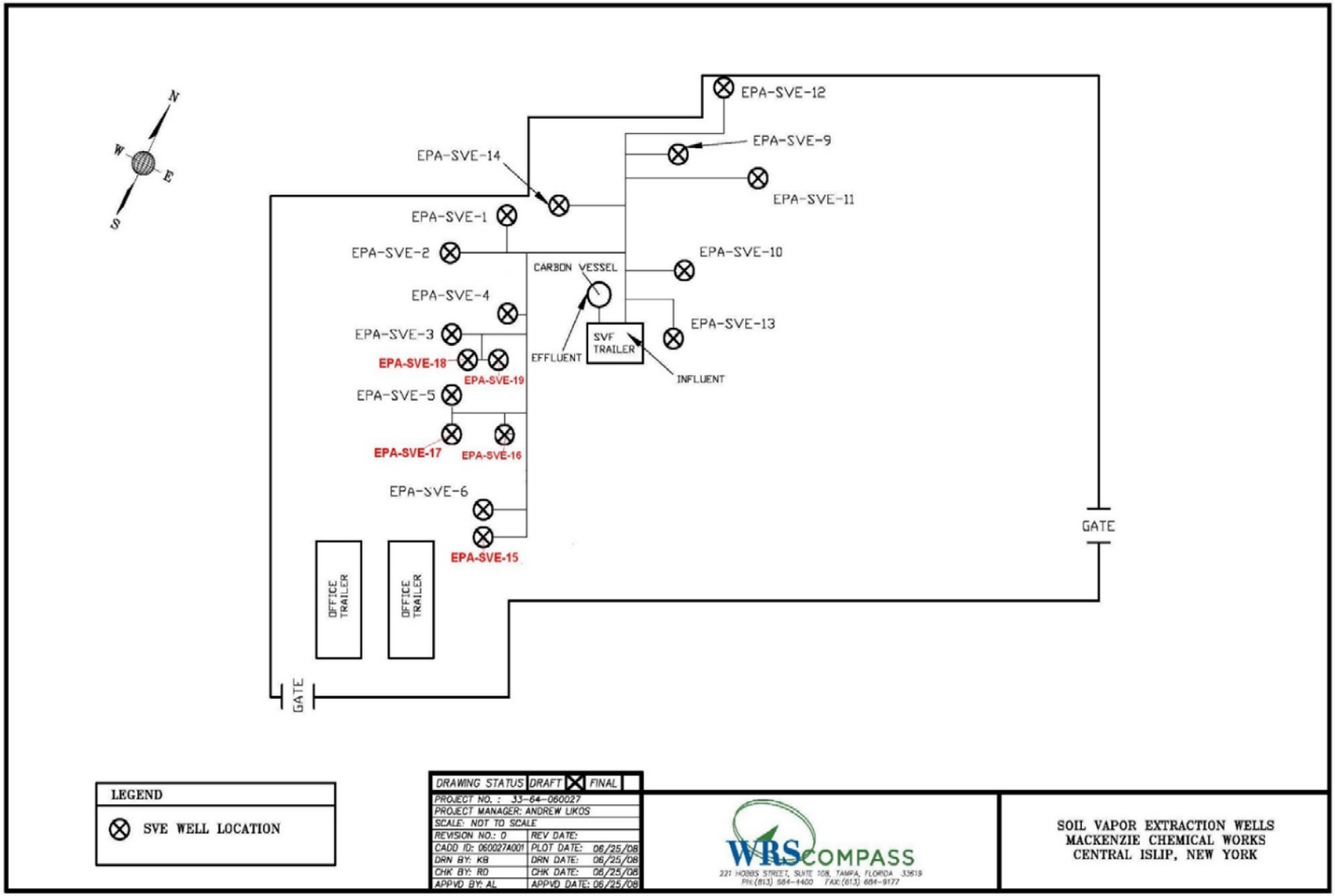


Figure 5a (2009-16): Group 1 - On-site Source-Area Wells (plus MWs 8I & 8D)

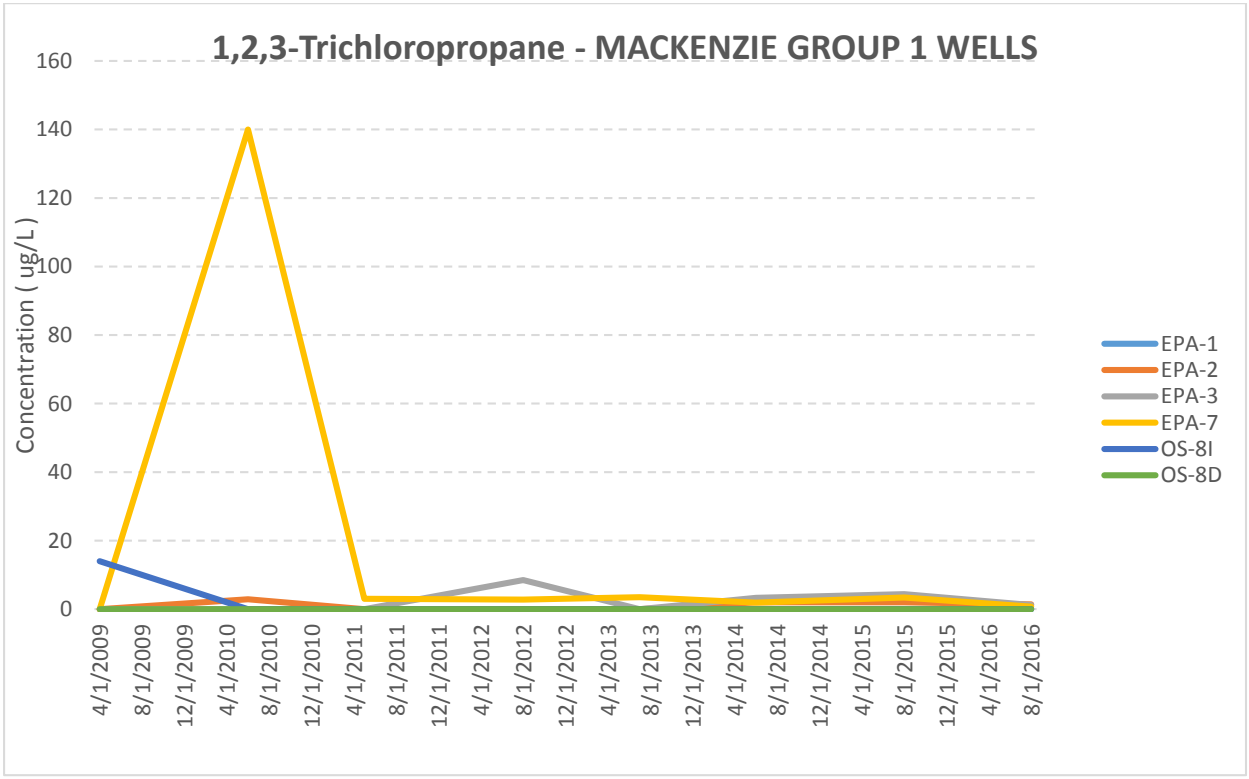


Figure 5b (2012-16): Group 1 - On-site Source-Area Wells (plus MWs 8I & 8D)

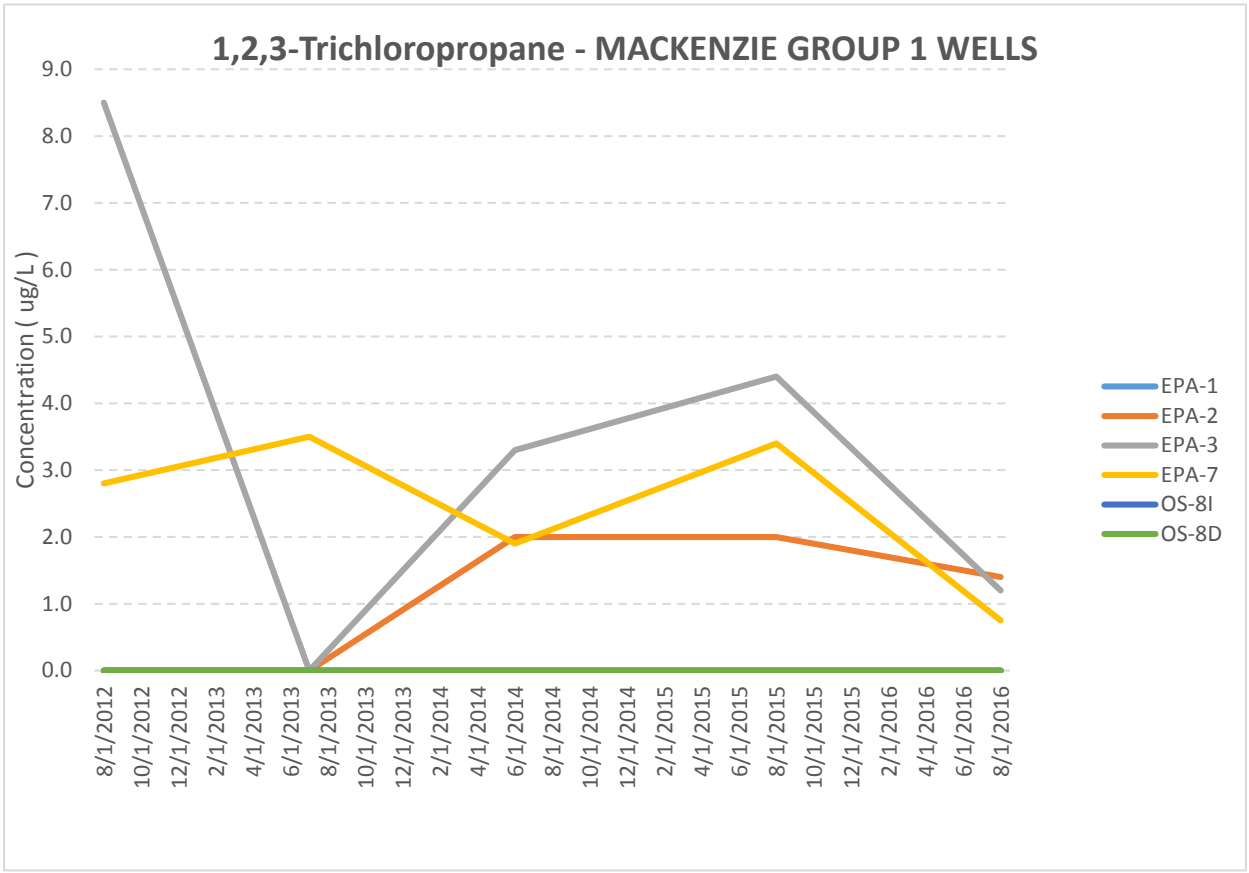


Figure 6a (2009-16): Group 2 - MacKenzie-East Fence Line Wells

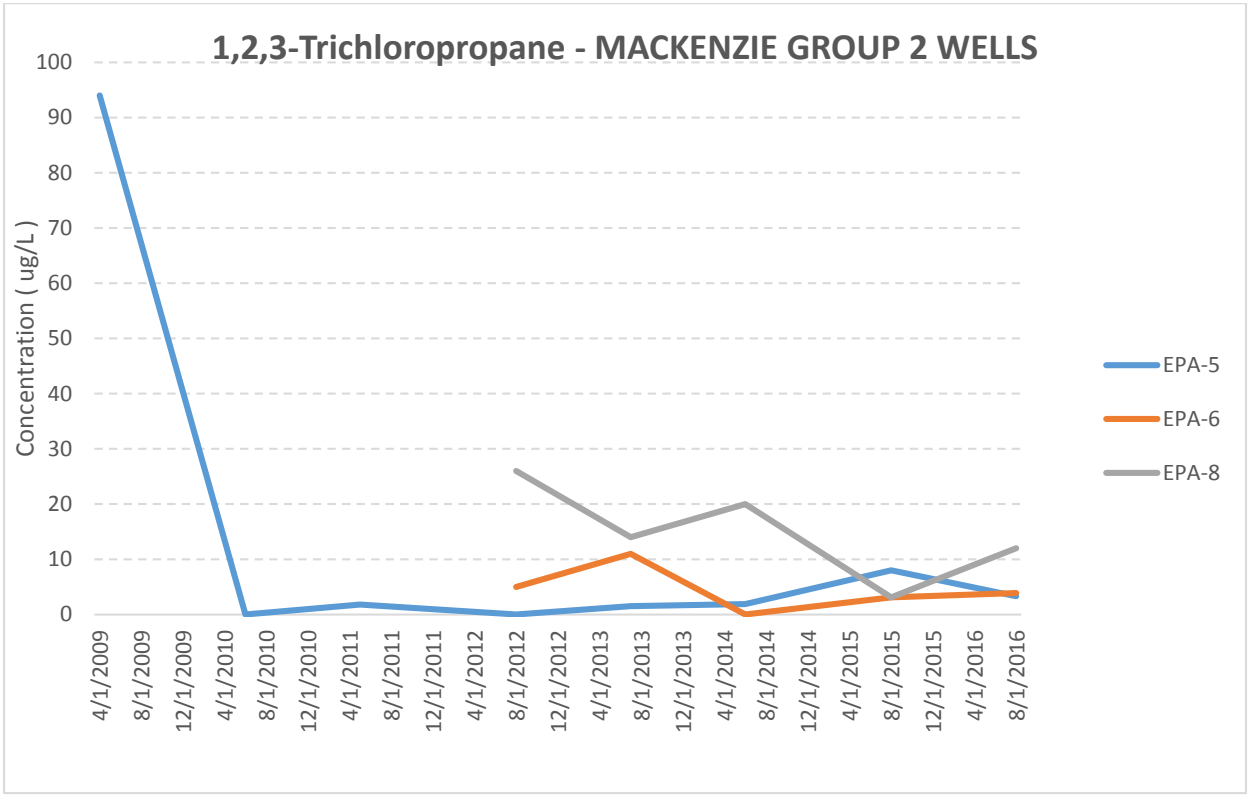


Figure 6b (2012-16): Group 2 - MacKenzie-East Fence Line Wells

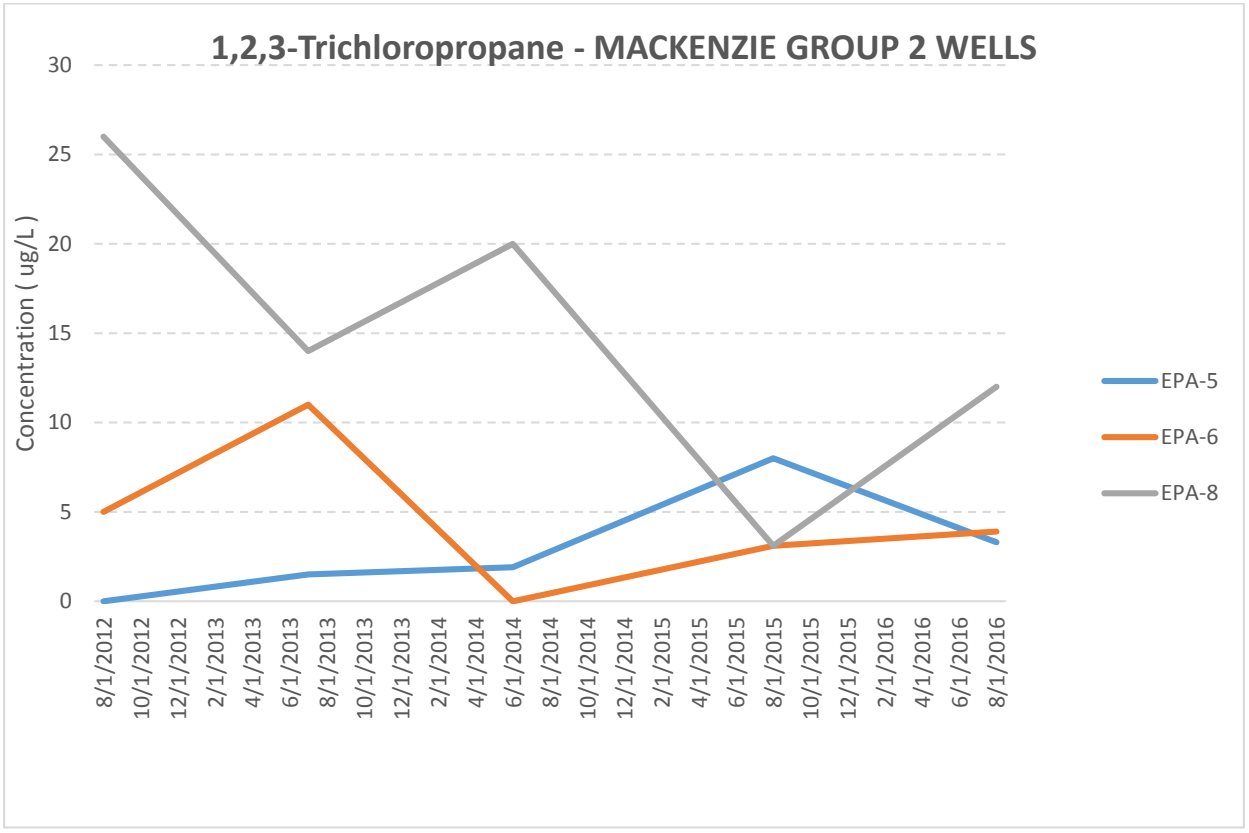


Figure 7 (2009-16): Group 3 - Brightside Avenue Cross Section (Shallow Wells)

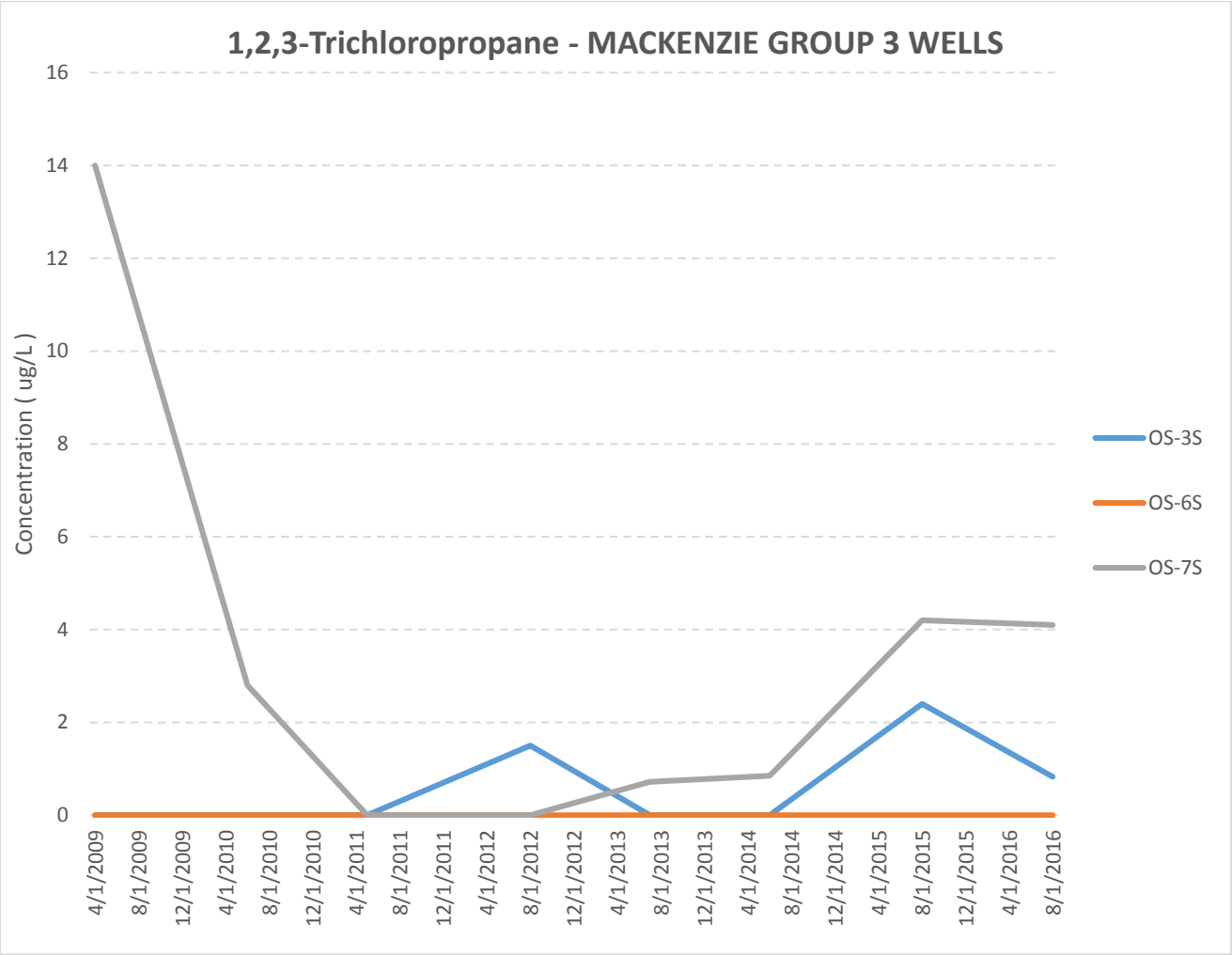


Figure 8 (2009-16): **Group 4 - Brightside Avenue Cross Section (Intermediate & Deep Wells)**

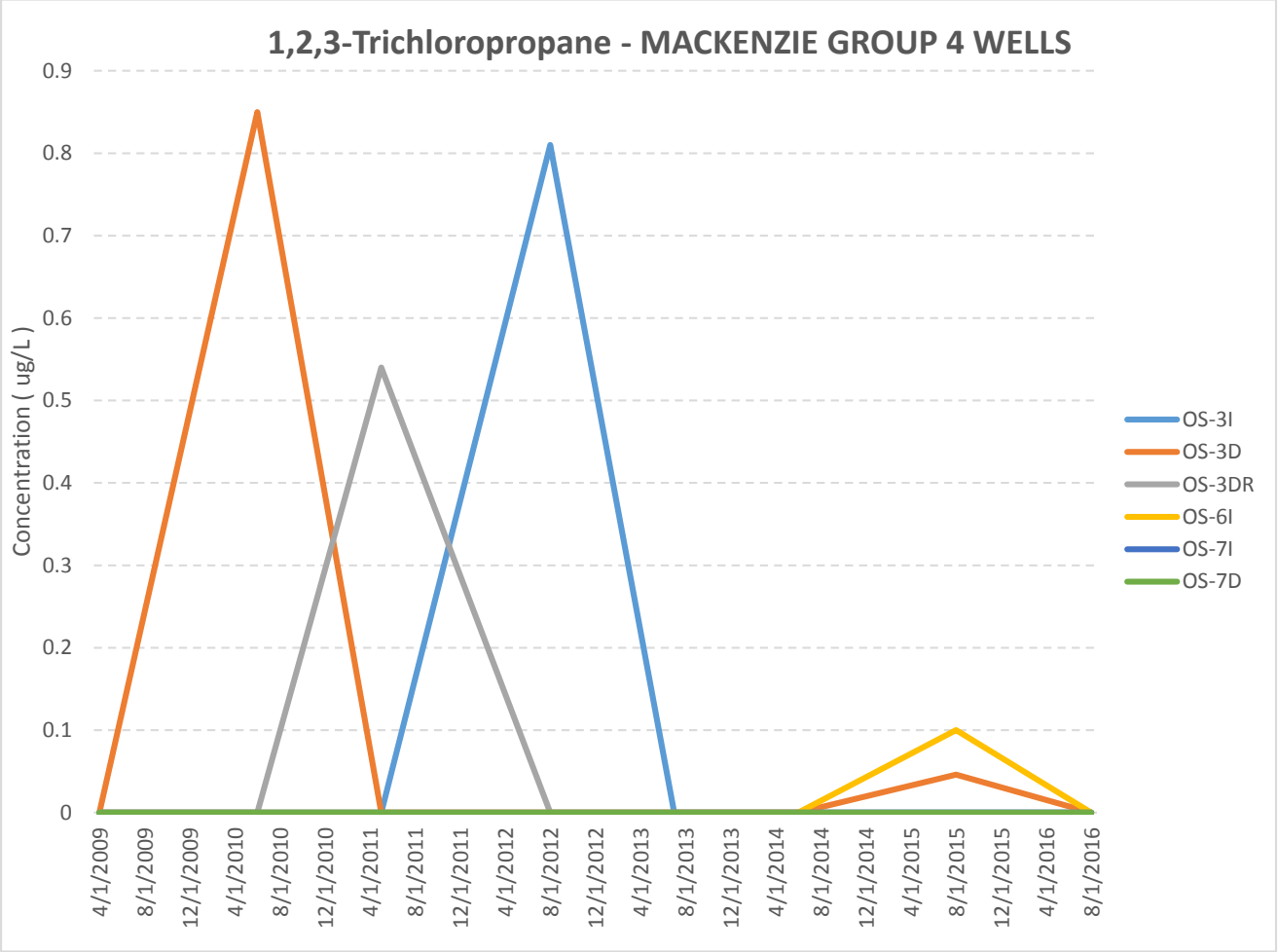


Figure 9a (2009-16): Group 5 – Downgradient-Plume Wells

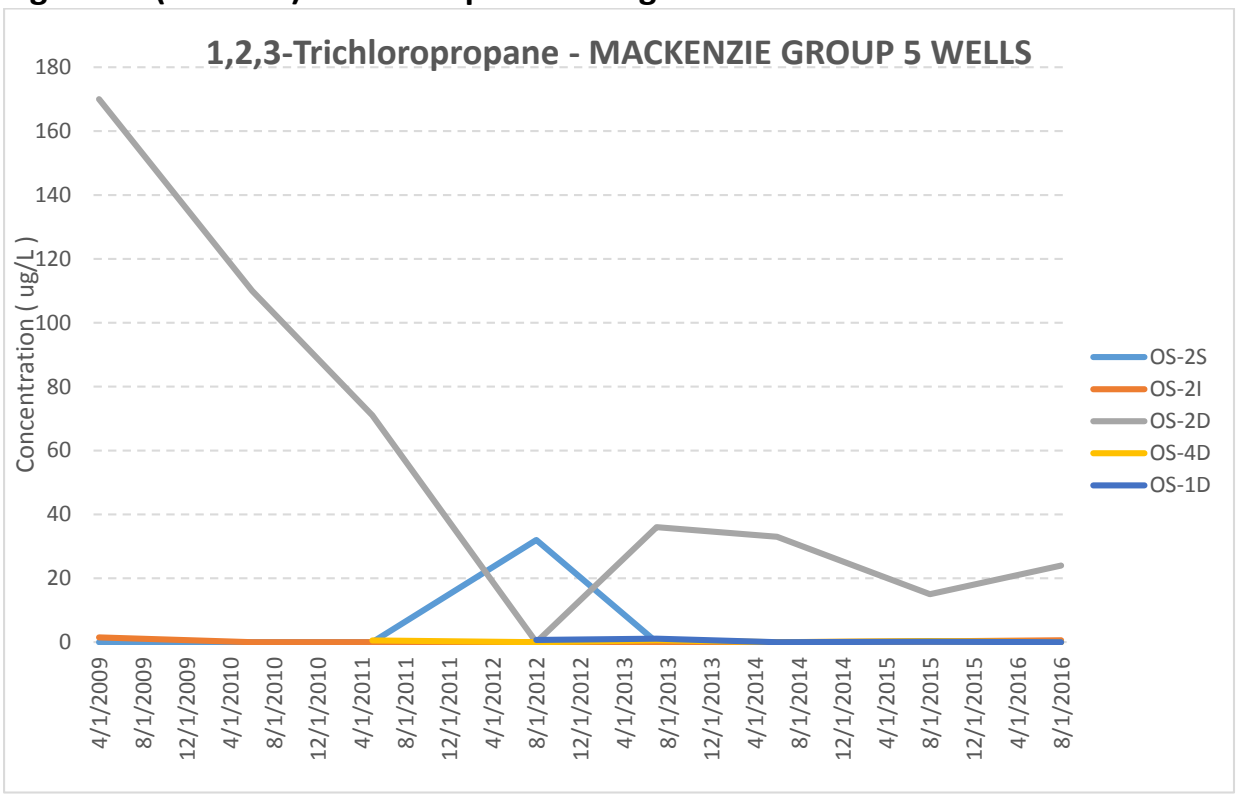
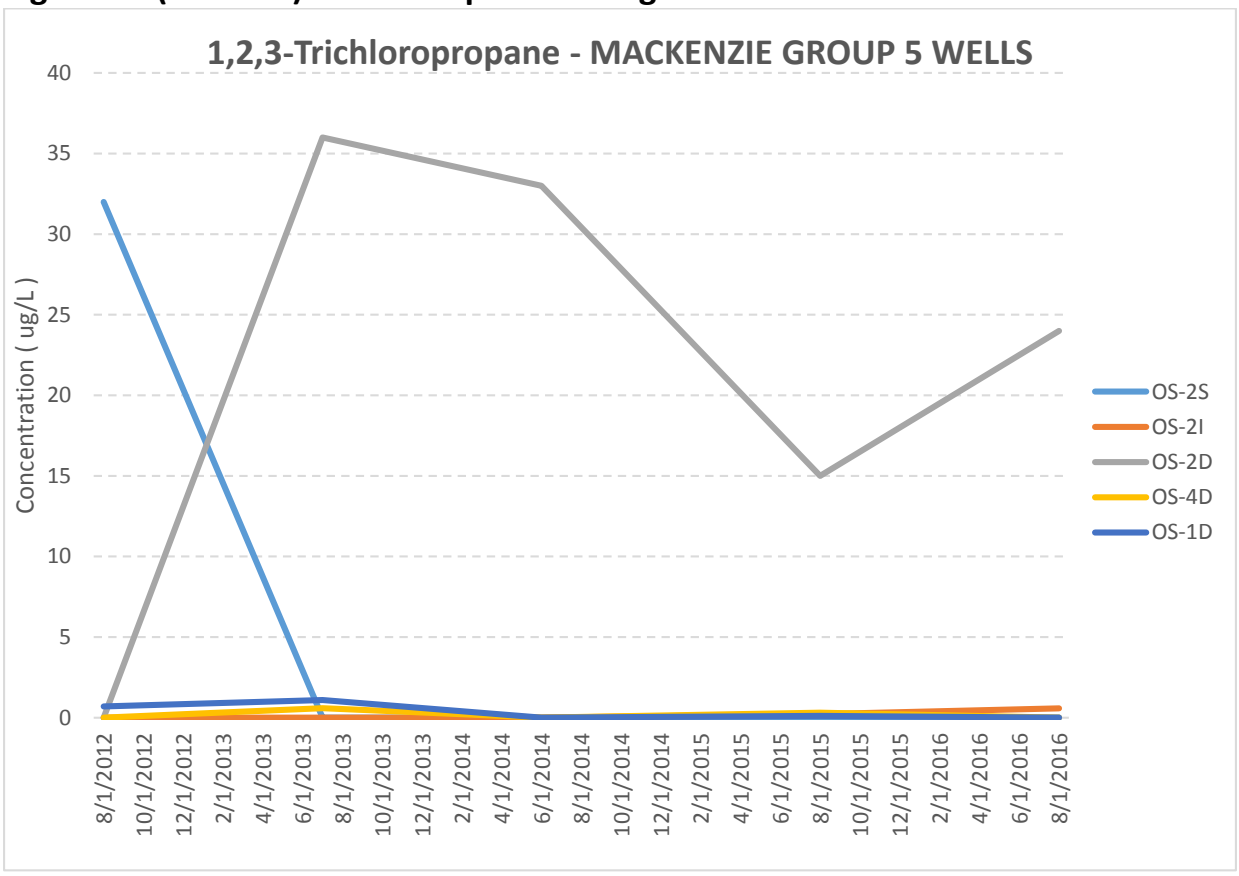


Figure 9b (2012-16): Group 5 – Downgradient-Plume Wells



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.

2015 Annual Groundwater Monitoring Report, MacKenzie Chemical Works Site, Central Islip, New York, USEPA, November 2015.

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

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

Five-Year Review Report, MacKenzie Chemical Works Site, Central Islip, New York, USEPA, October 2011.

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, March 2017.

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

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 feet 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 feet of topsoil/fill underlain by the sand and gravel of the upper geologic unit. Depth to groundwater is approximately 50 feet 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 feet southeast of the property (well beyond the contaminant plume) and is screened at a depth of 710 feet bgs. A review of Suffolk County Water Authority (SCWA) data for this well has shown that it is not impacted by site-related contaminants.