

PILOT TEST WORK PLAN

ISCO and SVE Pilot Tests

27-09 40th Avenue

Long Island City, Queens, New York

Prepared for:

40th Ave Dutch Kills Realty, LLC

38-08 30th Avenue

Astoria, NY 11103

Prepared by:




Liberty Environmental


600 Third Avenue, Second Floor

New York, NY 10016

Liberty Project No. 220192

September 8, 2022 (Revised October 12 & 21, 2022)


Prepared by:
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Reviewed by:
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Principal

Engineering Certification

I, James P. Cinelli, a licensed Professional Engineer, certify that all of the following statements are true:

- This Pilot Test Work Plan was prepared in accordance with the applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10); and
- The information presented in this report is accurate and complete.

I certify that all information and statements in this certification form are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law. I, James P. Cinelli, of Liberty Environmental, am certifying as the Owner's Designated Site Representative.

PE Signature and Seal:



Name: James P. Cinelli

Date: 10/21/2022

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1. INTRODUCTION

40th Avenue Dutch Kills Realty, LLC (Dutch Kills) retained Liberty Environmental (Liberty) to prepare a Pilot Test Work Plan for a soil vapor extraction (SVE) and in-situ chemical oxidation (ISCO) pilot tests at 27-09 40th Avenue, Long Island City, Queens, New York (the Site). The report was prepared as a follow up to the Remedial Action Work Plan (RAWP) dated May 2021. The planned cleanup activities are being conducted in accordance with the New York State Department of Environmental Conservation (NYSDEC) Decision Document for Site No C241241 issued in May 2021, approving the selected remedy for the Site.

The Site is 0.40 acres and is being redeveloped into a mixed-use building consisting of commercial and residential spaces. The selected remedy includes the excavation and off-site disposal of approximately 4,500 cubic yards of contaminated soil, backfilling of the site with clean fill to establish the design grades, and operation of a soil vapor extraction (SVE) system to remove volatile organic compounds (VOCs) from the subsurface and to prevent vapors migrating off site, install a zero-valent iron vertical permeable reactive barrier (PRB) neat the downgradient boundary to remedial groundwater leaving the Site, inject a chemical oxidant to remediate VOCs in groundwater beneath the Site, and install a subslab depressurization system beneath the proposed on-Site building to mitigate the migration of vapors into the building from the subsurface. The selected remedy intends to achieve a Track 1 unrestricted use; thus, no environmental easement or site management plan is anticipated.

1.1 PURPOSE AND SCOPE

The previous investigative work confirmed the presence of elevated dry cleaning solvent tetrachloroethylene (PCE) in soil, groundwater, and soil vapor at the Site. This pilot study consists of installing two SVE extraction points, four vapor extraction monitoring points, two injection wells, and six injection monitoring points. The SVE and injection points will be tested during the study to determine a radius of influence and will be used to complete the remedial design and implementation of the cleanup remedy.

2. SITE DESCRIPTION AND BACKGROUND

2.1 Site Description

The Site consists of three adjoining lots identified as Block 397 and Lots 33, 35, and 39 on the New York City Tax Map. The Site is approximately 17,500 square feet (0.40 acres) and is bounded by 40th Avenue to the south, 28th Street to the east, a three-story residential building with an automobile garage to the north, and a three-story residential building to the west. See Figure 1 for a Site Location Map.

The Site is currently undeveloped, but past operations have included a dry cleaner, automotive repair and machine shop businesses, a glass factory, woodworking, and a photo-engraving shop. Previously, it was developed with three vacant one-story commercial structures with one structure per lot. The buildings were constructed circa 1947 (39-44 28th Street), 1950 (27-09/11 40th Avenue), and 1970 (27-03 40th Avenue) and are constructed with concrete slabs-on-grade. The building at 39-44 28th Street had a partial basement present at the northern end of the structure. The buildings have been demolished. The owner of the site, 40th Avenue Dutch Kills Realty, LLC, has entered the site in the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program. NYSDEC approved a Remedial Action Work Plan (RWP) for the site on May 26, 2021.

2.2 Background

The Remedial Investigation indicated the localized presence of PCE source material in at least three areas on the Site, at depths varying from 20 to 27 feet, and the presence of chlorinated aliphatic hydrocarbon related-constituents in soil vapor and groundwater throughout the property. Metals, SVOCs, and pesticides were also identified in the Site's soil. The available information indicates that at least one potentially upgradient source, the Bridge Cleaners Site, may contribute to the presence of PCE in groundwater at and around the Site.

In general, contaminated historic fill material is underlain by fine to medium silty sands and silt layers, which overlie thick, competent, plastic clay at approximately 31 to 36 ft bgs. The high plasticity clay layer dips significantly towards the west and may be about 10 to 15 ft thick. The high plasticity clay acts as a hydraulic boundary layer.

As part of the Supplemental Remedial Investigation (SRI), 55 soil samples were collected and analyzed throughout the Site. In addition, ten groundwater monitoring wells were installed on-Site and off-Site as part of the SRI and sampled and analyzed to address data gaps in groundwater quality and to confirm localized groundwater flow direction. Four off-Site permanent groundwater monitoring wells were installed in sidewalks and driveways adjoining the Site. Eight soil vapor samples (four on-site and four off-site) were collected and analyzed.

AOC 1 – Former Dry Cleaning Operation

A localized PCE hotspot extends to a depth of approximately 5 ft bgs at SB-101B. PCE was present in soil vapor samples collected at 25 ft bgs, including a concentration of 270,000 µg/m³ PCE at SV-107 and a concentration of 1,600,00 at SV-4 d µg/m³ PCE during the 2019 RIR.

AOC 2 – Former Photo Engraving Operations, Machine Shop, and Subsurface Piping

A localized PCE hotspot extends to a depth of at least 27 ft bgs at historic boring B-A. This hot spot is approximately 10 ft wide, 25 ft long, and extending to depths of between 17 and 27 ft bgs, and potentially deeper, in the vicinity of historic boring B-A. The top of the extensive, thick, competent, plastic clay layer is present throughout the Site at depths of approximately 33 to 35 ft bgs in the vicinity of this hotspot.

AOC 3 – Vicinity of B-1

PCE was detected above NYSDEC Unrestricted Use Soil Cleanup Objectives (UUSCO) in the 1 to 4-foot interval at this location. A PID response of 26 ppm was recorded in the elastic silt at 16 to 20 ft bgs at SB-103, indicating the likely presence of PCE at concentrations that exceed applicable UUSCOs.

AOC 4 – Contaminated Historic Fill Material (CHFM)

Visual observations indicate the presence of CHFM to depths of approximately 4 ft bgs throughout the Site. The non-native CHFM generally consists of brown silty sands, concrete, brick, coal ash, and other construction debris. Analytical results indicate that PAHs and metals exceed UUSCOs in the CHFM.

AOC 5 – Groundwater

PCE was detected in all on-site groundwater samples at concentrations exceeding the NYSDEC Class GA groundwater standard of 5 µg/L. The highest concentration of PCE in groundwater was at MW-108, along the western Site boundary, which contained 400 µg/L. The concentration of PCE in groundwater was 170 µg/L at MW-105 (AOC 1) and 250 µg/L at MW-106 (AOC 2) in the central and eastern portions of the Site, respectively. The concentration of PCE in groundwater along the Site's northern boundary was 46 µg/L at MW-109 and 340 µg/L at MW-110.

An off-site source may potentially be contributing to the presence of dissolved-phase chlorinated solvents in groundwater. Dissolved-phase PCE was detected in groundwater above its NYSDEC Class GA groundwater standard (5 µg/L) at a concentration of 49 µg/L at MW-101 and 64 µg/L at MW-102, which are located hydraulically upgradient of the Site.

AOC 6 – Soil Vapor

To mitigate the potential soil vapor intrusion risk at the Site, a sub-slab depressurization system (SSDS) will be designed and installed.

AOC 7 – Former Vent Pipes

No compounds were detected at or above the NYSDEC UUSCO from soil samples in this area. No further action is warranted at AOC 7.

AOC 8 – Floor Drain

A floor drain was located within the former 27-03 40th Avenue building, towards the northern property boundary. No staining was noted in or on the concrete slab surrounding the floor drain. No further action is warranted at AOC 8.

See Figure 2 for the Site layout and soil and groundwater monitoring well locations.

3. ISCO PILOT TEST

Liberty will perform an ISCO pilot test at the Site to determine the in-situ performance of the injection of remedial compounds in groundwater for the destruction of PCE. An alkaline-activated persulfate (AAP) ISCO pilot test will be performed to provide implementation data, such as radius of influence (ROI), optimal application pressures and dosing. This data will be used to develop a well-designed, full-scale application. Section 6 of NYSDEC's decision document dated May 2021 indicates that laboratory-scale studies are to be conducted to more clearly define design parameters. A laboratory-scale or "bench-scale" test is performed to accomplish proof of concept or when comparing multiple technologies. In this instance, an AAP ISCO remedy has already been shown to be a proven technology for the treatment of chlorinated solvents at many sites (two case studies are included in Appendix 1 that document the proof of concept for AAP ISCO and the effectiveness of AAP treatment technology). The critical component of the in-situ test is evaluating the movement of injected remedial fluids in the subsurface and determine the ROI at various locations, which cannot be evaluated in a bench scale test. This field-scale test includes collecting samples to determine the soil oxidant demand (SOD) of soils, a hydraulic test, groundwater sampling, and obtaining an injection permit from the EPA.

3.1 Permits

The appropriate well and injection permits for the installation of the injection wells and injection monitoring points will be acquired from the NYSDEC and/or the United States Environmental Protection Agency (USEPA), as needed.

3.2 Well Installation

The ISCO pilot testing is anticipated to be performed in two locations; one at AOC #1 and one at AOC #2. These pilot test locations will utilize two existing monitoring wells, MW-105 and MW-106, to monitor the ROI at each of the two pilot test locations (the ISCO pilot test locations do not modify the conceptual ISCO injection layout presented in the Decision Document). Pilot injection wells, IW-1 and IW-2, will be installed to a depth of 45 feet below the ground surface (bgs), which is approximately 10 feet into the groundwater table, or two feet into the clay soil zone, whichever is encountered first at each pilot testing location. The injection wells will be constructed with 10 feet of 2-inch diameter, schedule 40 PVC well screen (20-slot), and 35 feet solid riser pipe. Well-graded sand will fill the annular space around the well-screen interval. The annular space above the screened interval of the well will be filled with grout to the surface. Each injection well will be completed at the surface with a stickup access cover and equipped with a lockable compression cap. Additionally, three two-inch diameter observation wells will be installed at distances of 10 feet and 20 feet from each of the injection wells and with the same screen length and total depth as the injection well. See Figure 3 for the layout of the two injection wells and the six observation wells. During this intrusive activity, the Community Air Monitoring Plan (CAMP) will be implemented to avoid short-term impacts. The CAMP is included in Appendix C.

3.3 Pre-Injection Soil Oxidant Demand and Groundwater Sampling

While the drilling equipment is mobilized at the site for the well installation task described above, soil borings will be advanced to collect non-contaminated soil for laboratory testing to evaluate

the soil oxidant demand (SOD). When applying AAP, a portion of the persulfate will react with the oxidizable components of the soil. The SOD is the measurement of how much additional AAP is needed over the contaminant demand on the oxidant. One kilogram (kg) of non-contaminated soil and two liters (L) of non-contaminated water will be collected. Soil borings will be advanced in the northwest portion of the site to generate the needed volume of soil, and water will be collected from monitoring well MW-109 (although PCE concentrations are detectable in MW-109, the PCE concentrations are low and are suitable for this evaluation of the oxidant demand). These samples will be evaluated by Evoniks (formerly Peroxychem) of Tonawanda, NY. The SOD test will measure the consumption of activated persulfate after a 2-day and 7-day exposure period.

In addition to the SOD sampling, core samples will be collected from one of the borings from each injection area for laboratory analysis of volatile organic compounds (VOCs). This data will assist in determining the soil oxidant demand and base buffering capacity for the full-scale treatment.

Finally, baseline groundwater samples will be collected from MW-103, MW-105, MW-106, MW-107, MW-108, MW-109, and MW-110. These aqueous samples will be analyzed for VOCs, metals (arsenic, chromium, iron, calcium, magnesium, and manganese), and anions (chloride, sulfate, nitrate).

3.4 Hydraulic Testing

Following the installation of the two injection wells described above, IW-1 and IW-2, a hydraulic test will be performed to determine the properties of the wells and surrounding formation receiving the injectate. For this hydraulic test, the injectate will be dyed potable water. The goal of the hydraulic test is to determine the rate, pressure and ROI of the injectate into the receiving formation.

The injectate will be pumped at a rate and pressure that can be optimized to maintain flow into the receiving formation and where water levels in the nearby observation points and monitoring wells are monitored for a response to the injectate. Water levels in surrounding wells and observation points will be monitored with an electric water level meter every 15 minutes from the start of the test. The injectate will be dyed, so if water level responses are not measurable, a bailer can be used to obtain a water sample from an observation well and examined for evidence of the dyed injectate. The test will cease after a water level response is recorded in all of the designated observation points for each injection well or after injecting 400 gallons of injectate into an injection well, whichever occurs first. The designated observation points and additional monitoring points where water levels will be recorded during the hydraulic test for IW-1 and IW-2 are as follows:

Injection Well	Designated Observation Points	Additional Monitoring Point
IW-1	IMP-1A, IMP-1B, IMP-1C, and MW-105	MW-103, MW-106 and MW-107
IW-2	IMP-2A, IMP-2B, IMP-2C, and MW-106	IW-1 and MW-107

The volume of injectate will be minimized to that volume needed to record a response at the designated observation points, but not in excess where the injectate causes unnecessary migration of the contaminant mass in the aquifer.

The data obtained from the hydraulic test will be evaluated to determine a project-specific flow rate, pressure and ROI for the ISCO injection event.

3.5 ISCO Injection

The ISCO pilot test is planned to evaluate the delivery and distribution of the sodium persulfate using the injection and monitoring well points described in the section above and incorporating the SOD, VOC data and ROI obtained prior to implementing the ISCO injection pilot test. The following provides the planned injection regimen. This injection regimen may be modified based on the test results of the SOD and hydraulic testing.

The sodium persulfate will be mixed with water and then with an activator (sodium hydroxide – alkaline activation) in the following ratios based on a degradation rate calculated by the provided by Evoniks (formerly Peroxychem):

- It is anticipated that up to approximately 826 pounds of sodium persulfate will be injected at each injection point. This is based on 198 lb. to treat the target constituents of concern (COCs) and 628 lb. to treat the non-target demand associated with the soil oxygen demand (SOD). A total of up to about 1,652 pounds of sodium persulfate will be injected into the target area.
- It is anticipated that approximately 1,250 gallons of water will be injected at each injection point. A total of up to approximately 2,500 gallons of water will be injected into the target area.
- The persulfate will be activated with a 25% alkaline solution of sodium hydroxide (NaOH). To activate the persulfate and meet the demand to neutralize the hydrogen sulfide (HSO₄) and soil buffering, this alkalinity demand is estimated to be 5,000 lb. of NaOH solution.

These volumes are calculated by Evoniks, a leading provider of persulfate material and with years of experience calculating the target and non-target demands. These injection volumes may be modified based on the results of the SOD and hydraulic testing described in sections 3.3 and 3.4.

During the injections, intrinsic parameters (pH, specific conductivity, ORP, DO, and temperature) will be periodically measured in the observation wells and surrounding observation points and monitoring wells.

If favorable results are not obtained from the pilot test, additional injections and/or onsite soil investigations may be proposed.

Fifteen days after the injection event, the existing groundwater monitoring well network will be purged, and aqueous samples collected. The wells will be purged of three volumes of water. Field parameters (pH, temperature, ORP, DO, and specific conductivity) will be monitored during purging.

The groundwater samples will be collected using a dedicated bailer into pre-cleaned, laboratory-supplied bottleware and submitted for laboratory analysis of volatile organic compounds (VOCs) and critical injection parameters, including metals (arsenic, chromium, iron, calcium, magnesium, and manganese), anions (chloride, sulfate, nitrate), alkalinity and hardness. The groundwater samples will be analyzed on a standard 10-business-day turnaround time. Liberty proposes to perform two rounds of groundwater characterization sampling to evaluate the pilot test. The initial round will be performed 15 days following the injection event, and the second round will be performed approximately 15 days later. Development water, purge water, and soil cuttings from the injection well installation will be staged on-site, pending the receipt of analytical results.

4. SVE PILOT TEST

Liberty will perform a pilot test at the Site to determine the feasibility of SVE for the removal of PCE from soil and soil gas. This will also include collecting vacuum measurements and effluent air samples to determine the ROI and contaminant concentrations in extracted air.

4.1 Permits

No permits will be necessary for the completion of this pilot test.

4.2 Well Installation

The SVE pilot test is anticipated to be performed in two locations in proximity to the perimeter of the site. The pilot test locations were selected to provide a ROI (the SVE pilot test locations does not modify the conceptual SVE injection layout presented in the Decision Document). Pilot extraction wells (SVE-1 and SVE-2) will be installed to a depth of 30 feet below the ground surface (bgs), which is approximately 5 feet above the groundwater table at each pilot testing location. The extraction wells will be constructed with 5 feet of 2-inch diameter, schedule 40 PVC well screen (20-slot), and 25 feet of solid riser pipe extending to the ground surface. Well-graded sand will fill the annular space around the well screen interval. The annular space above the screened interval of the extraction well will be filled with grout to the surface. This screened interval will be below the base of the planned soil excavation. Each extraction well will be completed at the surface with a stickup access cover and equipped with a lockable compression cap. The two extraction wells will be used to draw air from the subsurface, while the vacuum monitoring points and nearby monitoring wells will determine the vacuum radius of influence applied when a fan is operated at the extraction wells.

Three vacuum monitoring points will be constructed at each SVE pilot test location using 5 feet of 1-inch diameter PVC screen (20-slot) and 25 feet of solid riser material. Well-graded sand will fill the annular space around the well screen interval. The annular space above the screened interval of the vacuum monitoring point will be filled with grout to the surface. Each vacuum monitoring point will extend approximately two feet above the ground surface. Since these are temporary points, they will not be completed with manholes or steel stick-up assemblies. Vacuum monitoring points will be positioned at 10, 20, and 35 feet from the extraction pilot wells and screened over the same interval as the extraction pilot wells. Soil cuttings from the extraction well installation will be staged on-site, pending the receipt of analytical results. See Figure 3 for the layout of the two extraction wells and the four extraction monitoring points. During this intrusive activity, the Community Air Monitoring Plan (CAMP) will be implemented to avoid short-term impacts. The CAMP is included in Appendix C.

4.3 SVE Test

A positive displacement blower will be installed at the head of the pilot test wells, SVE-1, and SVE-2, to perform the test. The specification for a typical SVE pilot system consists of the following:

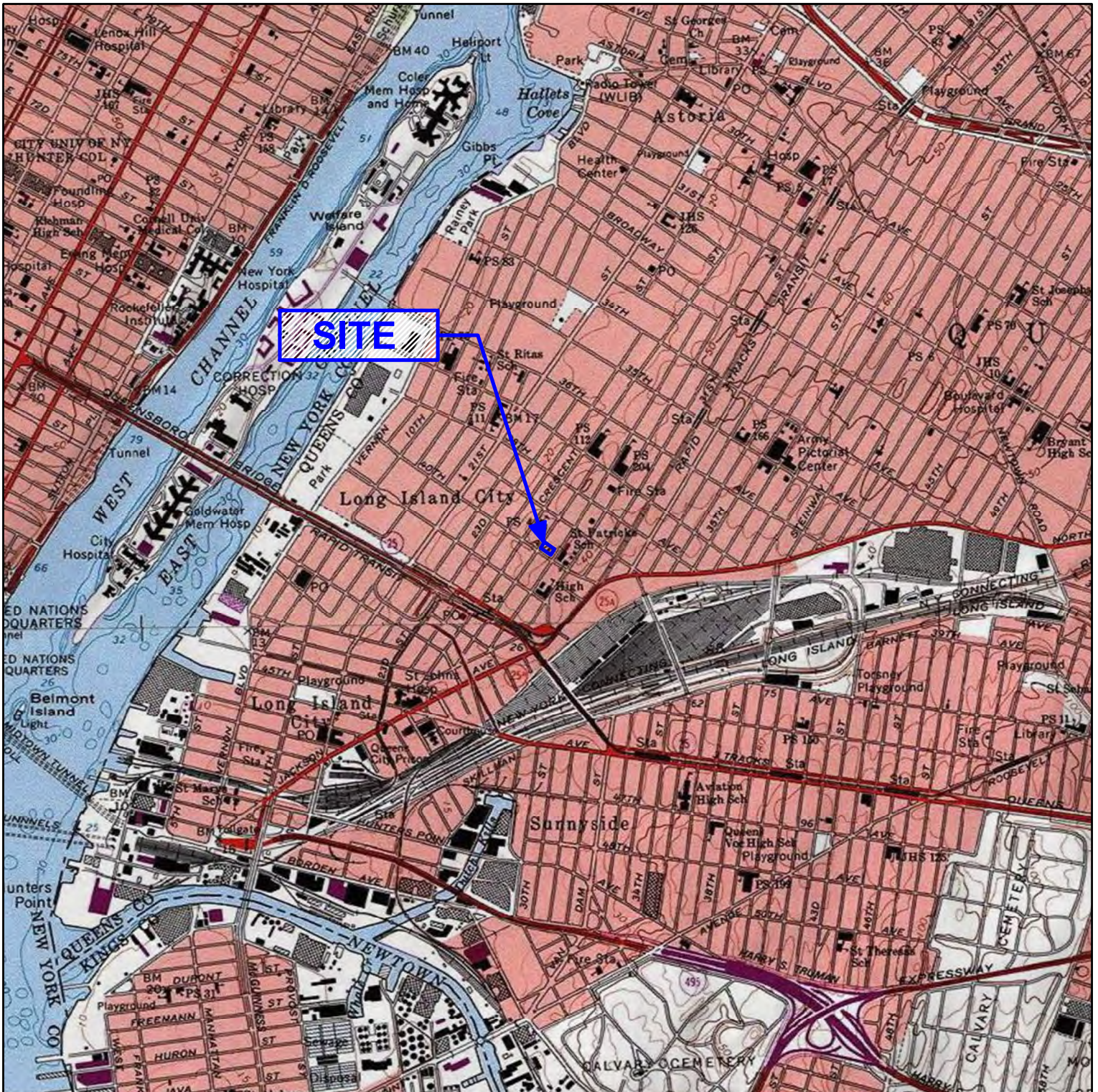
- Siemens (or similar) 2-stage regenerative blower
 - Rated for a minimum of 180 ACFM @ 2" Hg

- 8.5 HP TEFC Motor
- Moisture separator tank with auto-drain system to a 100-gallon holding tank
- Portable generator
- (2) 55-gallon drums containing vapor phase granular activated carbon (GAC)

The SVE pilot test will be performed as a three-step test with vacuum intervals of approximately 20, 40 and 60 inches of water column (in.H₂O). Each vacuum interval test will include monitoring of vacuums at 15-minute intervals, and conclude when consecutive readings of vacuum influence at the monitoring points show minimal fluctuation (three measurements within 5% of the prior measurement). A constant-rate test at 60 in. H₂O will be performed after the conclusion of the third step test. Vacuum monitoring will be performed hourly and will conclude after three consecutive measurements show minimal fluctuation (within 5%). All vacuum monitoring points will have a vacuum gauge attached. The vacuum will be observed throughout the test to determine the ROI achieved by the blower. Vapor samples will be collected via Tedlar bags from the blower exhaust at the start of the first step test and end of the constant rate test to analyze VOCs and determine the SVE system's effectiveness in removing contaminant mass.

5. RAWP ADDENDUM

A Remedial Action Work Plan (RAWP) Addendum will be prepared for submission to DEC after completing the pilot tests. The report will provide descriptions of the pilot test methods, an evaluation of the test results, and plans for full-scale implementation of remedial technologies at the Site.



SOURCE: USA TOPO MAPS - COPYRIGHT © 2013 NATIONAL GEOGRAPHIC SOCIETY, I-CUBED. CENTRAL PARK (SITE - 1995)) AND BROOKLYN (1995) NEW YORK 7.5-MINUTE QUADRANGLES.

SCALE: 1" = 2,000'

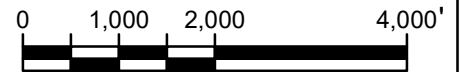


Figure 1 - Site Location Map

27-09 40th Avenue
Long Island City, Queens, New York

600 Third Avenue, Second Floor
New York, NY 10016
Phone: 800-305-6019
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PROJECT NO.: 220192

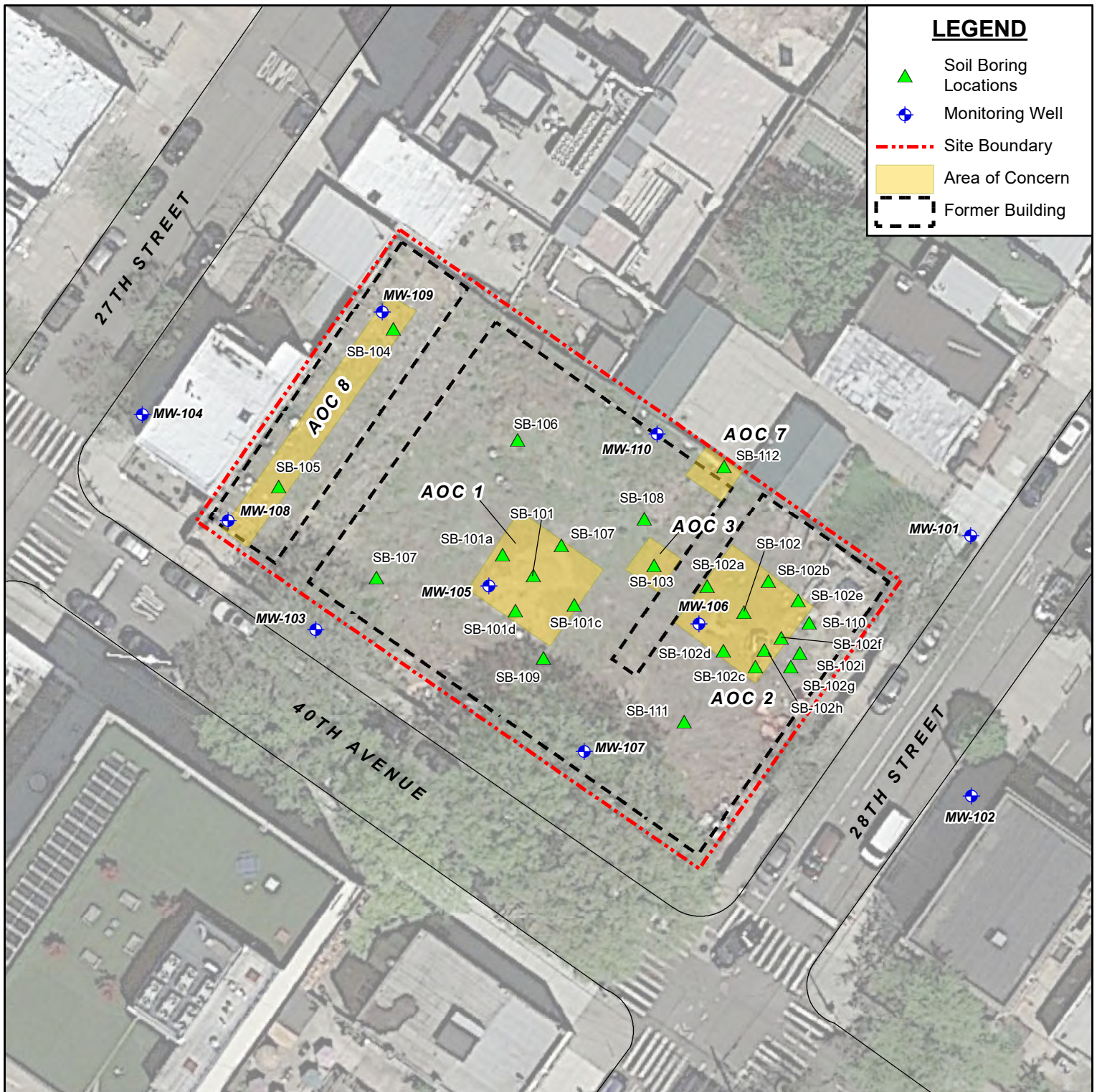
REV: 0

PREPARED BY: JRY

DATE: SEPTEMBER 6, 2022

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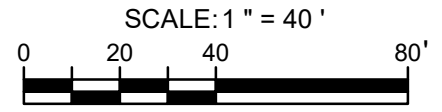
APPROVED BY: CNH



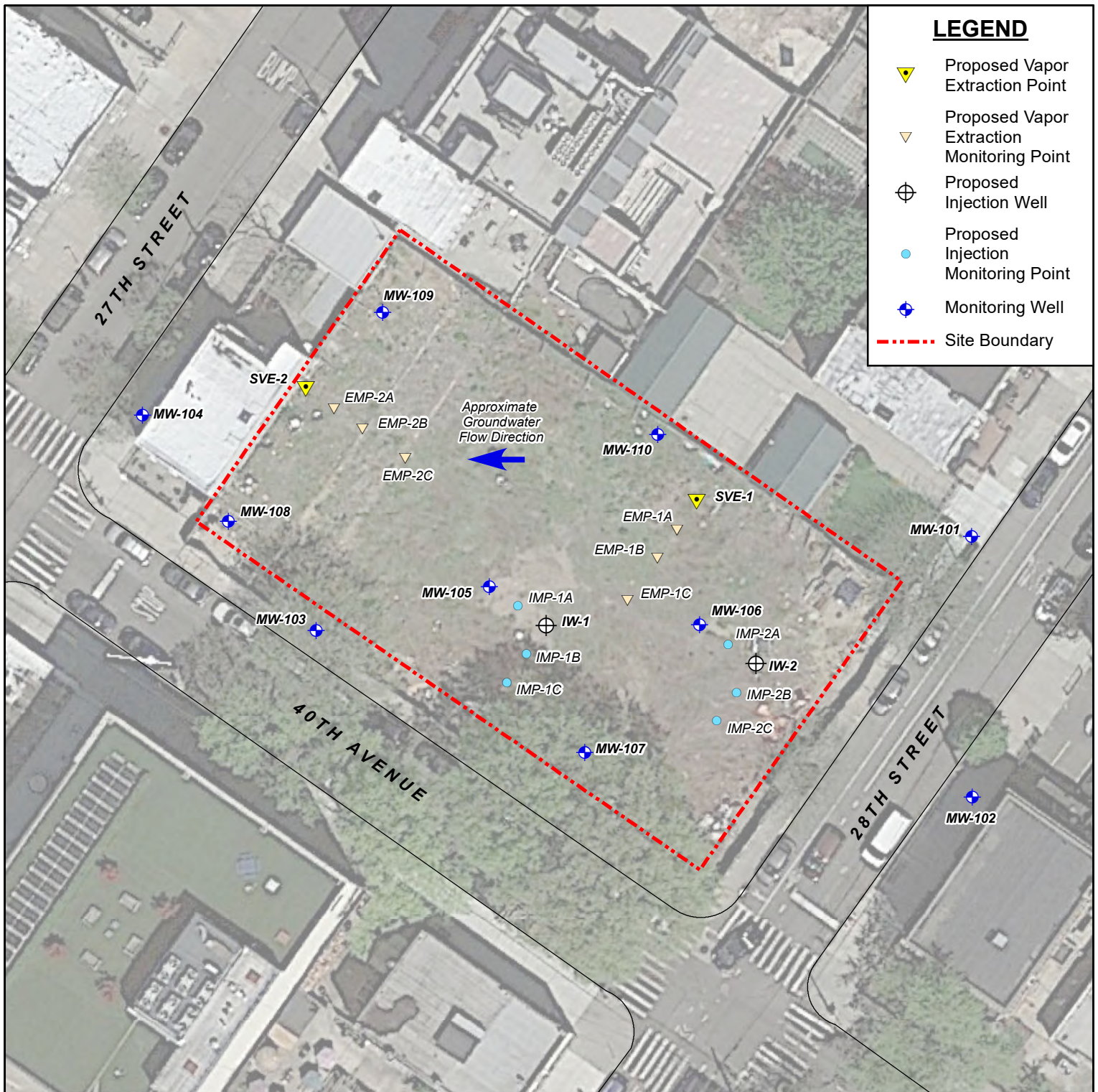
LEGEND

- Soil Boring Locations
- Monitoring Well
- Site Boundary
- Area of Concern
- Former Building

NOTE: THIS DRAWING INTENDED FOR ILLUSTRATIVE PURPOSES ONLY, AS PART OF A SITE CHARACTERIZATION.
 NOT TO BE USED AS A BASIS FOR ENGINEERING OR DESIGN
IMAGE SOURCE: GOOGLE EARTH. PHOTO DATE: APRIL 2022.



	<p>Liberty Environmental, Inc.</p>	<p>Figure 2 - Soil Boring and Well Locations</p>		
		<p>27-09 40th Avenue Long Island City, Queens, New York</p>		
<p>600 Third Avenue, Second Floor New York, NY 10016 Phone: 800-305-6019 www.libertyenviro.com</p>	PROJECT NO.: 220192	REV: 0	PREPARED BY: JRY	
	DATE: SEPTEMBER 6, 2022	SCALE: 1" = 40'	APPROVED BY: CNH	

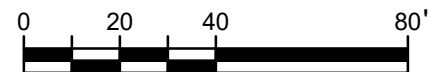


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NOT TO BE USED AS A BASIS FOR ENGINEERING OR DESIGN

IMAGE SOURCE: GOOGLE EARTH. PHOTO DATE: APRIL 2022.

SCALE: 1" = 40'



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Figure 3 - Pilot Test Work Plan

27-09 40th Avenue
 Borough of Queens, City of New York, New York

PROJECT NO.: 220192

REV: 3

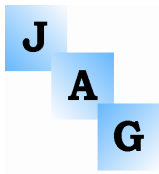
PREPARED BY: JRY

DATE: OCTOBER 12, 2022

SCALE: 1" = 40'

APPROVED BY: CNH

APPENDIX 1
AAP ISCO Case Studies



Consulting Group, Inc.

CASE STUDY: TREATMENT OF SHALLOW SOIL CONTAMINATION USING HIGH pH ACTIVATION OF SODIUM PERSULFATE INDUSTRIAL SITE, ILLINOIS

INTRODUCTION

JAG Consulting Group recently implemented an in-situ chemical oxidation (ISCO) application at an active industrial site in Illinois to treat the shallow soil contaminated with PCE, TCE, methylene chloride, toluene, and xylenes.



Use of sodium hydroxide (caustic) provided the high pH activation of sodium persulfate. High pH activation was selected as the optimal ISCO technology because of its treatment effectiveness on both chlorinated and petroleum hydrocarbons, the rapid cleanup timeframe, and its relative low cost application.

DESIGN OF FIELD INJECTION PARAMETERS

Prior to the field injections, JAG Consulting performed a soil buffering test in the laboratory in order to determine the amount of sodium hydroxide needed to raise the pH of the soil to above 10.5 pH units and maintain it for 2 weeks.

Because chemical oxidation requires an aqueous media, an infiltration gallery was constructed to slowly percolate water into the shallow soil (1 to 15 ft) to create saturated soil conditions. The full scale field injection consisted of 12 injection wells located in two Treatment Areas. Due to the low permeability silts and clays, each injection well had an estimated radius of influence of 10 feet.

Approximately 4,700 gallons of sodium hydroxide (25%) and 11,500 pounds of sodium persulfate were injected into the wells.

FIELD AND ANALYTICAL RESULTS

The following results were achieved in this ISCO project:

- Analytical sampling results indicate that PCE, TCE, methylene chloride, xylenes, and toluene levels were generally reduced from 88% to 99% within 6 months following treatment.
- The ISCO injections attained the soil cleanup criteria established by the State of Illinois EPA and “No Further Action” has been granted for Area #2. A second injection is planned for Area #1.

Boring No.	Constituent	Initial Concentration (ug/kg)	After ISCO Concentration (ug/kg)	Percent Reduction
SB-17	PCE	160,000	180	99.9%
	TCE	5,900	10	99.8%
	Methylene Chloride	360	1	99.7%
	Xylenes	1,200	82	93.2%
	Toluene	52,000	1,400	97.3%
SB-20	PCE	220,000	1,900	99.1%
	TCE	4,500	280	93.8%
	Methylene Chloride	620	10	98.4%
	Xylenes	1,900	10	99.5%
	Toluene	1,900	10	99.5%
SB-8	PCE	1,700,000	190,000	88.8%
	TCE	16,000	4,200	73.8%
	Methylene Chloride	5,900	10	99.8%
	Xylenes	220,000	7,000	96.8%
	Toluene	200,000	22,000	89.0%

CONTACT INFORMATION

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EX-SITU REMEDIATION OF PCE AND TCE IN SOILS USING A PROPRIETARY, PERSULFATE-BASED OXIDATION TECHNOLOGY

Peter J. Palko, P.E., CHMM, Chuck Elmendorf, Kevin D. Dyson, EIT (**Panther** Technologies), Medford, NJ, USA; Frank Sessa (FMC Corporation), Philadelphia, PA, USA



Soils and groundwater at the subject site had become contaminated with levels of perchloroethylene (PCE) and trichloroethylene (TCE) at concentrations in excess of 20,000 mg/kg and 100 mg/l, respectively, significantly above risk-based remedial standards set by the New Jersey Department of Environmental Protection (NJDEP). Because the PCE and TCE in soil presented an ongoing source of groundwater contamination, soil remediation comprising source area removal was a top remedial priority at the site. Groundwater studies and an interim groundwater recovery/treatment system are ongoing at the site.

The initial unsaturated soil remedy selected for this site included in-situ, enhanced anaerobic reductive dehalogenation (ERD). However, due to heterogeneous soils, which included a significant amount of clay and a depth to groundwater greater than 35 feet below grade, this technology was challenged by the NJDEP. **Panther** Technologies, Inc. (**Panther**) proposed a fast track delineation of site soils followed by an onsite ex-situ chemical oxidation approach including treatment cell construction (including a 100,000 cubic foot negative pressure structure), wetlands removal, steel sheet piling, water storage and treatment, soil excavation and treatment, vapor control and treatment, perimeter and work zone air monitoring, soil backfilling, and final wetlands restoration. The ex-situ chemical oxidation technology implemented by **Panther** was an aggressive approach specifically designed to assure mass removal of PCE and TCE to below site-specific treatment standards and allow re-use of the soil on-site in an expedited time frame due to an impending real estate transaction.

With chemistry support from FMC Corporation, **Panther** implemented a chemically catalyzed persulfate technology to remediate 40,000 tons of contaminated soils containing approximately 32,000 lbs of CVOCs at the site. After extensive bench-scale testing of different oxidation technologies including other forms of catalyzed persulfate (heat and iron) as well as sodium permanganate, a new combination of oxidants (FMC patent pending) was implemented at the site to overcome the challenges represented in a full-scale field application where ambient temperatures in the Northeast drop to below 0° F during the winter. Following excavation, chemical application and mixing, an extensive post-treatment soil sampling quality assurance plan was implemented to ensure soils met the re-use criteria of less than 5 mg/kg prior to backfilling.

Two major benefits of applying chemically catalyzed persulfate included the elimination of PCE and TCE in soil (preventing continued mass flux into groundwater) and on-site re-use of the treated soils as opposed to costly offsite disposal as hazardous waste. This remedy saved our client over \$6,000,000 in off-site disposal costs. The treatment of 40,000 tons of soils from a site wide average of greater than 1,000 mg/kg with highs in excess of 20,000 mg/kg to less than 5 mg/kg in less than a 72-hour period per 1000 ton batch represented the largest application of chemically catalyzed persulfate oxidation ever performed and solidifies this technology as an innovative and cost-effective approach to remediation of recalcitrant compounds in soil and groundwater. The design of this technology can (and in most cases must) be customized to meet the specific characteristics of a given site to assure successful application.

APPENDIX 2
SDS

MATERIAL SAFETY DATA SHEET

Klozür™



MSDS Ref. No.: 7775-27-1-12

Date Approved: 02/22/2005

Revision No.: 1

This document has been prepared to meet the requirements of the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200; the Canada's Workplace Hazardous Materials Information System (WHMIS) and, the EC Directive, 2001/58/EC.

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Klozür™

SYNONYMS: Sodium Persulfate, Sodium Peroxydisulfate; Disodium Peroxydisulfate

GENERAL USE: In situ and ex situ chemical oxidation of contaminants and compounds of concern for environmental remediation applications.

MANUFACTURER

FMC CORPORATION
Active Oxidants Division
1735 Market Street
Philadelphia, PA 19103
(215) 299-6000 (General Information)

EMERGENCY TELEPHONE NUMBERS

(800) 424-9300 (CHEMTREC - U.S.)
(303) 595-9048 (Medical - Call Collect)

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

- White, odorless, crystals
- Oxidizer.
- Decomposes in storage under conditions of moisture (water/water vapor) and/or excessive heat causing release of oxides of sulfur and oxygen that supports combustion. Decomposition could form a high temperature melt. See Section 10 ("Stability and Reactivity").

POTENTIAL HEALTH EFFECTS: Airborne persulfate dust may be irritating to eyes, nose, lungs, throat and skin upon contact. Exposure to high levels of persulfate dust may cause difficulty in breathing in sensitive persons.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	CAS#	Wt. %	EC No.	EC Class
Sodium Persulfate	7775-27-1	>99	231-892-1	Not classified as hazardous

4. FIRST AID MEASURES

EYES: Flush with plenty of water. Get medical attention if irritation occurs and persists.

SKIN: Wash with plenty of soap and water. Get medical attention if irritation occurs and persists.

INGESTION: Rinse mouth with water. Dilute by giving 1 or 2 glasses of water. Do not induce vomiting. Never give anything by mouth to an unconscious person. See a medical doctor immediately.

INHALATION: Remove to fresh air. If breathing difficulty or discomfort occurs and persists, contact a medical doctor.

NOTES TO MEDICAL DOCTOR: This product has low oral toxicity and is not irritating to the eyes and skin. Flooding of exposed areas with water is suggested, but gastric lavage or emesis induction for ingestions must consider possible aggravation of esophageal injury and the expected absence of system effects. Treatment is controlled removal of exposure followed by symptomatic and supportive care.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Deluge with water.

FIRE / EXPLOSION HAZARDS: Product is non-combustible. On decomposition releases oxygen which may intensify fire. Presence of water accelerates decomposition.

FIRE FIGHTING PROCEDURES: Do not use carbon dioxide or other gas filled fire extinguishers; they will have no effect on decomposing persulfates. Wear full protective clothing and self-contained breathing apparatus.

FLAMMABLE LIMITS: Non-combustible

SENSITIVITY TO IMPACT: No data available

SENSITIVITY TO STATIC DISCHARGE: Not available

6. ACCIDENTAL RELEASE MEASURES

RELEASE NOTES: Spilled material should be collected and put in approved DOT container and isolated for disposal. Isolated material should be monitored for signs of decomposition (fuming/smoking). If spilled material is wet, dissolve with large quantity of water and dispose as a hazardous waste. All disposals should be carried out according to regulatory agencies procedures.

7. HANDLING AND STORAGE

HANDLING: Use adequate ventilation when transferring product from bags or drums. Wear respiratory protection if ventilation is inadequate or not available. Use eye and skin protection. Use clean plastic or stainless steel scoops only.

STORAGE: Store (unopened) in a cool, clean, dry place away from point sources of heat, e.g. radiant heaters or steam pipes. Use first in, first out storage system. Avoid contamination of opened product. In case of fire or decomposition (fuming/smoking) deluge with plenty of water to control decomposition. For storage, refer to NFPA Bulletin 430 on storage of liquid and solid oxidizing materials.

COMMENTS: VENTILATION: Provide mechanical general and/or local exhaust ventilation to prevent release of dust into work environment. Spills should be collected into suitable containers to prevent dispersion into the air.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMITS

Chemical Name	ACGIH	OSHA	Supplier
Sodium Persulfate	0.1 mg/m ³ (TWA)		

ENGINEERING CONTROLS: Provide mechanical local general room ventilation to prevent release of dust into the work environment. Remove contaminated clothing immediately and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: Use cup type chemical goggles. Full face shield may be used.

RESPIRATORY: Use approved dust respirator when airborne dust is expected.

PROTECTIVE CLOTHING: Normal work clothes. Rubber or neoprene footwear.

GLOVES: Rubber or neoprene gloves. Thoroughly wash the outside of gloves with soap and water prior to removal. Inspect regularly for leaks.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR:	None
APPEARANCE:	White crystals
AUTOIGNITION TEMPERATURE:	Not applicable. No evidence of combustion up to 800°C. Decomposition will occur upon heating.
BOILING POINT:	Not applicable
COEFFICIENT OF OIL / WATER:	Not applicable
DENSITY / WEIGHT PER VOLUME:	Not available
EVAPORATION RATE:	Not applicable (Butyl Acetate = 1)
FLASH POINT:	Non-combustible
MELTING POINT:	Decomposes
ODOR THRESHOLD:	Not applicable
OXIDIZING PROPERTIES:	Oxidizer
PERCENT VOLATILE:	Not applicable
pH:	typically 5.0 - 7.0 @ 25 °C (1% solution)
SOLUBILITY IN WATER:	73 % @ 25 °C (by wt.)
SPECIFIC GRAVITY:	2.6 (H ₂ O=1)
VAPOR DENSITY:	Not applicable (Air = 1)
VAPOR PRESSURE:	Not applicable

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID:	Heat, moisture and contamination.
STABILITY:	Stable (becomes unstable in presence of heat, moisture and/or contamination).
POLYMERIZATION:	Will not occur
INCOMPATIBLE MATERIALS:	Acids, alkalis, halides (fluorides, chlorides, bromides and iodides), combustible materials, most metals and heavy metals, oxidizable materials, other oxidizers, reducing agents, cleaners, and organic or carbon containing compounds. Contact

with incompatible materials can result in a material decomposition or other uncontrolled reactions.

HAZARDOUS DECOMPOSITION PRODUCTS: Oxygen that supports combustion and oxides of sulfur.

COMMENTS: PRECAUTIONARY STATEMENT: Pumping and transport of Klozür persulfate requires appropriate precautions and design considerations for pressure and thermal relief.

Decomposing persulfates will evolve large volumes of gas and/or vapor, can accelerate exponentially with heat generation, and create significant and hazardous pressures if contained and not properly controlled or mitigated.

Use with alcohols in the presence of water has been demonstrated to generate conditions that require rigorous adherence to process safety methods and standards to prevent escalation to an uncontrolled reaction.

11. TOXICOLOGICAL INFORMATION

EYE EFFECTS: Non-irritating (rabbit) [FMC Study Number: ICG/T-79.029]

SKIN EFFECTS: Non-irritating (rabbit) [FMC Study Number: ICG/T-79.029]

DERMAL LD₅₀: > 10 g/kg [FMC Study Number: ICG/T-79.029]

ORAL LD₅₀: 895 mg/kg (rat) [FMC Study Number: ICG/T-79.029]

INHALATION LC₅₀: 5.1 mg/l (rat) [FMC I95-2017]

SENSITIZATION: May be sensitizing to allergic persons. [FMC Study Number: ICG/T-79.029]

TARGET ORGANS: Eyes, skin, respiratory passages

ACUTE EFFECTS FROM OVEREXPOSURE: Dust may be harmful and irritating. May be harmful if swallowed.

CHRONIC EFFECTS FROM OVEREXPOSURE: Sensitive persons may develop dermatitis and asthma [Respiration 38:144, 1979]. Groups of male and female rats were fed 0, 300 or 3000 ppm sodium persulfate in the diet for 13 weeks, followed by 5000 ppm for 5 weeks. Microscopic examination of tissues revealed some injury to the gastrointestinal tract at the high dose (3000 ppm) only. This effect is not unexpected for an oxidizer at high concentrations. [Ref. FMC I90-1151, Toxicologist 1:149, 1981].

CARCINOGENICITY:

NTP:	Not listed
IARC:	Not listed
OSHA:	Not listed
OTHER:	ACGIH: Not listed

12. ECOLOGICAL INFORMATION**ECOTOXICOLOGICAL INFORMATION:**

Bluegill sunfish, 96-hour LC₅₀ = 771 mg/L [FMC Study I92-1250]
Rainbow trout, 96-hour LC₅₀ = 163 mg/L [FMC Study I92-1251]
Daphnia, 48-hour LC₅₀ = 133 mg/L [FMC Study I92-1252]
Grass shrimp, 96-hour LC₅₀ = 519 mg/L [FMC Study I92-1253]

CHEMICAL FATE INFORMATION: Biodegradability does not apply to inorganic substances.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Dispose as a hazardous waste in accordance with local, state and federal regulatory agencies.

14. TRANSPORT INFORMATION**U.S. DEPARTMENT OF TRANSPORTATION (DOT)**

PROPER SHIPPING NAME:	Sodium Persulfate
PRIMARY HAZARD CLASS / DIVISION:	5.1 (Oxidizer)
UN/NA NUMBER:	UN 1505
PACKING GROUP:	III
LABEL(S):	5.1 (Oxidizer)
PLACARD(S):	5.1 (Oxidizer)
MARKING(S):	Sodium Persulfate, UN 1505
ADDITIONAL INFORMATION:	Hazardous Substance/RQ: Not applicable

49 STCC Number: 4918733

This material is shipped in 225 lb. fiber drums, 55 lb. poly bags and 1000 - 2200 lb. IBC's (supersacks).

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

PROPER SHIPPING NAME: Sodium Persulfate

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) / INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

PROPER SHIPPING NAME: Sodium Persulfate

OTHER INFORMATION:

Protect from physical damage. Do not store near acids, moisture or heat.

15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355, APPENDIX A):
Not applicable

SECTION 311 HAZARD CATEGORIES (40 CFR 370):

Fire Hazard, Immediate (Acute) Health Hazard

SECTION 312 THRESHOLD PLANNING QUANTITY (40 CFR 370):

The Threshold Planning Quantity (TPQ) for this product, if treated as a mixture, is 10,000 lbs; however, this product contains the following ingredients with a TPQ of less than 10,000 lbs.:
None

SECTION 313 REPORTABLE INGREDIENTS (40 CFR 372):

Not listed

CERCLA (COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT)

CERCLA DESIGNATION & REPORTABLE QUANTITIES (RQ) (40 CFR 302.4):

Unlisted, RQ = 100 lbs., Ignitability

TSCA (TOXIC SUBSTANCE CONTROL ACT)

TSCA INVENTORY STATUS (40 CFR 710):

Listed

**RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
RCRA IDENTIFICATION OF HAZARDOUS WASTE (40 CFR 261):**
Waste Number: D001

CANADA

WHMIS (WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM):

Product Identification Number: 1505
Hazard Classification / Division: Class C (Oxidizer), Class D, Div. 2, Subdiv. B. (Toxic)
Ingredient Disclosure List: Listed

INTERNATIONAL LISTINGS

Sodium persulfate:
Australia (AICS): Listed
China: Listed
Japan (ENCS): (1)-1131
Korea: KE-12369
Philippines (PICCS): Listed

HAZARD, RISK AND SAFETY PHRASE DESCRIPTIONS:

EC Symbols: (Not classified as hazardous)
EC Risk Phrases: (Not classified as hazardous)
EC Safety Phrases: (Not classified as hazardous)

16. OTHER INFORMATION

HMIS

Health	1
Flammability	0
Physical Hazard	1
Personal Protection (PPE)	J

Protection = J (Safety goggles, gloves, apron & combination dust & vapor respirator)

HMIS = Hazardous Materials Identification System

Degree of Hazard Code:
4 = Severe

3 = Serious
2 = Moderate
1 = Slight
0 = Minimal

NFPA

Health	1
Flammability	0
Reactivity	1
Special	OX

SPECIAL = OX (Oxidizer)

NFPA = National Fire Protection Association

Degree of Hazard Code:

4 = Extreme
3 = High
2 = Moderate
1 = Slight
0 = Insignificant

REVISION SUMMARY:

New MSDS

Klozür and FMC Logo - FMC Trademarks

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APPENDIX 3
CAMP



COMMUNITY AIR MONITORING PLAN

**27-09 40th AVENUE SITE
LONG ISLAND CITY, NEW YORK 11101
BROWNFIELDS ID: C241241-03-20**

**APRIL 22, 2021
LAUREL PROJECT # 19-410**

PREPARED FOR:

**LAW OFFICES OF THEODORE W. FIRETOG
111 THOMAS POWELL BOULEVARD
FARMINGDALE, NEW YORK, 11735-2251
On behalf its client: 40th Ave Dutch Kills Realty LLC**

PREPARED BY:

**LAUREL ENVIRONMENTAL GEOSCIENCES, DPC.
53 WEST HILLS ROAD, SUITE 1 HUNTINGTON
STATION, NEW YORK**

COMMUNITY AIR MONITORING PLAN FOR USE DURING INVESTIGATIVE AND REMEDIAL ACTIONS

Due to the nature of the identified contaminants at the property referred to as 27-09 40th Avenue, Long Island City, New York (“Site”), real-time air monitoring for volatile organic compounds (“VOCs”) and/or particulate levels at the perimeter of the work area is necessary. The scope of work for the Site will require VOC and particulate monitoring. Due to the proximity of the Site to residential properties, continuous air monitoring will be completed during all ground intrusive activities. For this program, ground intrusive activities include, but are not limited to, excavation, product recovery, manipulation of soil piles, extraction of sheet piling, etcetera. Continuous monitoring within the work zone is a requirement given the Site conditions.

Periodic monitoring for VOCs will be completed during all non-ground intrusive activities, such as purging and sample collection from groundwater monitoring wells. “Periodic” monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while conducting non-ground intrusive activities, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. All readings will be submitted for State (NYSDEC and NYSDOH) personnel to review on a weekly basis or as soon as possible if/when an exceedance occurs. All data from the CAMP will be included in the Remedial Action Report (“RAR”).

VOC Monitoring, Response Levels, and Actions

VOCs will be monitored at the at the down-wind perimeter of the work zone on a continuous basis and within the work zone during ground intrusive activities. The monitoring work will be performed using equipment appropriate to measure the types of contaminants known or suspected to be present (e.g. photoionization devices (“PIDs”) and particulate monitoring stations). As applicable, the equipment will be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below. Prior to work beginning for the day, the equipment will be setup and allow to run for a 15-minute period to allow for background readings to be recorded.

- If the ambient air concentration of total organic vapors at the down-wind perimeter or within the work zone exceeds 5 parts per million (“ppm”) above background for the 15-minute average, work activities will be temporarily halted and monitoring

continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.

- If total organic vapor levels at the down-wind perimeter or within the work zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will cease, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After which, work activities will resume provided that the total organic vapor level 200 feet downwind of the work zone or half the distance to the nearest potential receptor or residential structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.
- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

All 15-minute readings will be recorded and be available for State (NYSDEC and/or NYSDOH) personnel to review. Instantaneous readings used for decision purposes, if any, will also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored continuously at the down-wind perimeter of the work zone or within the work zone at particulate monitoring stations. The particulate monitoring will be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (“PM-10”) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment will be fitted with an audible alarm or modem with notification to email/text to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during all work activities.

- If the PM-10 particulate level at the down wind perimeter is 150 micrograms per cubic meter (“mcg/m³”) greater than background for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that the down-wind perimeter PM-10 particulate levels do not exceed 150 mcg/m³ above the background level and provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, PM-10 particulate levels at the down-wind perimeter of the work zone are greater than 150 mcg/m³ above the background level, work will be stopped and a re-evaluation of activities initiated. Work will resume provided that dust suppression measures and other controls are successful in reducing the PM-10 particulate concentration to within 150 mcg/m³ of the background level and in preventing visible dust migration.

All 15-minute readings will be recorded and be available for State (NYSDEC and/or NYSDOH) personnel to review. Instantaneous readings used for decision purposes, if any, will also be recorded.

VOC and Particulate Monitoring Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures

When work areas are within 20 feet of potentially exposed populations or occupied structures, the continuous monitoring locations for VOCs and particulates must reflect the nearest potentially exposed individuals and the location of ventilation system intakes for nearby structures. The use of engineering controls such as vapor/dust barriers, temporary negative-pressure enclosures, or special ventilation devices will be considered to prevent exposures related to the work activities and to control dust and odors.

- If total VOC concentrations opposite the walls of occupied structures or next to intake vents exceed 1 ppm, monitoring should occur within the occupied structure(s). Background readings in the occupied spaces must be taken prior to commencement of the planned work. Any unusual background readings should be discussed with NYSDOH prior to commencement of the work.
- If total particulate concentrations opposite the walls of occupied structures or next to intake vents exceed 150 mcg/m³, work activities should be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 mcg/m³ or less at the monitoring point.