11-28 31ST DRIVE

QUEENS, NEW YORK

Remedial Action Work Plan

NYSDEC BCP Number: C241159

Prepared for:

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SEPTEMBER 2016

CERTIFICATIONS

I, Ariel Czemerinski, certify that I am currently a NYS registered professional engineer and that this Remedial Action Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

I certify that all information and statements in this certification are true. I understand that a false statement made herein is punishable as Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

ARIEL CZEMERINSKI
076508

076508
NYS Professional Engineer #

9/2/216
Date

Signature

It is a violation of Article 145 of New York State Education Law for any person to alter this document in any way without the express written verification of adoption by any New York State licensed engineer in accordance with Section 7209(2), Article 145, New York State Education Law.

REMEDIAL ACTION WORK PLAN

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ACRONYMS

Acronym	Definition
AOC	Area of Concern
CAMP	Community Air Monitoring Plan
C/D	Construction/Demolition
COC	Certificate of Completion
CQAP	Construction Quality Assurance Plan
CSOP	Contractors Site Operation Plan
DCR	Declaration of Covenants and Restrictions
ECs/ICs	Engineering and Institutional Controls
HASP	Health and Safety Plan
IRM	Interim Remedial Measure
BCA	Brownfield Cleanup Agreement
MNA	Monitored Natural Attenuation
NOC	Notice of Completion
NYC BCP	New York City Brownfield Cleanup Program
NYC DEP	New York City Department of Environmental Protection
NYC DOHMH	New York State Department of Health and Mental Hygiene
NYCRR	New York Codes Rules and Regulations
NYC OER	New York City Office of Environmental Remediation
NYS DEC	New York State Department of Environmental Conservation
NYS DEC DER	New York State Department of Environmental Conservation Division of Environmental Remediation
NYS DOH	New York State Department of Health
NYS DOT	New York State Department of Transportation
ORC	Oxygen-Release Compound
OSHA	United States Occupational Health and Safety Administration
PAH	Poly Aromatic Hydrocarbons
PCE	Tetrachloroethylene
PE	Professional Engineer
PID	Photo Ionization Detector

Acronym	Definition
QEP	Qualified Environmental Professional
QHHEA	Qualitative Human Health Exposure Assessment
RAOs	Remedial Action Objectives
RAR	Remedial Action Report
RAWP	Remedial Action Work Plan or Plan
RCA	Recycled Concrete Aggregate
RD	Remedial Design
RI	Remedial Investigation
RMZ	Residual Management Zone
SCOs	Soil Cleanup Objectives
SCG	Standards, Criteria and Guidance
SMP	Site Management Plan
SPDES	State Pollutant Discharge Elimination System
SVOC	Semi-Volatile Organic Compound
TCE	Trichloroethylene
USGS	United States Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

Site Description/Physical Setting/Site History

Mr. George Man filed an application to enter into the Brownfield Cleanup Program (BCP) Agreement with the New York State Department of Environmental Conservation (NYSDEC) as a volunteer. A Site number C241159 was issued to this BCP project.

The Site consists of Lot 22 located at the Block 502 on the southwest side of 31 Drive, between Vernon Boulevard to the northwest and 12 Street to the southeast in the Long Island City section of the borough of Queens, NY. The Site location map is provided as Figure 1.

The Site is approximately 2,416.40 square feet (0.055 acres) in area and is currently developed with a 1-story building. The Site is bounded by 31st Drive to the north-northeast, a vacant land and a 1-story manufacturing building to the south-southwest, a 1-story cabinet manufacturing facility to the east-southeast and a vacant 1-story warehouse to the west-northwest.

The Site was historically utilized as an auto repair shop between 1934 and 1936, a machine shop between 1945 and 1970 and commercial facility between 1977 and 2006. Until most recently, the site was utilized as a manufacturing facility of wood cabinets and then became vacant during the last quarter of 2012.

The ground surface at the Site consists of a concrete slab. The topography of the Site is slightly declined toward the southwest. The topography of the Site vicinity is generally level. Access to the Site is via 31st Drive to the northeast and is currently secured by a roll up gates.

Summary of the Remedial Investigation

A remedial investigation was performed and the results are documented in companion documents called “Remedial Investigation Report” (RIR) dated January 2014 and “Supplemental RIR” dated March 2015. These remedial investigations focused on the following areas of concern for this Site:

1. Presence of E-designation for Hazardous Materials/Air Quality (E-245) at the site
2. Historic automotive repairs and industrial uses at the site
3. Presence of suspected historical USTs
4. Presence of a dry pit and a floor drain
5. Chlorinated solvents identified in groundwater and soil vapor

The RI for the Site consisted of the following activities:

1. Conducted a Site inspection to identify AOCs and physical obstructions (i.e. structures, buildings, etc.);
2. Performed a Ground Penetrating Radar (GPR) survey throughout the 50 percent of the Site and explored a GRP anomaly via a test pit;
3. Installed five (5) soil borings across the entire project Site, and collected eleven (11) soil samples consisting of four (4) shallow samples from zero to 2 feet bgs, one (1) shallow sample from 2 to 4 feet bgs, two (2) deep samples from 6 to 8 feet bgs and four (4) deep samples from 8 to 9 feet bgs including one (1) duplicate sample for chemical analysis from the soil borings to evaluate soil quality;
4. Installed eight (8) groundwater monitoring wells including three (3) on-Site wells and five (5) off-site in order to establish groundwater flow and collected twelve (12) groundwater samples including one (1) duplicate sample for chemical analysis to evaluate groundwater quality;
5. Installed three (3) sub-slab vapor probes around Site perimeter and one (1) off-site soil vapor probe and collected four (4) samples for chemical analysis.

The RI findings at the Site indicated the following:

1. Elevation of the property is approximately 11 feet.

2. The test pit exercise performed at the location of the GPR anomaly beneath northeastern portion of the Site confirmed the presence of a vacant UST of unknown capacity with no evidence of interior staining or odor reflecting its former use.

3. Depth to groundwater beneath the Site ranges from 8.7 feet to 9.13 feet.

4. Groundwater flow beneath the Site is generally from northeast to southwest.

5. Depth to bedrock at the Site is in excess of 40 feet.

6. The stratigraphy of the site, from the surface down, consists of historic fill (sand with traces of pebbles, silt, and ash) at variable depths ranging in thickness from zero to 5 feet. The fill layer is underlain by clayey sand to variable depths ranging from 2 to 10 feet. This layer is underlain by granular soils to 40 feet.

7. Soil samples collected during the RI indicate that Pesticides and PCBs were not detected in any of the soil samples. VOCs were detected in shallow and deep soil samples at concentrations that are below the Unrestricted Use SCOs. Tetrachloroethene (PCE) was detected in 2 of 5 shallow soil samples (maximum 0.0042 ppm). PCE was not detected in any of the 6 deep samples. Trace concentrations of Toluene were detected in 1 shallow and 1 deep soil samples. Other VOCs including acetone and methylene chloride were also detected in soil samples and were also reported in the analysis of batch blank. No other VOCs were detected in any soil samples. Trace levels of several SVOC's were detected in 2 of 5 shallow soil samples (maximum total SVOCs of 6.33 ppm) and in 1 of 6 deep soil samples (total SVOCs of 0.39 ppm). No SVOC compounds exceeded Unrestricted Use SCOs. Metals including copper (maximum of 54.6 mg/kg), lead (maximum of 191 mg/kg), zinc (maximum of 111 mg/kg), mercury (0.2 mg/kg), chromium trivalent (maximum of 38.5 mg/kg), chromium Hexavalent (1.47 mg/kg) and selenium (maximum of 7.73 mg/kg) were detected in shallow soil samples at concentrations that exceeded the Track 1 Unrestricted SCOs. Metal concentrations in deeper soils included selenium (maximum of 9.87 mg/kg) in 2 samples and exceeded Unrestricted Use SCO. No metals exceeded Restricted Residential SCOs. Data collected

during the RI is sufficient to delineate the vertical and horizontal distribution of contaminants in soil/fill at the Site.

8. Groundwater samples collected during the RI showed ten chlorinated VOCs in 2 of the 3 on-Site monitoring wells and in all 5 off-site monitoring wells. These included PCE and its degradation products such as TCE, vinyl chloride, trans-1,2-dichloroethylene, chloroform, acetone, 1,1,1,2-tetrachoroethane, 1,1,2-trichoroethane, 1,1-dichloroethylene and cis-1,2-dichloroethylene. Of these compounds, PCE was identified at concentrations exceeding 6NYCRR Part 703.5 Class GA Groundwater Quality Standards (GQS) in 1 on-site monitoring (maximum of 20.83 ug/L) and 3 off-site monitoring wells (maximum of 3,799.83 ug/L). TCE (maximum of 17 ug/L) and cis-1,2-dichloroethylene (cis-1,2-DCE) (maximum of 40 ug/L) were also detected at concentrations exceeding GQS in 2 off-site monitoring wells. None of the remaining chlorinated VOCs concentrations exceed their GQS. One SVOC, Di-n-butyl phthalate, which is a common laboratory contaminant, was detected in 1 of the 3 on-site wells at a concentration (11.2 ug/L) below its GQS. No pesticides or PCBs were detected in groundwater samples collected beneath the Site. Two dissolved metals, sodium and magnesium, were detected groundwater beneath the Site above their GQS.
9. Soil vapor samples collected during the RI showed a wide range of compounds throughout the property including BTEX and associated derivative compounds and chlorinated hydrocarbons. BTEX were found in all soil vapor samples and included a wide number of compounds. These compounds were not identified in soil or groundwater on the property. PCE was detected in all on-site vapor samples at concentrations of 140 ug/m^3, 1,400 ug/m^3 and 1,600 ug/m^3 and in off-site vapor sample at a concentration of 1,600 ug/m^3. TCE was detected in 2 of 3 on-site vapor samples at concentrations of 9.5 ug/m^3 and 15 ug/m^3 and in off-site vapor sample at a concentration of 130 ug/m^3. TCA and carbon tetrachloride were not detected in any samples. Other chlorinated hydrocarbon compounds included chloroform (18 ug/m^3), methylene chloride (maximum 29 ug/m^3) and acetone (maximum 900 ug/m^3).

Qualitative Human Health Exposure Assessment

Human exposure to contaminants in Site soils may occur through direct contact or airborne transport. Construction and remedial workers are expected to be exposed to surface and subsurface soils and groundwater. Their greatest exposure to contaminated materials will be during excavation. Therefore, all construction activities related to excavation will be subject to strict health and safety and air monitoring procedures.

There will be no future human exposures to contaminated soils at the Site. All soils will be excavated to the depth of 3 feet across the entire Site and to 7 feet 8 inches for the elevator pit beneath the eastern portion. The soil excavation for the elevator pit will be above the water table. Groundwater containing elevated levels of VOCs will be isolated through the implementation of a soil vapor mitigation plan. Therefore, potential exposure pathways are considered incomplete for future conditions.

As such, potential exposures would only occur during site remediation and construction but not under future use scenarios, thus not impacting future occupants of the Site.

The primary human health concern associated with groundwater contamination is the use of groundwater as a potable water supply. No significant human exposure to contaminated groundwater from the Site is occurring at present nor will it occur in the future because the area is served by a public water supply.

Incidental exposure to the groundwater plume contamination beneath the Site will not occur during excavation and construction activities beneath the Site that will be subject to strict health and safety and air monitoring procedures.

Construction workers could be exposed to airborne contamination (volatile organics or fugitive dust) during construction activities. To protect construction workers from ingestion and inhalation of dust or volatiles, dust monitoring and dust suppression measures will be implemented based on the procedures outlined in the Site Construction Health and Safety Plan (CHASP).

Under future conditions, there will be no potential exposures via transport of fugitive dust or vapors in ambient air because the Site will be covered by a building, pavement or clean fill, and a sub-slab depressurization system will be installed and operating. .

Nearby residents (i.e., those living along adjoining sides of the site) may be exposed to either volatile or dust emissions during the construction activities via the inhalation exposure route. As such, continuous air monitoring will be conducted during construction. Measures to suppress either volatile or dust emissions will be also implemented based on the air monitoring data.

It should be noted that visitors to the Site could also be exposed to vapors or fugitive dust released during construction activities. However, their exposures would be occasional (during a visit) and for relatively short periods of time (e.g., one to two hours) so that the overall exposures would be less than the exposures to construction workers and nearby residents.

Summary of the Remedy

The elements of the selected remedy are as follows:

1. Remedial Design

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

- Considering the environmental impacts of treatment technologies and remedy stewardship over the long term;
- Reducing direct and indirect greenhouse gases and other emissions;
- Increasing energy efficiency and minimizing use of non-renewable energy;
- Conserving and efficiently managing resources and materials;

- Reducing waste, increasing recycling and increasing reuse of materials which would otherwise be considered a waste;
- Maximizing habitat value and creating habitat when possible;
- Fostering green and healthy communities and working landscapes which balance ecological, economic and social goals; and
- Integrating the remedy with the end use where possible and encouraging green and sustainable re-development.

2. Excavation

The remediation will include demolition of the existing building to accommodate excavation and off-site disposal of contaminant source areas, including but not limited to:

- removal of an underground storage tank (UST), underground piping or other structures associated with the UST, any associated contaminated soil, or other contaminated soil found during the excavation. Confirmation samples will be taken across the site at 4 feet below grade and end point samples will be taken within the tank excavation. The excavation end point samples and the Site confirmation samples need to achieve RRSCOs as well as GW protection SCOs for PCE; and

- clean fill meeting the requirements of 6 NYCRR Part 375-6.7(d) for residential use may be brought in to fill in the tank excavation.

3. Vapor Mitigation

Any on-site buildings will be required to have a sub-slab depressurization system, or a similar engineered system, to mitigate the migration of vapors into the building from groundwater.

4. In-Situ Chemical Oxidation or Reduction

In-situ chemical oxidation (ISCO) will be implemented to treat volatile organic compounds (VOCs) in groundwater. A chemical oxidant identified as FeEDTA-activated

Sodium persulfate will be injected into the subsurface to destroy the contaminants in an approximately 625 square foot area located in the northeastern portion of the site where a UST is currently located. The method and depth of injection will be determined during the remedial design.

5. Institutional Controls

Imposition of an institutional control in the form of an environmental easement for the controlled property that:

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

6. Site Management Plan

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

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

Institutional Controls: The environmental easement discussed in remedy bullet #5.

Engineering Controls: The vapor mitigation system discussed in remedy bullet #3.

This plan includes, but may not be limited to:

  - an Excavation Plan which details the provisions for management of future excavations in areas of remaining contamination;
  - descriptions of the provisions of the environmental easement including any land use, and/or groundwater use restrictions;
  - provisions for the management and inspection of the identified engineering controls;
  - maintaining site access controls and Department notification; and
  - the steps necessary for the periodic reviews and certification of the institutional and/or engineering controls.

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

  - monitoring groundwater to assess the performance and effectiveness of the remedy;
  - a schedule of monitoring and frequency of submittals to the Department;
  - monitoring for vapor intrusion for any buildings developed on the site, as may be required by the Institutional and Engineering Control Plan discussed above.

REMEDIAL ACTION WORK PLAN

1.0 INTRODUCTION

Mr. George Man entered into a Brownfield Cleanup Agreement (BCA) with the New York State Department of Environmental Conservation (NYSDEC) in June 2014, to investigate and remediate a 0.055-acre property located at 11-28 31st Drive in Queens, New York. Mr. George Man is a Volunteer in the Brownfield Cleanup Program. Residential use is proposed for the property. When completed, the Site will contain a 6-story residential building with slab on grade, plus stair/elevator and bulkhead. Refer to the Brownfield Cleanup Program (BCP) application for additional details.

This Remedial Action Work Plan (RAWP) summarizes the nature and extent of contamination as determined from data gathered during the Remedial Investigation (RI), performed between April 2013 and January 2015. It provides an evaluation of a Track 1 cleanup and other applicable Remedial Action alternatives, their associated costs, and the recommended and preferred remedy. The remedy described in this document is consistent with the procedures defined in DER-10 and complies with all applicable standards, criteria and guidance. The remedy described in this document also complies with all applicable Federal, State and local laws, regulations and requirements. The NYSDEC and New York State Department of Health (NYSDOH) have determined that this Site does pose a significant threat to human health and the environment. The RI for this Site did not identify fish and wildlife resources.

1.1 SITE LOCATION AND DESCRIPTION

The Site is located in the County of Queens, New York and is identified as Block 502 and Lot 22 on the New York City Tax Map. A United States Geological Survey (USGS) topographical quadrangle or other suitable type map (Figure 1) shows the Site location. The Site is situated on an approximately 0.055-acre area bounded by 31st Drive to the north-northeast, vacant land and a 1-story manufacturing building to the south-southwest, a 1-story cabinet manufacturing facility to the east-southeast and a vacant 1-story warehouse to the west-northwest (see Figure 2). A boundary map is attached to the BCA as required by Environmental

Conservation Law (ECL) Title 14 Section 27-1419. A global positioning system coordinate for the starting point is included in the BCA.

1.2 CONTEMPLATED REDEVELOPMENT PLAN

The Remedial Action to be performed under the RAWP is intended to make the Site protective of human health and the environment consistent with the contemplated end use. The proposed redevelopment plan and end use is described here to provide the basis for this assessment. However, the Remedial Action contemplated under this RAWP may be implemented independent of the proposed redevelopment plan.

The proposed future use of the Site will consist of residential use. The Site will be developed into 6-story building with slab on grade, plus stair/elevator and bulkhead. The footprint of the building will be approximately 1,550 square feet. The proposed slab on grade will be 6 inches in thickness. Column footings and grade beam footings will be installed at approximately 2 feet 6 inches below grade surface. An elevator pit approximately 8 feet 8 inches long and 6 feet 8 inches wide will be located in the east-central portion and the will extend 5 feet 8 inches below grade surface. Below the elevator shaft a 2-feet thick concrete base will be installed. The first floor will consist of a residential apartment and mechanical/janitorial space. Upper second to 5 floors will each consist of two residential apartments. A landscaped rear yard of approximately 850 square feet will exist in the rear southwestern portion of the Site. A layout of the proposed site development is presented in Figure 3. The current zoning designation is R7A residential district. Appendix 1 provides a project description letter prepared by the project architect.

1.3 DESCRIPTION OF SURROUNDING PROPERTY

The Sites is located in the Astoria section in Queens, which is predominantly low-rise residential, commercial and light manufacturing/industrial neighborhood. The predominant land use within 500 feet radius of the project area consists of a variety of land uses including: residential (multi-story residential apartments), commercial, industrial and institutions. Properties located within 1/4-mile radius of the Site are zoned R6, R5B, R7A, R7X, (general residential districts), and C1-2, C1-2, C2-1 (general commercial district).

A Receptor Survey was performed within a 1000 radius of the Site. The results of the sensitive receptor database search indicate two (2) sensitive receptors are located within the search area. These sensitive receptors are listed as Long Island City High School (Q450), which is located crossgradient within 900 feet to the southeast of the Site, and the East River, which is located in a downgradient vicinity and within 300 feet to the east. No other sensitive receptors including day care facilities, hospitals, streams, wetlands or other sensitive receptors were identified within 1,000 feet from the Site. The closest sensitive receptors to the Sites are listed as follows:

	Distance (feet)	Direction
Schools	900	SE
Day care facilities	2150	SE
Hospitals	2500	East
Rivers, streams	300	W

2.0 DESCRIPTION OF REMEDIAL INVESTIGATION FINDINGS

The Site was investigated in accordance with the scope of work presented in the NYCOER-approved Remedial Investigation (RI) Work Plan dated March 20, 2013 and the supplemental NYSDEC-approved Remedial Investigation (RI) Work Plan dated October 21, 2014. The investigation was conducted between April 2013 and January 2015. The RI was submitted to NYSDEC on January 29, 2014 and the Supplemental RIR was submitted on August 12, 2015.

2.1 SUMMARY REMEDIAL INVESTIGATIONS PERFORMED

Table 1 provides the number, location and sampling criteria of soil probes.

Table 2 provides the number and location of monitoring wells;

Table 3 provides the number, location and sampling criteria of soil vapor probes.

2.1.1. Borings and Wells

1. Installed five (5) soil borings across the entire project Site.
2. Installed eight (8) groundwater monitoring wells including three (3) on-Site wells and five (5) off-site wells.
3. Installed three (3) sub-slab vapor probes around Site perimeter and one (1) off-site soil vapor probe.

2.1.2 Samples Collected

1. Collected eleven (11) soil samples across the entire Site including one (1) duplicate sample for chemical analysis;
2. Collected twelve (12) groundwater samples including one (1) duplicate sample for chemical analysis to evaluate groundwater quality;
3. Collected four (4) soil vapor samples for chemical analysis including three (3) sub-slab vapor samples around Site perimeter and one (1) off-site soil vapor sample.

2.1.3 Chemical Analytical Work Performed

Soil samples were analyzed for volatile organic compounds (VOCs) via EPA Method 8260, semi-volatile organic compounds (SVOCs) via EPA Method 8270, Pesticides and Polychlorinated Biphenyls (PCBs) via EPA Method 8081/8082 and Target Analyte List (TAL) Metals.

Groundwater samples collected on-Site were analyzed for VOCs via EPA Method 8260, SVOCs via EPA Method 8270, Pesticides and PCBs via EPA Method 8081/8082 and total/dissolved TAL Metals. Groundwater samples collected on-Site and off-site were analyzed for VOCs via EPA Method 8260.

Sub-slab vapor samples and soil vapor sample were analyzed for VOCs via EPA TP-15.

2.1.4 Geophysical Work and Test Pits

1. Performed a Ground Penetrating Radar (GPR) survey throughout the 50 percent of the Site;
2. Explored a GPR anomaly beneath the northeastern portion of the Site via a test pit.

2.1.5 Documentation

The results of remedial investigations performed at the Site were documented in a Remedial Investigation Report dated January 29, 2014 and an RIR addendum dated March 20, 2015. Figure 4 provides a sampling plan at the Site.

Below is a summary of RI findings:

2.2 SIGNIFICANT THREAT

The NYSDEC and NYSDOH have reviewed the results of recent remedial investigation at the Site and determined that this Site poses a significant threat to human health and the environment. As required by law, notice of this determination was made to the public. A copy of this notice is included in a fact sheet provided in Appendix 2.

2.3 SITE HISTORY

2.3.1 Past Uses and Ownership

The Site was historically occupied by an auto repair shop between 1934 and 1936, a machine shop between 1945 and 1970 and commercial facility between 1977 and 2006. Until most recently, the site was utilized as a manufacturing facility of wood cabinets and then became vacant during the last quarter of 2012. Currently the property is owned by Mr. George, Man who acquired its title on January 25, 2013.

2.3.2 Phase I and Phase II Reports

- Phase I Environmental Site Assessment Report, prepared by Hydro Tech Environmental, Corp. for Mr. George Man, dated March 8, 2013.
- RIR, by Hydro Tech Environmental, Corp. for Mr. George Man, dated January 29, 2014.
- Supplemental RIR, prepared by Hydro Tech Environmental, Corp. for Mr. George Man, dated March 20, 2015.

2.3.3 Sanborn Maps

All Sanborn Maps available for this Site were reviewed prior to preparation of the RAWP. The Site was utilized as an auto repair shop between 1934 and 1936, a machine shop between 1945 and 1970 and commercial facility between 1977 and 2006. Until most recently, the site was utilized as a manufacturing facility of wood cabinets and then became vacant during the last quarter of 2012. Evidence of one (1) gasoline UST was identified in the northeastern portion of the Site in 1934. The Sanborn Maps do not list the Site as a dry cleaning facility.

2.4 GEOLOGICAL CONDITIONS

1. Elevation of the property is approximately 11 feet.

2. Depth to groundwater beneath the Site vicinity ranges from 8.7 feet to 9.17 feet.

3. Groundwater flow beneath the Site is generally from northeast to southwest.

4. Depth to bedrock at the Site is in excess of 40 number feet.

5. The stratigraphy of the site, from the surface down, consists of historic fill (sand with traces of pebbles, silt, and ash) at variable depths ranging in thickness from zero to 5 feet. The fill layer is underlain by clayey sand to variable depths ranging from 2 to 10 feet. This layer is underlain by granular soils to 40 feet.

A groundwater flow map is shown in Figure 5a for well monitoring performed during the RI and Figure 5b and Figure 5c for well monitoring performed during RI addendum. Groundwater monitoring and surveying data is provided in Table 4.

2.5 CONTAMINATION CONDITIONS

Five Areas of Concerns were identified based on the review of historical Site records, previous investigations and field observations. These AOCs included the following:

1. AOC -1: Presence of Historic fill material

2. AOC-2 : Presence of a UST

3. AOC-3 : Presence of a dry pit

4. AOC-4 : Presence of dissolved chlorinated solvents

5. AOC 5- Presence of Soil Gas at the Site and immediately off-Site

2.5.1 Conceptual Model of Site Contamination

The contamination present beneath the Site is associated with soil/fill material impacted with levels of metals including lead, mercury and chromium exceeding the unrestricted use Soil Cleanup Objectives (SCOs) from grade surface to the groundwater interface, and chlorinated hydrocarbons including PCE and its degradation products in groundwater and in soil vapor beneath the Site. The highest dissolved concentrations of PCE and its degradation products occurred in the immediate vicinity of a UST located beneath the upgradient northeastern portion of the Site. Utilizing groundwater flow modeling techniques, it appears that the source of chlorinated hydrocarbons beneath the Site is not related to a surrounding regional impact.

Five areas of concern are identified at the Site as follows:

AOC -1: Presence of Historic fill material

AOC-2: Presence of a UST

AOC-3: Presence of a dry pit

AOC-4: Presence of dissolved chlorinated solvents

AOC 5- Presence of Soil Gas at the Site and immediately off-Site

2.5.2 Description of Areas of Concern

AOC 1- Presence of fill material beneath the Site

Investigations indicate soil/fill material is present throughout the Site from grade to the depth of 5 feet. The soil/fill is impacted with levels of metals including lead, mercury and chromium that exceed Track 1 SCOs at shallow depths. PCE was detected in shallow soil at concentrations below Track 1 SCOs. No PCE of its degradation products were detected in any deep soil samples at the interface with groundwater.

AOC 2 – Presence of a UST

The gasoline UST, which was initially identified in the Sanborn maps beneath the northeastern portion of the Site, was explored via a test pit. The UST was found to be empty and buried in dirt with no evidence of a concrete encasement. No evidence of a petroleum release was identified in the soil or the groundwater samples collected in the immediate vicinity of the UST.

AOC 3 – Presence of a dry pit

PCE was detected at a concentration below its unrestricted use SCO at the bottom of a dry pit present beneath the western portion of the Site. No PCE or PCE derivative compounds occurred in deep soil beneath the dry pit at the groundwater interface. Metals including lead, mercury and chromium were found at concentrations that exceeded their respective UUSCOs but do not exceed the restricted residential SCOs in soil beneath the dry pit.

AOC 4 – Presence of chlorinated solvents in Groundwater

A groundwater plume consisting of chlorinated hydrocarbons at concentrations exceeding their respective GA Groundwater Standards is located beneath the eastern portion of the Site, of the Site, where the highest concentrations were detected in the immediate vicinity of a UST situated in the northeastern portion of the property.

AOC 5- Presence of Soil Gas at the Site and immediately off-Site.

Analytical results of soil gas indicate elevated levels of VOCs consisting of chlorinated solvents and gasoline vapors are present beneath the existing building slab on-grade at the Site. Soil vapor concentrations of chlorinated solvents were also abundant at a location in the northwest vicinity of the Site.

2.5.3 Identification of Standards, Criteria and Guidance

In accordance with DER-10 and ECL § 27-1415, the objectives of the remedial action are to: (1) reduce the concentrations of contaminants of concern at the Site to meet those levels that will protect public health and the environment, and (2) isolate the Site from migration of contaminated groundwater and soil vapor from potential on- and off-site sources. Where identifiable sources of contamination are found on the Site, the sources will be removed or eliminated to the greatest extent feasible, regardless of presumed risk or intended use of the Site. Also in accordance with DER-10, the Remedial Action Objectives (RAO) for this Site are defined as medium-specific objectives for the protection of public health and the environment and are developed based on contaminant-specific standards, criteria, and guidance (SCGs). The SCGs for the Site include:

- NYSDEC Draft Brownfield Cleanup Program Guide – May 2004;
- NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (2010);
- NYSDEC TAGM No. 4031– Fugitive Dust Suppression and Particulate Monitoring
- NYSDEC TOGS 1.1.1 – Ambient Water Quality Standards and Guidance Values and
- Groundwater Effluent Limitations (1998);
- NYSDOH – Guidance for Evaluating Soil Vapor Intrusions in the State of New York
- (2006);
- New York State Codes, Rules and Regulations (NYCRR) Title 6 Part 364 – Waste
- Transporter Permits;
- 6 NYCRR Part 370 – Hazardous Waste Management System;
- 6 NYCRR Part 375 – Environmental Remediation Program (December 2006);
- Code of Federal Regulations (CFR) Title 29 Part 1910.120 - Hazardous Waste Operations and Emergency Response Standard;
- CFR Title 29 Part 1926 – Safety and Health Regulations for Construction; and
- NYSDEC CP-51 – Soil Cleanup Guidance (2010).
- NYSDEC 40 CFR Part 144 - Underground Injection Control Program
- Permanent Closure of Petroleum Storage Tanks
- 6 NYCRR Part 612 - Registration of Petroleum Storage Facilities (February 1992)
- 6 NYCRR Part 613 - Handling and Storage of Petroleum (February 1992)

Site remediation will be achieved in compliance with the remedial goals to Track 2 Restricted Residential cleanup levels. Impacted soil/fill material at the Site will be excavated to a minimum depth of 3 feet across the entire Site and to 7 feet 8 inches for the elevator pit beneath the eastern portion. This excavation will not extend into the groundwater, which is affected by chlorinated solvents. SCGs for groundwater contamination will be achieved during Site remedial activities. Potential health impacts associated with contaminated groundwater will be eliminated consistent with the RAOs established for the Site. Compliance with SCGs for soil vapor from on-Site and potential off-site sources is expected following completion of the remedial action. Any residual soil vapor will be addressed through the installation of an active sub-slab depressurization system beneath the Site

2.5.4 Soil/Fill Contamination

Soil characterization indicates the soil beneath the site consisted of brown fine grained silty sand mixed with pebbles and fill material from grade surface to 5 feet below grade surface. The fill layer is underlain by clayey sand to variable depths ranging from 2 to 10 feet.

2.5.4.1 Summary of Soil/Fill Data

PCE is detected in the soil in two locations at concentrations below UUSCO. These locations are SP-3 from zero to 2 feet bgs at a concentration of 0.0034 mg/kg and SP-4 from 2 to 4 feet at a concentration of 0.0042 mg/kg. In each location, the deeper sample contains no PCE or its degradation compounds. PCE or its degradation compounds did not occur in any other soil samples.

Lead was identified in three locations between zero and 4 feet at concentrations exceeding the UUSCO. Lead concentrations ranged from 96.8 mg/kg in SP-3, 0-2 feet, to 191 mg/kg in SP-1, 0-2 feet. The samples meet the residential SCO for lead, which is 400 mg/kg. Mercury was detected in SP-4, 2-4 feet, at a concentration of 0.2 mg/kg, which marginally exceeds the UUSCO. The sample meets the residential SCO for mercury, which is 0.81 mg/kg. Trivalent Chromium is present in SP-2, 0-2 feet, and SP-4, 2-4 feet, at respective concentrations of 37.7 mg/kg and 38.5 mg/kg, which marginally exceed the UUSCO of 30 mg/kg and residential SCO of 36 mg/kg. Hexavalent Chromium was detected in SP-2, 0-2 feet, at a concentration of 1.47 mg/kg, which marginally exceeds the UUSCO. The sample meets the residential SCO of 22 mg/kg. Copper was detected in two locations at concentrations above the UUSCO; in SP-3, 0-2 feet, at of 54.6 mg/kg and in SP-4, 2-4 feet, at 58.7 mg/kg. The samples meet the residential SCO of 270 mg/kg. Selenium is present in two locations between zero and 8 feet at concentrations above the UUSCO and ranging between 6.7 mg/kg in SP-4, 0-2 feet, and 9.87 mg/kg in SP-5, 6-8 feet. The samples meet the residential SCO for selenium, which is 36 ppm.

2.5.4.2 Comparison of Soil/Fill with SCGs

Table 5 shows soil results compared to Unrestricted SCOs and Restricted Residential SCOs for all soil/fill at the Site. Figure 6 is a spider map that shows the location and summarizes exceedances from Track 1 Unrestricted SCOs for all soil/fill. However, the soil meets Restricted Residential SCOs from Part 375.6(b).

As this data indicates, the soil contamination at the Site in exceedance of Unrestricted SCOs is present in the shallow soil and fill material across the entire Site extending vertically to the interface with groundwater beneath the western and northwestern portions. No exceedances of Restricted Residential SCOs occurred in any soil samples collected at the Site.

2.5.5 On-Site and Off-Site Groundwater Contamination

2.5.5.1 Summary of Groundwater Data

The monitoring well network associated with the Site currently consists of eight monitoring wells including three temporary monitoring wells installed at the Site and five permanent wells installed in sidewalks located in the Site vicinity. Groundwater investigations performed at the Site identified a groundwater plume consisting of chlorinated solvents consisting of PCE and its degradation products such as TCE beneath the eastern portion of the Site and also in the adjacent sidewalk at concentrations exceeding their respective GA Groundwater Standards.

The greatest concentration of PCE (3,799.83 ug/L) was detected in MW-4, which is located immediately adjacent to the UST. Lower concentrations of PCE were detected in one on-Site well and two off-site wells and ranged between 5.43 ug/L in MW-5 and 85.83 ug/L in MW-6. PCE concentrations detected over time in on-Site well MW-3 ranged between 20.8 ug/L an d 83 ug/L. TCE was detected in two off-site wells MW4 and MW-6 with the higher concentration of 17 ug/L detected in MW-4. Cis-1,2-Dichloroethylene was also identified MW4 and MW-6 with the higher concentration of 40 ug/L detected in MW-4.

The levels of PCE do not extend beneath the southern portion of the Site as evidenced by the analytical results of MW-2 and MW-3.

Dissolved metals including Sodium and Manganese were detected in the groundwater beneath the Site at concentrations exceeding their respective GA Standards.

2.5.5.2 Comparison of Groundwater with SCGs

The table that indicates exceedances from GA groundwater standards in monitor wells prior to the remedy is shown in Table 6. A spider map that indicates the locations of and summarizes exceedances from GA groundwater standards prior to the remedy is shown in Figure 7 and Figure 8.

The plume of chlorinated solvents at concentrations exceeding their respective GA Standards is present beneath the northern vicinity of the Site and extends to the northeast-adjacent sidewalk along the southwest Side of 31st Drive. The plume was delineated beneath the eastern portion of the Site. The PCE concentrations within the plume range from 5.43 µg/L to 3,799.83 µg/L. Consistent with a regional hydraulic gradient identified beneath the Site vicinity, dissolved chlorinated compounds detected in the plume are related to a regional groundwater impact.

2.5.6 On-Site and Off-Site Soil Vapor Contamination

Chlorinated hydrocarbons are also commonly observed in soil vapor samples throughout the property. PCE was found in all samples and occurred in high concentrations with a maximum of 1,600 ug/m^3 beneath the eastern portion of the Site and beneath the northern vicinity of the Site. TCE was found in 2 of 3 soil vapor samples collected at the Site and its concentrations increased from 9.3 ug/m^3 beneath the eastern portion of the Site to a maximum of 130 ug/m^3 detected off-Site. Acetone also occurred in moderate to high concentrations with a maximum of 900 ug/m^3. Gasoline type soil vapor consisting of o-xylene, m&p-xylene and toluene were commonly detected in all on-Site and off-Site vapor samples and occurred at low concentrations and ranged from 8.1 ug/m^3 to of 55 ug/m^3.

2.5.6.1 Comparison of Soil Vapor with SCGs

A table of soil vapor data collected prior to the remedy is shown in Table 7. A spider map that indicates the location(s) of and summarizes soil vapor data prior to the remedy is shown in Figure 9.

Significant levels of PCE, TCE and a variety of other VOCs including gasoline vapors and associated derivatives were detected in soil vapor point samples. r. Gasoline compounds were not identified in soil or groundwater on the property.

2.6 ENVIRONMENTAL AND PUBLIC HEALTH ASSESSMENTS

2.6.1 Qualitative Human Health Exposure Assessment

Based on the results of the RIR and RIR addendum, the contaminants of concern found are:

1. The presence of VOCs consisting of PCE and its degradation products in saturated soil and groundwater at concentrations exceeding regulatory standards.
2. The presence of metals in dry soil/fill present across the entire Site including lead, mercury and chromium hexavalent and trivalent at concentrations exceeding regulatory standards.
3. The soil vapors beneath the Site have been impacted from a release of chlorinated solvents from an unconfirmed location on the Site and also from off-site sources of petroleum hydrocarbons.

Potential human exposures to the exceedances of Track 1 SCOs for metals in soil and to PCE in groundwater and soil vapors and will be addressed in this under this RAWP as follows:

Nature, Extent, Fate and Transport of Contaminants

Metals are present at very low concentrations in the historic fill materials throughout the Site at shallow depths. Metals were not found in deep onsite soil above Track 1 SCO and were not identified in groundwater at levels exceeding GQS. The VOCs PCE and TCE that were identified in soil gas at high concentrations were also found in groundwater and are most likely related to a regional groundwater impact. Metals including magnesium and sodium were detected in dissolved groundwater and are also related to regional groundwater quality.

Potential Routes of Exposure

The five elements of an exposure pathway are: (1) a contaminant source; (2) contaminant release and transport mechanisms; (3) a point of exposure; (4) a route of exposure; and (5) a receptor population. An exposure pathway is considered complete when all five elements of an exposure pathway are documented. A potential exposure pathway exists when any one or more of the five elements comprising an exposure pathway cannot be documented. An exposure pathway may be eliminated from further evaluation when any one of the five elements comprising an exposure pathway has not existed in the past, does not exist in the present, and will never exist in the future. Three potential primary routes exist by which chemicals can enter the body:

- Ingestion of water, fill or soil;
- Inhalation of vapors and particulates; and
- Dermal contact with water, fill and soil.

Existence of Human Health Exposure

Existing – The Site is entirely developed and is capped with a concrete slab-on grade with isolated alterations from past geotechnical assessments. Therefore, exposure to surficial soil/fill material is possible. Groundwater is not exposed at the Site, and because the Site is served by the public water supply and groundwater use for potable supply is prohibited, groundwater is not used at the Site and there is no potential for exposure. The existing building structure is not airtight and there is potential for soil vapor accumulation.

Construction/ Remediation Activities– Once redevelopment activities begin, construction workers will come into direct contact with surface and subsurface soils as a result of on-Site construction/excavation activities. Similarly, off-Site receptors could be exposed to dust from onsite activities. During construction, on-Site and off-Site exposures to contaminated dust from on-Site will be addressed through dust controls, and through the implementation of the Community Air Monitoring Plan and a Construction Health and Safety Plan. Groundwater is not to be encountered, and there will be no structures on site where soil vapor could accumulate.

Proposed Future Conditions – Once the remedial actions and redevelopment of the Site have been completed, there will be no potential onsite exposure pathways. All soils exceeding the residential SCOs will be removed as part of the remedy. Any exposures to vapors from on-site and off-site sources will be prevented by installation of an active SSD system.

Receptor Populations

The immediate area to the Site is mixed use residential/commercial/light industrial, and is anticipated to remain as such. The new building at the site will be utilized as residential facility. Potential receptor populations are as follows:

On-Site Receptors - The Site is currently vacant and contains a 1-story building that was until most recently occupied by a manufacturing facility of wood cabinets. Therefore, the only potential on-Site receptors are trespassers and site representatives. During redevelopment of the Site, the on-Site potential receptors will include construction workers, site representatives, and visitors. Once the Site is redeveloped, the on-Site potential sensitive receptors will include adult and child building residents and visitors.

Off-Site Receptors - Potential offsite receptors within a 0.25-mile radius of the Site include: adult and child residents, commercial and construction workers, pedestrians, trespassers, and cyclists, based on the following:

1. Commercial Businesses (up to 0.25 mile) – existing and future
2. Residential Buildings (up to 0.25 mile) – existing and future
3. Building Construction/Renovation (up to 0.25 mile) – existing and future
4. Pedestrians, Trespassers, Cyclists (up to .25 mile) – existing and future
5. Schools (up to .25 mile) – existing and future
6. Community (up to .25 mile) – existing and future

Overall Human Health Exposure Assessment

Based upon this analysis, complete on-site exposure pathways appear to be present only during the current unremediated phase and the remedial action phase. Under current conditions, preventing access to the Site could minimize on-Site exposure pathways. During the remedial action, on-site exposure pathways will be eliminated by preventing access to the Site, through implementation of soil/materials management, storm water pollution prevention, dust controls, employment of a community air monitoring plan, and implementation of a Construction Health and Safety Plan. This assessment takes into consideration the reasonably anticipated use of the site, which includes a residential structure. Potential post-construction use of groundwater is not considered an option because groundwater in this area of New York City is not used as a potable water source. There are no surface waters in close proximity to the Site that could be impacted or threatened. After the remedial action is complete, there will be no remaining exposure pathways to on-Site soil/ fill, as all soil that exceeds Residential Use SCOs will have been removed, and the active SSDS and concrete building slab will interrupt potential for soil vapor intrusion.

2.6.2 Fish & Wildlife Remedial Impact Analysis

NYSDEC DER-10 requires an on-site and off-site Fish and Wildlife Resources Impact Analysis (FWRIA). However, based on the requirements stipulated in Section 3.10 -Appendix 3C of DER-10, there was no need to prepare an FWRIA for The Site. A completed form of DER-10 Appendix 3C is enclosed in this RAWP as Appendix 3.

2.7 REMEDIAL ACTION OBJECTIVES

Based on the results of the Remedial Investigation, the following Remedial Action Objectives (RAOs) have been identified for this Site.

Groundwater

RAOs for Public Health Protection

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

RAOs for Environmental Protection

- Restore ground water aquifer, to the extent practicable, to pre-disposal/pre-release conditions.
- Remove the source of ground or surface water contamination.

Soil Vapor

RAOs for Public Health Protection

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

3.0 DESCRIPTION OF REMEDIAL ACTION PLAN

3.1 EVALUATION OF REMEDIAL ALTERNATIVES

The goal of the remedy selection process is to select a remedy that is protective of human health and the environment taking into consideration the current, intended and reasonably anticipated future use of the property. The remedy selection process begins by establishing remedial action objectives (RAOs) for media in which chemical constituents were found in exceedance of applicable standards, criteria and guidance values (SCGs). A remedy is then developed based on the following ten criteria:

- Protection of human health and the environment;
- Compliance with standards, criteria, and guidelines (SCGs);
- Short-term effectiveness and impacts;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume of contaminated material;
- Implementability;
- Cost effectiveness;
- Community Acceptance; and
- Land use.

The following is a detailed description of the alternatives analysis and remedy selection to address impacted media at the Site. As required, a minimum of two remedial alternatives (including a Track 1 scenario) are evaluated, as follows:

Alternative 1 involves:

- Establishment of Unrestricted Use Track 1 SCOs for the Site.

- Removal of all soil/ fill exceeding Unrestricted Use (Track 1) Soil Cleanup Objective (SCOs) throughout the Site. This alternative would require excavation a depth of approximately 8 feet throughout the property to remove all historic fill and confirmation that Track 1 SCOs have been achieved through post-excavation end point sampling. If soil/fill containing analytes at concentrations above Unrestricted Use SCOs is still present at the base of the excavation after removal of all soil required for construction of the new buildings complete, additional excavation will be performed to ensure complete removal of soil that does not meet Track 1 Unrestricted Use SCOs; and

- Based on the level of soil vapor, an active SSD system is required as an Engineering Control and a Track 1 Remedial Action cannot be achieved prior to the removal action. Such remedial action would be a Track 2 Remedial Action and would require Site Management for the active SSD system Engineering Control.

Alternative 2 involves:

- Establishment of site-specific Track 2 SCOs for the Site;

- Removal of all soil/ fill exceeding Track 2 Site-Specific SCOs. For development purposes, the site would be excavated to a depth of approximately 3 feet throughout the property and to 7 feet 8 inches for the elevator pit beneath the eastern portion and confirmation that the site-specific Track 2 SCOs have been achieved through post-excavation end point sampling;

- Installation of an active sub-slab depressurization system beneath the foundation slab to prevent soil vapor entering the new building;

- Establishment of use restrictions including prohibitions on the use of groundwater from the site and prohibitions on sensitive site uses, such as farming or vegetable gardening, to eliminate future exposure pathways; and prohibition of a higher level of land use without OER approval;

- Establishment of a Site Management Plan to ensure long-term management of these engineering and institutional controls including the performance of periodic inspections and certification that the controls are performing as they were intended.

3.2 THRESHOLD CRITERIA

Protection of Public Health and the Environment

This criterion is an evaluation of the remedy’s ability to protect public health and the environment, and an assessment of how risks posed through each existing or potential pathway of exposure are eliminated, reduced or controlled through removal, treatment, and implementation of Engineering Controls or Institutional Controls. Protection of public health and the environment must be achieved for all approved remedial actions.

Alternative 1 would be protective of human health and the environment by removing the historic fill at the Site and installing a SSDS, thus eliminating potential for direct contact with contaminated soil/ fill once construction is complete and eliminating the risk of contamination leaching into groundwater.

Alternative 2 would achieve comparable protections of human health and the environment since all impacted soil/fill will be removed for purposes of construction and by ensuring that remaining soil/ fill on-Site meets residential SCOs as well as by placement of institutional and engineering controls, including an active SSDS system. Implementing institutional controls including a site management plan would ensure that the SSDS remains operational and protective. SSD system would protect new building from vapor intrusion.

For both Alternatives, potential exposure to contaminated soils or groundwater during construction would be minimized by implementing a Construction Health and Safety Plan, an approved Soil and Materials Management Plan and Community Air Monitoring Plan (CAMP) would minimize potential exposure to contaminated soils during construction. Potential contact with contaminated groundwater would be prevented as City laws and regulations prohibit its use, and it is not anticipated to be encountered during construction. Potential future migration of off-Site soil vapors into the new building would be prevented by installing an active SSD system.

3.3 BALANCING CRITERIA

Compliance with Standards, Criteria and Guidance (SCGs)

This evaluation criterion assesses the ability of the alternative to achieve applicable standards, criteria and guidance.

Alternative 1 would achieve compliance with the remedial goals, SCGs and RAOs for soil through removal to Track 1 Unrestricted Use SCOs and groundwater protection standards. Compliance with SCGs for soil vapor would also be achieved by installation of an active sub-slab depressurization system below the new building's basement slab. However, a Track 1 Remedial Action would not be achieved, pending completion of the removal action and additional sampling of the SSD system.

Alternative 2 would achieve compliance with the remedial goals, SCGs and RAOs for soil through removal to meet Track 2 Site Specific SCOs. Compliance with SCGs for soil vapor would also be achieved by installation of an active sub-slab depressurization system. A Site Management Plan would ensure that these controls remained protective for the long term.

Health and safety measures contained in the HASP and Community Air Monitoring Plan (CAMP) that comply with the applicable SCGs would be implemented during Site redevelopment under this RAWP. For both Alternatives, focused attention on means and methods employed during the remedial action would ensure that handling and management of contaminated material would be in compliance with applicable SCGs. These measures will protect on-site workers and the surrounding community from exposure to any Site-related concerns.

Short-term effectiveness and impacts

This evaluation criterion assesses the effects of the alternative during the construction and implementation phase until remedial action objectives are met. Under this criterion, alternatives are evaluated with respect to their effects on public health and the environment during implementation of the remedial action, including protection of the community, environmental impacts, time until remedial response objectives are achieved, and protection of workers during remedial actions.

Both Alternatives 1 and 2 have similar-short term effectiveness during their respective implementations, as each requires excavation of historic fill material. Both alternatives would result in short-term dust generation impacts associated with excavation, handling, load out of materials, and truck traffic. Short-term impacts would potentially be higher for Alternative 1 if excavation of greater amounts of historical fill material were encountered below the excavation depth of the proposed building. However, focused attention to means and methods during the remedial action during a Track 1 removal action, including community air monitoring and appropriate truck routing, would minimize or negate the overall impact of these activities and any differences between these alternatives.

An additional short-term adverse impact and risks to the community associated with both remedial alternatives is increased truck traffic. Approximately 20, 20-ton capacity truck trips would be necessary to transport fill and soil excavated during Site development. Truck traffic will be routed on the most direct course using major thoroughfares where possible and flaggers will be used to protect pedestrians at Site entrances and exits.

Both alternatives would employ appropriate measures to prevent short-term impacts, including a Construction Health and Safety Plan, a Community Air Monitoring Plan (CAMP) and a Soil/Materials Management Plan (SMMP), during all on-Site soil disturbance activities and would minimize the release of contaminants into the environment. Both alternatives provide short-term effectiveness in protecting the surrounding community by decreasing the risk of contact with on-Site contaminants. Construction workers operating under appropriate management procedures and a Health and Safety Plan (CHASP) will be protected from on-Site contaminants (personal protective equipment would be worn consistent with the documented risks within the respective work zones).

Long-term effectiveness and permanence

This evaluation criterion addresses the results of a remedial action in terms of its permanence and quantity/nature of waste or residual contamination remaining at the Site after response objectives have been met, such as permanence of the remedial alternative, magnitude of remaining contamination, adequacy of controls including the adequacy and suitability of ECs/ICs that may be used to manage contaminant residuals that remain at the Site and assessment of containment systems and ICs that are designed to eliminate exposures to contaminants, and long-term reliability of Engineering Controls.

Alternative 1 would achieve long-term effectiveness and permanence by permanently removing all impacted soil/ fill material and enabling unrestricted usage of the property. The active SSD system employed and would be considered to be permanent controls for future off-site soil vapor management pending future vapor sampling.

Alternative 2 would provide long-term effectiveness by removing most on-site contamination and attaining Track 2 Site-Specific SCOs, establishing Engineering Controls including an active SSD system, establishing Institutional Controls to ensure long-term management including use restrictions, a Site Management Plan to memorialize these controls for the long term. The SMP would ensure long-term effectiveness of all ECs and ICs by requiring periodic inspection and certification that these controls and use restrictions continue to be in place and are functioning as they were intended assuring that protections designed into the remedy will provide continued high level of protection in perpetuity.

Reduction of toxicity, mobility, or volume of contaminated material

This evaluation criterion assesses the remedial alternative's use of remedial technologies that permanently and significantly reduce toxicity, mobility, or volume of contaminants as their principal element. The following is the hierarchy of source removal and control measures that are to be used to remediate a Site, ranked from most preferable to least preferable: removal and/or treatment, containment, elimination of exposure and treatment of source at the point of exposure. It is preferred to use treatment or removal to eliminate contaminants at a Site, reduce the total mass of toxic contaminants, cause irreversible reduction in contaminants mobility, or reduce of total volume of contaminated media.

Alternative 1 would achieve the greatest measure of long-term effectiveness and permanence related to on-Site contamination by permanently removing all impacted soil/fill above Track 1 Unrestricted Use SCOs. Removal of on-Site contaminant sources will prevent future groundwater contamination. However, a Track 1 Remedial Action would not be achieved because the active SSD system Engineering Control would be required, pending completion of the removal action and additional sampling of the SSD system.

Alternative 2 would provide long-term effectiveness by permanently removing most on-Site contamination and attaining Track 2 Site-Specific SCOs;, maintaining use restrictions, establishing an SMP to ensure long-term management of Institutional Controls (ICs), Engineering Controls (ECs), and maintaining continued registration as an E-designated property to memorialize these controls for the long term. The SMP would ensure long-term effectiveness of all ECs and ICs by requiring periodic inspection and certification that these controls and restrictions continue to be in place and are functioning as they were intended assuring that protections designed into the remedy will provide continued high level of protection in perpetuity. Alternative 1 would eliminate a greater total mass of contaminants form soil on Site.

Both alternatives would result in removal of soil contamination exceeding the SCOs providing the highest level, most effective and permanent remedy over the long-term with respect to a remedy for contaminated soil, which will eliminate or minimize any migration to groundwater. Potential sources of soil vapor and groundwater contamination will also be eliminated or minimized as part of the remedy.

Implementability

This evaluation criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation, including technical feasibility of construction and operation, reliability of the selected technology, ease of undertaking remedial action, monitoring considerations, administrative feasibility (e.g. obtaining permits for remedial activities), and availability of services and materials.

The techniques, materials and equipment to implement both remedial Alternatives 1 and 2 are readily available and have been proven effective in remediating the contaminants associated with the Site. They use standard materials and services that are well established technology. The reliability of each remedy is also high. There are no special difficulties associated with any of the activities proposed.

Cost effectiveness

This evaluation criterion addresses the cost of alternatives, including capital costs (such as construction costs, equipment costs, and disposal costs, engineering expenses) and site management costs (costs incurred after remedial construction is complete) necessary to ensure the continued effectiveness of a remedial action.

The costs associated with both Alternative 1 and Alternative 2 would likely be the comparable. Costs associated with Alternative 1 could potentially be higher than Alternative 2 if soil with analytes above Unrestricted Use SCOs is encountered below the excavation depth required for development. Additional costs would include disposal of additional soil, and import of clean soil for backfill. However, long-term costs for Alternative 2 are likely higher than Alternative 1 based on implementation of a Site Management Plan.

Community Acceptance

This evaluation criterion addresses community opinion and support for the remedial action. Observations here will be supplemented by public comment received on the RAWP.

Based on the overall goals of the remedial program and the intended Site use, it is anticipated that Alternatives 1 and 2 for the Site would be acceptable to the community. This RAWP will be subject to public review under the NYC VCP and will provide the opportunity for detailed public input on the remedial alternatives and the selected remedial action. This public comment will be considered by OER prior to approval of this plan. Observations here will be supplemented by public comment received on the RAWP.

Land use

This evaluation criterion addresses the proposed use of the property. This evaluation has considered reasonably anticipated future uses of the Site and takes into account: current use and historical and/or recent development patterns; applicable zoning laws and maps; NYS Department of State's Brownfield Opportunity Areas (BOA) pursuant to section 970-r of the general municipal law; applicable land use plans; proximity to real property currently used for residential use, and to commercial, industrial, agricultural, and/or recreational areas; environmental justice impacts, Federal or State land use designations; population growth patterns and projections; accessibility to existing infrastructure; proximity of the site to important cultural resources and natural resources, potential vulnerability of groundwater to contamination that might emanate from the site, proximity to flood plains, geography and geology; and current Institutional Controls applicable to the site.

The proposed redevelopment of the Site is compatible with its current R7A zoning designation and is consistent with recent development patterns. Following remediation, the Site will meet either Track 1 Unrestricted Use or Track 2 Site-Specific SCOs, both of which are appropriate for its planned residential use. Improvements in the current environmental condition of the property achieved by both alternatives are also consistent with the City's goals for cleanup of contaminated land and bringing such properties into productive reuse. Both alternatives are equally protective of natural resources and cultural resources.

Applicable Regulations

- 6 NYCRR Part 375-6 Soil Cleanup Objectives

Based upon 6 NYCRR Part 375-6 Soil Cleanup Objectives for this project will be the Restricted Residential Use Soil Cleanup Objective (6 NYCRR Part 375-6.8):

- New York State Groundwater Quality Standards – 6 NYCRR Part 703;
- NYSDEC Ambient Water Quality Standards and Guidance Values – TOGS 1.1.1;

Based upon *6 NYCRR 703.5*, the groundwater standards for this project are as follows:

Contaminant	Max. on-Site Concentration (ug/L)	GA Groundwater Standard (ug/L)
PCE	83	5

- NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation - May 2010;
- NYSDEC CP-51 – Soil Cleanup Guidance (2010).

This guidance will be followed during the remediation of the Site. This guidance will be further discussed in Section 5.2 of this report.

- NYSDEC Draft Brownfield Cleanup Program Guide – May 2004;
- Environmental Remediation Program (December 2006) – 6 NYCRR Part 375

This guidance will be followed during the remediation of the Site. This guidance will be further discussed in Section 5.2 of this report.

- Underground Injection Control Program – NYSDEC 40 CFR Part 144

This guidance will be followed during the performance of ISCO injections to remediate groundwater.

- Permanent Closure of Petroleum Storage Tanks
- 6 NYCRR Part 612 - Registration of Petroleum Storage Facilities (February 1992)
- 6 NYCRR Part 613 - Handling and Storage of Petroleum (February 1992)

This guidance will be followed during the closure and removal of USTs present at the Site.

- Fugitive Dust Suppression and Particulate Monitoring – NYSDEC TAGM No. 4031
- New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan
- NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York

This guidance will be followed during the remediation of the Site and will be further discussed in Section 4.1.6 of this report.

- NYS Waste Transporter Permits – 6 NYCRR Part 364;

These permits will be held by haulers of the petroleum-contaminated soil/fill material. These permits will be provided in the Final Engineering Report.

- NYS Solid Waste Management Requirements – 6 NYCRR Part 360 and Part 364;
- Hazardous Waste Management System – 6 NYCRR Part 370;
- Hazardous Waste Operations and Emergency Response Standard – Code of Federal Regulations (CFR) Title 29 Part 1910.120;

Where applicable these regulations will be followed by the soil disposal facility.

3.4 SELECTION OF THE PREFERRED REMEDY

3.4.1 Zoning;

The new development at the Site will consist of a 6-story residential building. This development is in compliance with the NYC local zoning designation R7A provided in the NYC planning commission.

3.4.2 Applicable comprehensive community master plans or land use plans;

As discussed in the BCA, The Site remedial construction is an as-of right development that is consistent with local city resolutions and local community plans.

3.4.3 Surrounding property uses;

The remedial method selected for the Site will not impact upon surrounding property uses.

3.4.4 Citizen participation;

The citizens are likely to welcome the proposed remedial action because it will allow for the Site to be remediated to Track 2 SCOs under a proposed redevelopment into a residential facility, which would reinforce the neighborhood character of a residential district that was implemented as part of a 2010 Astoria rezoning action.

3.4.5 Environmental justice concerns;

No Environmental justice concerns are currently foreseeable since the goal of the remediation is to mitigate the soil vapor intrusion impact associated with chlorinated solvents from off-site sources to render the Site protective to public health and environmental.

3.4.6 Land use designations;

As previously discussed, utilization of the Site for residential use will meet the goals of the New York City Department of Planning.

3.4.7 Population growth patterns;

As previously discussed, utilization of the Site for residential use will meet the goals of the New York City Department of Planning.

3.4.8 Accessibility to existing infrastructure;

The Site remediation will ultimately prevent impacts associated with soil vapor intrusion of chlorinated solvents in on-Site groundwater from off-Site sources.

3.4.9 Proximity to cultural resources;

Site remediation will protect future inhabitants from exposure to chlorinated compounds present in groundwater as a result of a regional impact and therefore, no impact to cultural resources present in the vicinity of the Site will occur.

3.4.10 Proximity to natural resources;

As discussed above, Site remediation will protect future inhabitants from exposure to chlorinated compounds present in groundwater as a result of a regional impact and therefore impact to natural resources present in the vicinity of the Site will occur.

3.4.11 Off-Site groundwater impacts;

The groundwater plume of chlorinated hydrocarbons was delineated beneath the eastern portion of the Site. Based upon groundwater mapping programs, it appears that this plume is in fact generated at an unknown off-site source located in the east-upgradient vicinity of the Site. Therefore, no off-Site groundwater impacts associated with the Site remediation.

3.4.12 Proximity to floodplains;

The groundwater plume generated at an unknown off-site source is not impacting nor does it have the potential to impact upon any floodplains.

3.4.13 Geography and geology of the Site; and

As part of Site remedial construction, the entire Site will be excavated to 3 feet bgs. An elevator pit located beneath the eastern portion will be excavated to 7 feet 8 inches bgs. This new development will be in compliance with NYC building codes, and therefore Site remedial construction is not expected to undermine the geography and geology of the Site.

3.4.14 Current Institutional Controls.

There are currently no institutional controls on the Site.

3.5 SUMMARY OF SELECTED REMEDIAL ACTIONS

The elements of the selected remedy are as follows:

1. **Remedial Design**

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

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

2. **Excavation**

   The remediation will include demolition of the existing building to accommodate excavation and off-site disposal of contaminant source areas, including but not limited to:

- removal of an underground storage tank (UST), underground piping or other structures associated with the UST and collection of post-excavation endpoint samples around the removed UST; and

- Clean fill meeting the requirements of 6 NYCRR Part 375-6.7(d) for residential use may be brought in to fill in the tank excavation.

3. Vapor Mitigation

Any on-site buildings will be required to have a sub-slab depressurization system, or a similar engineered system, to mitigate the migration of vapors into the building from groundwater.

4. In-Situ Chemical Oxidation or Reduction

In-situ chemical oxidation (ISCO) will be implemented to treat volatile organic compounds (VOCs) in groundwater. A chemical oxidant identified as FeEDTA-activated Sodium persulfate will be injected into the subsurface to destroy the contaminants in an approximately 625 square foot area located in the northern portion of the site in the vicinity of existing UST. The method and depth of injection will be determined during the remedial design.

5. Institutional Controls

Imposition of an institutional control in the form of an environmental easement for the controlled property that:

- requires the remedial party or site owner to complete and submit to the Department a periodic certification of institutional and engineering controls in accordance with Part 375-1.8 (h)(3);
- allows the use and development of the controlled property for restricted residential, commercial and industrial uses as defined by Part 375-1.8(g), although land use is subject to local zoning laws;
- restricts the use of groundwater as a source of potable or process water, without necessary water quality treatment as determined by the NYSDOH or NYCDOH; and

- requires compliance with the Department approved Site Management Plan.

6. Site Management Plan

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

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

Institutional Controls: The environmental easement discussed in remedy bullet #5.

Engineering Controls: The vapor mitigation system discussed in remedy bullet #3.

This plan includes, but may not be limited to:

- an Excavation Plan which details the provisions for management of future excavations in areas of remaining contamination;
- descriptions of the provisions of the environmental easement including any land use, and/or groundwater use restrictions;
- provisions for the management and inspection of the identified engineering controls;
- maintaining site access controls and Department notification; and
- the steps necessary for the periodic reviews and certification of the institutional and/or engineering controls.

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

- monitoring groundwater to assess the performance and effectiveness of the remedy;
- a schedule of monitoring and frequency of submittals to the Department;
- monitoring for vapor intrusion for any buildings developed on the site, as may be required by the Institutional and Engineering Control Plan discussed above.

4.0 REMEDIAL ACTION PROGRAM

4.1 GOVERNING DOCUMENTS

4.1.1 Site Specific Health & Safety Plan (HASP)

All remedial work performed under this plan will be in full compliance with governmental requirements, including Site and worker safety requirements mandated by Federal OSHA.

The Volunteer and associated parties preparing the remedial documents submitted to the State and those performing the construction work, are completely responsible for the preparation of an appropriate Health and Safety Plan and for the appropriate performance of work according to that plan and applicable laws.

The Health and Safety Plan (HASP) and requirements defined in this Remedial Action Work Plan pertain to all remedial and invasive work performed at the Site until the issuance of a Certificate of Completion.

The Site Safety Coordinator will be Paul I. Matli. A resume will be provided to NYSDEC prior to the start of remedial construction.

Confined space entry will comply with all OSHA requirements to address the potential risk posed by combustible and toxic gasses.

4.1.2 Quality Assurance Project Plan (QAPP)

The QAPP is provided under Appendix 4.

4.1.3 Construction Quality Assurance Plan (CQAP)

The Construction Quality Assurance Plan (CQAP) will be provided by the Construction Manager. This document will be submitted prior to the start of remedial construction.

4.1.4 Soil/Materials Management Plan (SoMP)

This document is included as Section 5.2 and includes detailed plans for managing all soils/materials that are disturbed at the Site, including excavation, handling, storage, transport and disposal. It also includes all of the controls that will be applied to these efforts to assure effective, nuisance-free performance in compliance with all applicable Federal, State and local laws and regulations.

4.1.5 Storm-Water Pollution Prevention Plan (SWPPP)

The erosion and sediment controls will be in conformance with requirements presented in the New York State Guidelines for Urban Erosion and Sediment Control. A Storm Water Pollution Prevention Plan (SWPPP) is provided under Appendix 5.

4.1.6 Community Air Monitoring Plan (CAMP)

The Community Air Monitoring Plan (CAMP) is provided under Appendix 6.

4.1.7 Contractors Site Operations Plan (SOP);

The Remedial Engineer has reviewed all plans and submittals for this remedial project (including those listed above and contractor and sub-contractor document submittals) and confirms that they are in compliance with this RAWP. The Remedial Engineer is responsible to ensure that all later document submittals for this remedial project, including contractor and sub-contractor document submittals, are in compliance with this RAWP. All remedial documents will be submitted to NYSDEC and NYSDOH in a timely manner and prior to the start of work.

A detailed remedial construction design document will be submitted to NYSDEC for approval upon its completion

4.1.8 Citizen Participation Plan

A CPP has been developed for this project. The public will be notified through fact sheets of the various stages of the project. These stages will include the submittal of the RAWP, the commencement of the remedial actions at the Site and any other stage indicated by the NYSDEC. The Fact Sheets will be mailed to the NYSDEC approved contact list.

A certification of mailing will be sent by the Volunteer to the NYSDEC project manager following the distribution of all Fact Sheets and notices that includes: (1) certification that the Fact Sheets were mailed, (2) the date they were mailed; (3) a copy of the Fact Sheet, (4) a list of recipients (contact list); and (5) a statement that the repository was inspected on (specific date) and that it contained all of applicable project documents.

No changes will be made to any approved Fact Sheets authorized for release by NYSDEC without written consent of the NYSDEC. No other information, such as brochures and flyers, will be included with the Fact Sheet mailing.

The approved Citizen Participation Plan for this project is attached in Appendix 7.

Document repositories have been established at the following location and contain all applicable project documents:

Queens Library - Astoria
14-01 Astoria Blvd, Astoria, NY
(718) 278-2220
Library hours:

Sunday	closed
Monday	11:00AM-7:00PM
Tuesday	2:00AM-7:00PM
Wednesday	1:00AM-7:00PM
Thursday	11:00AM-7:00PM
Friday	11:00AM-7:00PM
Saturday	closed

Queens 1 Community District
45-02 Ditmars Boulevard, Suite 1025 Astoria, NY 11106
Chairperson: Joseph Risi
(718) 626-1021

4.2 GENERAL REMEDIAL CONSTRUCTION INFORMATION

4.2.1 Project Organization

The following individuals will be involved in the performance of the RAWP at the Site.

Individual Name	Title
Ariel Czemerinski	Remedial Engineer
Mark Robbins	Project Director/Quality Assurance Officer
Rachel Ataman	Project Coordinator
Paul Matli	Project Geologist/Health and Safety Officer
Morgan Violette	Project Geologist/Health and Safety Officer (Alternate)

Resumes of key personnel involved in the Remedial Action are included in Appendix 8.

4.2.2 Remedial Engineer

The Remedial Engineer for this project will be Ariel Czemerinski. The Remedial Engineer is a registered professional engineer licensed by the State of New York. The Remedial Engineer will have primary direct responsibility for implementation of the remedial program for the 11-28 31st Drive Site (NYSDEC BCA Index No.–C241159-04-14Site No. C241159). The Remedial Engineer will certify in the Final Engineering Report that the remedial activities were observed by qualified environmental professionals under his supervision and that the remediation requirements set forth in the Remedial Action Work Plan and any other relevant provisions of ECL 27-1419 have been achieved in full conformance with that Plan. Other Remedial Engineer certification requirements are listed later in this RAWP.

The Remedial Engineer will coordinate the work of other contractors and subcontractors involved in all aspects of remedial construction, including soil excavation, stockpiling, characterization, removal and disposal, air monitoring, emergency spill response services, import of back fill material, and management of waste transport and disposal. The Remedial Engineer will be responsible for all appropriate communication with NYSDEC and NYSDOH.

The Remedial Engineer will review all pre-remedial plans submitted by contractors for compliance with this Remedial Action Work Plan and will certify compliance in the Final Engineering Report.

The Remedial Engineer will provide the certifications listed in Section 10.1 in the Final Engineering Report.

4.2.3 Remedial Action Construction Schedule

Currently, a 7-month remediation construction schedule is anticipated. Refer to Section 11.0.**4.2.4 Work Hours**

The hours for operation of remedial construction will conform to the New York City Department of Buildings construction code requirements or according to specific variances issued by that agency. The NYSDEC will be notified by the Volunteer of any variances issued by the Department of Buildings. NYSDEC reserves the right to deny alternate remedial construction hours.

4.2.5 Site Security

The Site will be secured at night in accordance with New York City Department of Building Construction Codes.

4.2.6 Traffic Control

Proper traffic control will be performed in accordance with New York City Department of Buildings Construction Codes.

4.2.7 Contingency Plan

The Construction Health and Safety Plan is provided under Appendix 9.

4.2.8 Worker Training and Monitoring

Remedial work performed under this RAWP will be in full compliance with applicable health and safety laws and regulations, including Site and OSHA worker safety requirements and HAZWOPER requirements. All workers will be trained in accordance with New York City Department of Building Construction Codes and in accordance with the Construction Health and Safety Plan provided under Appendix 9.

4.2.9 Agency Approvals

The Volunteer has addressed all SEQRA requirements for this Site. All permits or government approvals required for remedial construction have been, or will be, obtained prior to the start of remedial construction.

The planned end use for the Site is in conformance with the current zoning for the property as determined by New York City Department of Planning. A Certificate of Completion will not be issued for the project unless conformance with zoning designation is demonstrated.

A complete list of all local, regional and national governmental permits, certificates or other approvals or authorizations required to perform the remedial and development work is attached in Appendix 10. This list includes a citation of the law, statute or code to be complied with, the originating agency, and a contact name and phone number in that agency. This list will be updated in the Final Engineering Report.

All planned remedial or construction work in regulated wetlands and adjacent areas will be specifically approved by the NYSDEC Division of Natural Resources to ensure that it meets the requirements for substantive compliance with those regulations prior to the start of construction. Nothing in the approved Remedial Action Work Plan or its approval by NYSDEC should be construed as an approval for this purpose.

4.2.11 Pre-Construction Meeting with NYSDEC

This meeting will take place prior to the start of major construction activities. The meeting will be scheduled with the NYSDEC at least 5 days prior to its occurrence.

4.2.12 Emergency Contact Information

An emergency contact sheet with names and phone numbers is included in the HASP provided under Appendix 9. That document will define the specific project contacts for use by NYSDEC and NYSDOH in the case of a day or night emergency.

4.2.13 Remedial Action Costs

An itemized and detailed summary of estimated costs for all remedial activity is attached as Appendix 11. This will be revised based on actual costs and submitted as an Appendix to the Final Engineering Report.

4.3 SITE PREPARATION

4.3.1 Mobilization

All equipment will be brought to the Site. The equipment will be maintained on-site and will be checked out as operational prior to the mobilization.

4.3.2 Erosion and Sedimentation Controls

The entire Site will be excavated for development during the remediation process. Any necessary Erosion and Sediment Controls are detailed in the Storm-Water Pollution Prevention Plan (SWPPP) provided in Appendix 5.

4.3.3 Stabilized Construction Entrance(s)

As indicated in the SWPPP a temporary gravel construction entrance will be installed on the southeast side of the property towards Southern Boulevard. This will be done to reduce the amount of sediment transported onto roads by construction vehicles and run-off. The entrance will be graded so that runoff water will be directed to an inlet protection structure and away from the steep fill area.

4.3.4 Utility Marker and Easements Layout

The Volunteer and its contractors are solely responsible for the identification of utilities that might be affected by work under the RAWP and implementation of all required, appropriate, or necessary health and safety measures during performance of work under this RAWP. The Volunteer and its contractors are solely responsible for safe execution of all invasive and other work performed under this RAWP. The Volunteer and its contractors must obtain any local, State or Federal permits or approvals pertinent to such work that may be required to perform work under this RAWP. Approval of this RAWP by NYSDEC does not constitute satisfaction of these requirements.

The presence of utilities and easements on the Site has been investigated by the Remedial Engineer. It has been determined that no risk or impediment to the planned work under this Remedial Action Work Plan is posed by utilities or easements on the Site.

4.3.5 Sheeting and Shoring

Appropriate management of structural stability of on-Site or off-Site structures during on-Site activities include excavation is the sole responsibility of the Volunteer and its contractors. The Volunteer and its contractors are solely responsible for safe execution of all invasive and other work performed under this Plan. The Volunteer and its contractors must obtain any local, State or Federal permits or approvals that may be required to perform work under this Plan. Further, the Volunteer and its contractors are solely responsible for the implementation of all required, appropriate, or necessary health and safety measures during performance of work under the approved Plan.

4.3.6 Equipment and Material Staging

All equipment and material will be staged onsite as per the New York City Department of Building Requirements.

4.3.7 Decontamination Area

A Decontamination Area will be staged at the Site.

4.3.8 Site Fencing

A fence will be installed around the perimeter of the property in accordance with New York City Department of Building requirements.

4.3.9 Demobilization

The Demobilization plan will be submitted and will include

- Restoration of areas that may have been disturbed to accommodate support areas (e.g., staging areas, decontamination areas, storage areas, temporary water management areas, and access area);
- Removal of temporary access areas (whether on-Site or off-Site) and restoration of disturbed access areas to pre-remediation conditions;
- Removal of sediment and erosion control measures and disposal of materials in accordance with acceptable rules and regulations;
- Equipment decontamination;
- General refuse disposal.

4.4 REPORTING

All daily and monthly Reports will be included in the Final Engineering Report.

4.4.1 Daily Reports

Daily reports will be submitted to NYSDEC and NYSDOH Project Managers by the end of each day following the reporting period and will include:

- An update of progress made during the reporting day;
- Locations of work and quantities of material imported and exported from the Site;
- References to alpha-numeric map for Site activities;
- A summary of any and all complaints with relevant details (names, phone numbers);
- A summary of CAMP finding, including excursions;
- An explanation of notable Site conditions.

Daily reports are not intended to be the mode of communication for notification to the NYSDEC of emergencies (accident, spill), requests for changes to the RAWP or other sensitive or time critical information. However, such conditions must also be included in the daily reports. Emergency conditions and changes to the RAWP will be addressed directly to NYSDEC Project Manager via personal communication.

Daily Reports will include a description of daily activities keyed to an alpha-numeric map for the Site that identifies work areas. These reports will include a summary of air sampling results, odor and dust problems and corrective actions, and all complaints received from the public.

A Site map that shows a predefined alpha-numeric grid for use in identifying locations described in reports will be established in coordination with a disposal facility and will be submitted to NYSDEC prior to the start of invasive remedial activities.

The NYSDEC assigned project number will appear on all reports.

4.4.2 Monthly Reports

Monthly reports will be submitted to NYSDEC and NYSDOH Project Managers within one week following the end of the month of the reporting period and will include:

- Activities relative to the Site during the previous reporting period and those anticipated for the next reporting period, including a quantitative presentation of work performed (i.e. tons of material exported and imported, etc.);
- Description of approved activity modifications, including changes of work scope and/or schedule;
- Sampling results received following internal data review and validation, as applicable; and,
- An update of the remedial schedule including the percentage of project completion, unresolved delays encountered or anticipated that may affect the future schedule, and efforts made to mitigate such delays.

4.4.3 Other Reporting

Photographs will be taken of all remedial activities and submitted to NYSDEC in digital (JPEG) format. Photos will illustrate all remedial program elements and will be of acceptable quality. Representative photos of the Site prior to any Remedial Actions will be provided. Representative photos will be provided of each contaminant source, source area and Site structures before, during and after remediation. Photos will be submitted to NYSDEC on CD or other acceptable electronic media and will be sent to NYSDEC's Project Manager (2 copies) and to NYSDOH's Project Manager (1 copy). CD's will have a label and a general file inventory structure that separates photos into directories and sub-directories according to logical Remedial Action components. A photo log keyed to photo file ID numbers will be prepared to provide explanation for all representative photos. For larger and longer projects, photos should be submitted on a monthly basis or another agreed upon time interval.

Job-site record keeping for all remedial work will be appropriately documented. These records will be maintained on-Site at all times during the project and be available for inspection by NYSDEC and NYSDOH staff.

4.4.4 Complaint Management Plan

If public complaints are made, the public will be directed to the project manager whom will be on-site during construction. The project manager will be able to explain the results of the measurements and the actions taken if the measurements are elevated.

4.4.5 Deviations from the Remedial Action Work Plan

If conditions arise that require deviation from this Work Plan, the Remedial Engineer will contact NYSDEC immediately to notify what changes are required and request approval. All changes will be thoroughly documented in the Final Engineering Report and include a discussion of its effect on the remedy.

5.0 REMEDIAL ACTION: MATERIAL REMOVAL FROM SITE

As part of the proposed remedial construction at the Site, approximately 62 feet of existing masonry retaining walls and underlying footings on both side of the current building will be maintained and incorporated into the new building. Column footings and grade beam footings for the new building will be installed at approximately 2 feet 6 inches bgs, and therefore, the top 3 feet across the entire Site will be excavated and removed. An elevator pit will be excavated to 7 feet 8 inches beneath the eastern portion as shown on Figure 10. No groundwater is expected to be encountered during Site invasive activities. A Qualified Environmental Professional (QEP) under the supervision of the Remedial Engineer will be on-site during all excavation activities to supervise the excavation, document the fieldwork and provide progress report(s) and to insure the proper implementation of a CAMP. All soil that is excavated will be visually examined by the QEP for the presence of visual/olfactory evidence of contamination. Additionally, select soil samples will be screened for the presence of organic vapors utilizing a Photoionization Detector (PID).

A total of approximately 350 tons of soil/fill material impacted with metals will be excavated at the Site and disposed at permitted facilities in accordance with all Federal, State laws and regulations for handling, transport, and disposal. The soil is expected to be disposed as non-hazardous material. Final volumes for all waste(s) or soil that is disposed will be provided in the form of waste manifests.

Collection of end point samples is not required at the conclusion of Site excavation. However, end point soil samples will collected following the UST removal and will be obtained from the bottom and sidewalls of the USTexcavation.

Soil end point samples will be compared to the residential SCOs. All field sampling will be performed in accordance with DER-10 and with the QAPP. General requirements mandate sidewall sampling for every thirty feet of each side and bottom sampling for every nine hundred square feet of excavation area.

5.1 SOIL CLEANUP OBJECTIVES

The Soil Cleanup Objectives for this Site are the Residential SCOs listed in Table 8.

Soil and materials management on-Site and off-Site will be conducted in accordance with the Soil Management Plan as described below.

All soil samples met the SCOs proposed for this Remedial Action. A spider map that shows all soil samples that exceeded the Unrestricted SCOs is shown in Figures 6.

UST closures will, at a minimum, conform to criteria defined in DER-10.

5.2 REMEDIAL PERFORMANCE EVALUATION (POST EXCAVATION END-POINT SAMPLING)

In accordance with NYSDEC DER-10 end point soil samples will be collected from the bottom and sidewalls following Site excavation and also from the bottom and sidewalls of the tank excavation.

5.2.1 End-Point Sampling Frequency

-Post-excavation end point samples will only be obtained in the vicinity of the closed and removed UST located beneath the slab in the northeastern portion of the Site. In accordance with Section 5.5 of DER-10 a minimum of five endpoint samples will be collected around the removed UST including 4 sidewall samples and one bottom sample. Figure 10 provides a proposed end point sampling plan.

5.2.2 Methodology

Soil end point samples will be collected by hand directly from undisturbed soil at sides and bottom of excavation Separate aliquots of each endpoint sample will be placed into both airtight zip-lock bags and 4-ounce and 8-ounce jars and appropriately labeled. The QEP will then characterize each soil sample in the field. The soil characterization will consist of determining the soil classification utilizing the Unified Soil Classification System and screening each sample for organic vapors utilizing a Photoionization Detector (PID) with an 11.7eV bulb.

A PID makes use of the principle of photoionization for the detection and qualitative measurement of organic vapors. A PID does not respond to all compounds similarly, rather, each compound has its own response factor relative to its calibration. For this investigation, the

PID will be calibrated to the compound isobutylene, which is published by the manufacturer. The PID has a minimum detection limit of 0.1 parts per million (ppm). This meter measures the hydrocarbon concentrations in isolated portions of the secured samples.

Headspace analyses will be conducted on each soil sample by partially filling the zip lock bag and sealing it, thereby creating a void. This void is referred to as the sample headspace. To facilitate the detection of any hydrocarbons contained within the headspace, the container will be agitated for a period of 30 seconds. The probe of the PID will then be placed within the headspace to measure the organic vapors present

The endpoint samples will be analyzed for VOCs via EPA 8260, SVOCs via EPA 8270BN, pesticides via 8081, herbicides via 8051, PCBs via 8082 and TAL metals via 6010.

5.2.3 Reporting of Results

A summary of end point samples results will be provided in a tabular format and compared to Track 2 Restricted Residential SCOs. All results will also be provided to NYSDEC in the appropriate electronic data deliverable (EDD) format.

5.2.4 QA/QC

All field sampling will be performed in accordance with the QAPP provided in Appendix 4**.** Samples will be properly handled and placed into the appropriate labeled containers. The samples will be placed in a cooler filled with ice and maintained at a maximum 4 degrees Celsius. All samples will be transmitted under proper chain of custody procedures to a State-certified (ELAP) laboratory for confirmatory laboratory analyses. All holding times for each matrix and analysis will be met.

Additionally, trip blanks will be provided with all laboratory transmittals. Field blanks will be prepared associated with all field samples. Matrix Spike and Matrix Spike Duplicate samples will be obtained throughout the sampling at a rate of 1 per 20 samples for each group of analytes.

5.2.5 DUSR

The final FER will provide a Data Usability Summary Report (DUSR). The DUSR will compare all sampling results to the QAPP provided under Appendix 4.

5.2.6 Reporting of End-Point Data in FER

Chemical labs used for all end-point sample results and contingency sampling will be NYSDOH ELAP certified.

End point sampling, including bottom and sidewall sampling, will be performed in accordance with DER-10 sample frequency requirements. Sidewall samples will be collected a minimum of every 30 linear feet. Bottom samples will be collected at a rate of one for every 900 square feet. Endpoint samples will be collected from the sidewalls and bottom soils around the removed UST. The FER will provide a tabular and map summary of all end-point sample results and exceedances of SCOs.

5.3 ESTIMATED MATERIAL REMOVAL QUANTITIES

The estimated quantity of soil/fill to be removed from the Site is 350 tons. The estimated quantity of soil to be imported into the Site for backfill is 130 tons. No soil/fill is expected to be reused/relocated on Site~~.~~ Where necessary, concrete footings associated with existing building will be removed and disposed as concrete and demolition materials (C&D) at a permitted and registered recycling facility.

5.4 SOIL/MATERIALS MANAGEMENT PLAN

During site construction activities, an excavator will remove contaminated soil under the direction of a QEP, who will work under the supervision of the Remedial Engineer. The soil will be “live loaded” onto appropriate trucks and transported directly to an approved disposal facility. Waste characterization samples will be obtained and analyzed prior to excavation activities. Final volumes for all waste(s) or soil that is disposed will be provided in the form of waste manifests.

5.4.1 Soil Screening Methods

Visual, olfactory and PID soil screening and assessment will be performed by a QEP during all remedial and development excavations into known or potentially contaminated material (Residual Contamination Zone). Soil screening will be performed regardless of when the invasive work is done and will include all excavation and invasive work performed during the remedy and during development phase, such as excavations for foundations and utility work, prior to issuance of the COC.

All primary contaminant sources (including but not limited to tanks and hotspots) identified during Site Characterization, Remedial Investigation, and Remedial Action will be surveyed by a surveyor licensed to practice in the State of New York. This information will be provided on maps in the Final Engineering Report.

Screening will be performed by QEPs under the supervision of the Remedial Engineer. Prior to the start of the excavation, resumes will be provided for all QEPs responsible for field screening (i.e. those representing the Remedial Engineer) of invasive work for unknown contaminant sources during remediation and development work.

5.4.2 Stockpile Methods

Stockpiles will be inspected at a minimum once each week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by NYSDEC.

Stockpiles will be kept covered at all times with appropriately anchored tarps. Stockpiles will be routinely inspected and damaged tarp covers will be promptly replaced.

Soil stockpiles will be continuously encircled with silt fences. Hay bales will be used as needed near catch basins, surface waters and other discharge points.

Water will be available on-site via an existing water main at suitable supply and pressure for use in dust control.

5.4.3 Materials Excavation and Load Out

The Remedial Engineer or a qualified environmental professional under his/her supervision will oversee all invasive work and the excavation and load-out of all excavated material.

The Volunteer and its contractors are solely responsible for safe execution of all invasive and other work performed under this Plan.

The presence of utilities and easements on the Site has been investigated by the Remedial Engineer. It has been determined that no risk or impediment to the planned work under this Remedial Action Work Plan is posed by utilities or easements on the Site.

Loaded vehicles leaving the Site will be appropriately lined, tarped, securely covered, manifested, and placarded in accordance with appropriate Federal, State, local, and NYSDOT requirements (and all other applicable transportation requirements).

A truck wash will be operated on-Site. The Remedial Engineer will be responsible for ensuring that all outbound trucks will be washed at the truck wash before leaving the Site until the remedial construction is complete.

Locations where vehicles enter or exit the Site shall be inspected daily for evidence of off-Site sediment tracking.

The Remedial Engineer will be responsible for ensuring that all egress points for truck and equipment transport from the Site will be clean of dirt and other materials derived from the Site during Site remediation and development. Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to Site -derived materials.

The Volunteer and associated parties preparing the remedial documents submitted to the State, and parties performing this work, are completely responsible for the safe performance of all invasive work, the structural integrity of excavations, and for structures that may be affected by excavations (such as building foundations and bridge footings).

The Remedial Engineer will ensure that Site development activities will not interfere with, or otherwise impair or compromise, remedial activities proposed in this Remedial Action Work Plan.

Each hotspot and structure to be remediated (USTs, vaults and associated piping, transformers, etc.) will be removed and end-point remedial performance sampling completed before excavations related to Site development commence proximal to the hotspot or structure.

Development-related grading cuts and fills will not be performed without NYSDEC approval and will not interfere with, or otherwise impair or compromise, the performance of remediation required by this plan.

Mechanical processing of historical fill and contaminated soil on-Site will not be performed due to limitations related to the lack of free space on-Site during site remediation and other restrictions related to noise and vibration

All primary contaminant sources (including but not limited to tanks and hotspots) identified during Site Characterization, Remedial Investigation, and Remedial Action will be surveyed by a surveyor licensed to practice in the State of New York. The survey information will be shown on maps to be reported in the Final Engineering Report.

5.4.4 Materials Transport Off-Site

All transport of materials will be performed by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers will be appropriately licensed and trucks properly placarded.

Truck transport routes are provided in Figure 11 All trucks loaded with Site materials will exit the vicinity of the Site using only these approved truck routes.

The Site will have one access gate from 31st Drive to the north, which will accommodate the entry and exit of a single truck at a time. The truck transport routes identified in Figure 11 are the most appropriate routes and take into account: (a) limiting transport through residential areas and past sensitive sites; (b) use of city mapped truck routes; (c) prohibiting off- Site queuing of trucks entering the facility; (d) limiting total distance to major highways; (e) promoting safety in access to highways; and (f) overall safety in transport.

Trucks will be prohibited from stopping and idling in the neighborhood outside the project Site.

Egress points for truck and equipment transport from the Site will be kept clean of dirt and other materials during Site remediation and development.

Queuing of trucks will be performed on-Site in order to minimize off-Site disturbance. Off-Site queuing will be prohibited.

Material transported by trucks exiting the Site will be secured with tight-fitting covers. Loose-fitting canvas-type truck covers will be prohibited. If loads contain wet material capable of producing free liquid, truck liners will be used.

All trucks will be washed prior to leaving the Site. Truck wash waters will be collected and disposed of off-Site in an appropriate manner.

5.4.5 Materials Disposal Off-Site

Disposal location for soil removed from this Site will be determined at a later date and will be documented and submitted to the NYSDEC Project Manager prior to the start of remedial activities.

The total quantity of material expected to be disposed off-Site is approximately 350 tons of non-hazardous soil/fill material destined for disposal.

All soil/fill/solid waste excavated and removed from the Site will be treated as contaminated and regulated material and will be disposed in accordance with all local, State (including 6NYCRR Part 360) and Federal regulations. If disposal of soil/fill from this Site is proposed for unregulated disposal (i.e. clean soil removed for development purposes), a formal request with an associated plan will be made to NYSDEC's Project Manager. Unregulated off-Site management of materials from this Site is prohibited without formal NYSDEC approval.

Material that does not meet Track 1 unrestricted SCOs is prohibited from being taken to a New York State recycling facility (6NYCRR Part 360-16 Registration Facility).

The following documentation will be obtained and reported by the Remedial Engineer for each disposal location used in this project to fully demonstrate and document that the disposal of material derived from the Site conforms with all applicable laws: (1) a letter from the Remedial Engineer or BCP Volunteer to the receiving facility describing the material to be disposed and requesting formal written acceptance of the material. This letter will state that material to be disposed is contaminated material generated at an environmental remediation Site in New York State. The letter will provide the project identity and the name and phone number of the Remedial Engineer. The letter will include as an attachment a summary of all chemical data for the material being transported (including Site Characterization data); and (2) a letter from all receiving facilities stating it is in receipt of the correspondence (above) and is approved to accept the material. These documents will be included in the FER.

Non-hazardous historic fill and contaminated soils taken off-Site will be handled, at minimum, as a Municipal Solid Waste per 6NYCRR Part 360-1.2

Historical fill and contaminated soils from the Site are prohibited from being disposed at Part 360-16 Registration Facilities (also known as Soil Recycling Facilities).

Soils that are contaminated but non-hazardous and are being removed from the Site are considered by the Division of Materials Management (DMM) in NYSDEC to be Construction and Demolition (C/D) materials with contamination not typical of virgin soils. These soils may be sent to a permitted Part 360 landfill. They may be sent to a permitted C/D processing facility without permit modifications only upon prior notification of NYSDEC Region 2 DMM. This material is prohibited from being sent or redirected to a Part 360-16 Registration Facility. In this case, as dictated by DMM, special procedures will include, at a minimum, a letter to the C/D facility that provides a detailed explanation that the material is derived from a DER remediation Site, that the soil material is contaminated and that it must not be redirected to on-Site or off-Site Soil Recycling Facilities. The letter will provide the project identity and the name and phone number of the Remedial Engineer. The letter will include as an attachment a summary of all chemical data for the material being transported.

The Final Engineering Report will include an accounting of the destination of all material removed from the Site during this Remedial Action, including excavated soil, contaminated soil, historic fill, solid waste, and hazardous waste, non-regulated material, and fluids. Documentation associated with disposal of all material must also include records and approvals for receipt of the material. This information will also be presented in a tabular form in the FER.

Bill of Lading system or equivalent will be used for off-Site movement of non-hazardous wastes and contaminated soils. This information will be reported in the Final Engineering Report.

Hazardous wastes derived from on-Site will be stored, transported, and disposed of in full compliance with applicable local, State, and Federal regulations.

Appropriately licensed haulers will be used for material removed from this Site and will be in full compliance with all applicable local, State and Federal regulations.

Waste characterization will be performed for off-Site disposal in a manner suitable to the receiving facility and in conformance with applicable permits. Sampling and analytical methods, sampling frequency, analytical results and QA/QC will be reported in the FER. All data available for soil/material to be disposed at a given facility must be submitted to the disposal facility with suitable explanation prior to shipment and receipt.

5.4.6 Materials Reuse On-Site

No on-Site reuse of soil fill material is planned as part of Site remedial activities.

Concrete crushing or processing on-Site is prohibited.

Organic matter (wood, roots, stumps, etc.) or other solid waste derived from clearing and grubbing of the Site is prohibited for reuse on-Site.

Contaminated on-Site material, including historic fill and contaminated soil, removed for grading or other purposes will not be reused within a cover soil layer, within landscaping berms, or as backfill for subsurface utility lines. This will be expressed in the final Site Management Plan.

5.4.7 Fluids Management

All liquids to be removed from the Site, including dewatering fluids, will be handled, transported and disposed in accordance with applicable local, State, and Federal regulations. Liquids discharged into the New York City sewer system will be addressed through approval by NYCDEP.

Dewatered fluids will not be recharged back to the land surface or subsurface of the Site. Dewatering fluids will be managed off-Site.

Discharge of water generated during remedial construction to surface waters (i.e. a local pond, stream or river) is prohibited without a SPDES permit.

5.4.8 Demarcation

After the completion of soil removal and any other invasive remedial activities and prior to backfilling, a land survey will be performed by a New York State licensed surveyor. The survey will define the top elevation of residual contaminated soils. A physical demarcation layer, consisting of orange snow fencing material or equivalent material will be placed on this surface to provide a visual reference. This demarcation layer will constitute the top of the 'Residuals Management Zone', the zone that requires adherence to special conditions for disturbance of contaminated residual soils defined in the Site Management Plan. The survey will measure the grade covered by the demarcation layer before the placement of cover soils, pavement and sub-soils, structures, or other materials. This survey and the demarcation layer placed on this grade surface will constitute the physical and written record of the upper surface of the 'Residuals Management Zone' in the Site Management Plan. A map showing the survey results will be included in the Final Engineering Report and the Site Management Plan.

5.4.9 Backfill from Off-Site Sources

All materials proposed for import onto the Site will be approved by the Remedial Engineer and will be in compliance with provisions in this RAWP prior to receipt at the Site.

Material from industrial sites, spill sites, other environmental remediation sites or other potentially contaminated sites will not be imported to the Site.

The Final Engineering Report will include the following certification by the Remedial Engineer: "I certify that all import of soils from off-Site, including source evaluation, approval and sampling, has been performed in a manner that is consistent with the methodology defined in the Remedial Action Work Plan".

All imported soils will meet NYSDEC approved backfill or objectives for this Site. These NYSDEC approved backfill objectives are listed as the lower of the protection of groundwater or the protection of public health for residential use SCOs. Non-compliant soils will not be imported onto the Site without prior approval by NYSDEC. Nothing in the approved Remedial Action Work Plan or its approval by NYSDEC should be construed as an approval for this purpose.

Soils that meet ‘exempt’ fill requirements under 6 NYCRR Part 360, but do not meet backfill objectives for this Site, will not be imported onto the Site without prior approval by NYSDEC. Nothing in this Remedial Action Work Plan should be construed as an approval for this purpose.

Solid waste will not be imported onto the Site.

Trucks entering the Site with imported soils will be securely covered with tight fitting covers.

5.4.10 Storm water Pollution Prevention

Barriers and hay bale checks will be installed and inspected once a week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by NYSDEC. All necessary repairs shall be made immediately.

Accumulated sediments will be removed as required to keep the barrier and hay bale check functional.

All undercutting or erosion of the silt fence toe anchor shall be repaired immediately with appropriate backfill materials.

Manufacturer's recommendations will be followed for replacing silt fencing damaged due to weathering.

Erosion and sediment control measures identified in the RAWP shall be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters

Silt fencing or hay bales will be installed around the entire perimeter of the remedial construction area.

5.4.11 Contingency Plan

If underground tanks or other previously unidentified contaminant sources are found during on-Site remedial excavation or development related construction, sampling will be performed on product, sediment and surrounding soils, etc. Chemical analytical work will be for full scan parameters (TAL metals; TCL volatiles and semi-volatiles, TCL pesticides and PCBs). These analyses will not be limited to STARS parameters where tanks are identified without prior approval by NYSDEC. Analyses will not be otherwise limited without NYSDEC approval.

Identification of unknown or unexpected contaminated media identified by screening during invasive Site work will be promptly communicated by phone to NYSDEC's Project Manager. These findings will be also included in daily and periodic electronic media reports.

5.4.12 Community Air Monitoring Plan

The Community Air Monitoring Plan (CAMP) has been prepared to monitor air quality during ground intrusive activities at the Site, which include but not limited to soil excavation, lagging and installation of concrete foundations. Air quality monitoring will include monitoring the air Volatile Organic Compounds (VOCs) using a PID and the presence of elevated levels of dust using Particulate Dust Track Real-time Particle Counter. Exceedances observed in the CAMP will be reported to NYSDEC and NYSDOH Project Managers and included in the Daily Report. CAMP details are provided in Appendix 6.

5.4.13 Odor, Dust and Nuisance Control Plan

The Final Engineering Report will include the following certification by the Remedial Engineer: "I certify that all invasive work during the remediation and all invasive development work were conducted in accordance with dust and odor suppression methodology defined in the Remedial Action Work Plan."

5.4.13.1 Odor Control Plan

This odor control plan is capable of controlling emissions of nuisance odors on- and off-Site. Specific odor control methods to be used on a routine basis will include the spraying of an odor-suppressing agent, brand name Biosolve. If nuisance odors are identified, work will be halted and the source of odors will be identified and corrected. Work will not resume until all nuisance odors have been abated. NYSDEC and NYSDOH will be notified of all odor events and of all other complaints about the project. Implementation of all odor controls, including the halt of work, will be the responsibility of the Volunteer's Remedial Engineer, who is responsible for certifying the Final Engineering Report.

All necessary means will be employed to prevent on- and off-Site nuisances. At a minimum, procedures will include: (a) limiting the area of open excavations; (b) shrouding open excavations with tarps and other covers; and (c) using foams to cover exposed odorous soils. If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: (d) direct load-out of soils to trucks for off-Site disposal; (e) use of chemical odorants in spray or misting systems; and, (f) use of staff to monitor odors in surrounding neighborhoods.

Where odor nuisances have developed during remedial work and cannot be corrected, or where the release of nuisance odors cannot otherwise be avoided due to on-Site conditions or close proximity to sensitive receptors, odor control will be achieved by sheltering excavation and handling areas under tented containment structures equipped with appropriate air venting/filtering systems.

5.4.13.2 Dust Control Plan

A dust suppression plan that addresses dust management during invasive on-Site work, will include, at a minimum, the items listed below:

- Water will be available on-site at suitable supply and pressure for use in dust control.] Clearing and grubbing of larger sites will be done in stages to limit the area of exposed, unvegetated soils vulnerable to dust production.
- Gravel will be used on roadways to provide a clean and dust-free road surface.
- On-Site roads will be limited in total area to minimize the area required for water truck sprinkling.

5.4.13.3 Other Nuisances

A plan for rodent control will be developed and utilized by the contractor prior to and during Site clearing and Site grubbing, and during all remedial work.

A plan will be developed and utilized by the contractor for all remedial work and will conform, at a minimum, to NYCDEP noise control standards.

6.0 RESIDUAL CONTAMINATION TO REMAIN ON-SITE

Since residual contaminated soil, groundwater and soil vapor will exist beneath the Site after the remedy is complete, Engineering and Institutional Controls (ECs and ICs) are required to protect human health and the environment. These ECs and ICs are described hereafter. Long-term management of EC/ICs and of residual contamination will be executed under a site-specific Site Management Plan (SMP) that will be developed and included in the FER.

ECs will be implemented to protect public health and the environment by appropriately managing residual contamination. The Controlled Property (the Site) will have two primary EC systems. These are: (1) groundwater treatment and (2) an active SSD system.

The FER will report residual contamination on the Site in tabular and map form. This will include presentation of exceedances of both Track 1 and Track 2 sites.

7.0 ENGINEERING CONTROLS

7.1 In-Situ Chemical Oxidation

An in-situ chemical oxidant (ISCO) consisting of FeEDTA-activated sodium persulfate (Klozur) has been proposed as part of the remedy at the Site. Volume and density application rates for chemical oxidants will be based on the manufacturer's recommendations. A letter from the manufacturer stating recommended dosage rates will be provided to NYSDEC and will be included in the Final Engineering Report.

Dry sodium persulfate will be applied to the base of UST excavation to address residual VOCs remaining in soil following tank removal. The amount of oxidant to be applied will be dependent on the size of the excavation and the degree of residual contamination remaining. It is anticipated that approximately 5-6 bags of persulfate will be applied in this situation. If application is on dry soil, dry sodium persulfate will then be wetted with water prior to backfilling.

The proposed remediation of on-site plume of chlorinated hydrocarbon will consist of the injection of FeEDTA-activated sodium persulfate through 6 injection points located in the vicinity of the UST in the northern portion of the Site. It is estimated a total of 1,886 pounds of persulfate along a total of 117 pounds of FeEDTA for persulfare activation will be required. Approximately 34 gallons of activated persulfate solution will be applied in each injection point from 8 feet below the water table to 2 ft above the water table.

The effectiveness of SCO injections will be evaluated by conducting a round of groundwater sampling prior to injections in order to establish background levels of contaminants and six (6) weeks and twelve (12) weeks after injections. Samples will be obtained from MW1, MW2, MW3, MW-4, MW-5 and MW-6.

Appendix 12 provides the ISCO design plan.

7.2 Sub-Slab Depressurization System

The active SSDS will prevent soil gas from accumulating beneath the building slab by creating a negative pressure zone beneath the slab. To create this negative pressure zone, a 6-inch layer consisting of ¾" aggregate of a virgin source beneath the building slab, and a sub-slab loop of 4-inch perforated piping schedule 40 PVC connected to 6-inch schedule 40 PVC risers. The riser pipes will be connected on the roof to a Radon-Away RP265 fan. These systems will be subject to an Operation and Maintenance Plan that will presented in a final SMP at the completion of site remedial construction in order to insure that these systems are operational and protective to public health and the environment. The SSD design and specifications is provided in Appendix 13.

The primary EC systems will be implemented during remedial construction at the Site. All as-built drawings, diagrams, calculation and manufacturer documentation for these-systems will be presented in the FER.

8.0 CRITERIA FOR COMPLETION OF REMEDIATION/TERMINATION OF REMEDIAL SYSTEMS9.2

8.1 In-Situ Chemical Oxidation

At least one round of groundwater treatment will be completed on the site. Future treatments, if necessary, will be dictated by the results of groundwater monitoring. This will be addressed in the Site Management Plan (see section 9.2).

Groundwater monitoring activities to assess the performance of the remedy, or natural attenuation following the removal of contaminant sources, will continue, as determined by NYSDOH and NYSDEC, until residual groundwater concentrations are found to be below NYSDEC standards or have become asymptotic over an extended period. Monitoring will continue until permission to discontinue is granted in writing by NYSDEC and NYSDOH. Monitoring activities will be outlined in the Monitoring Plan of the SMP. It is anticipated that, following remediation, a minimum of eight quarterly monitoring events will be performed.

8.2 Sub-Slab Depressurization System

Future soil vapor intrusion of on-and off-site soil vapor will be mitigated by installation of an active sub-slab depressurization system beneath the building slab.

The active SSD system will not be discontinued without written approval by NYSDEC and NYSDOH. A proposal to discontinue the active SSD system may be submitted by the property owner based on confirmatory data that justifies such request. Systems will remain in place and operational until permission to discontinue use is granted in writing by NYSDEC and NYSDOH.

SSDS design and specifications is provided in Appendix 13.

9.0 INSTITUTIONAL CONTROLS

After the remedy is complete, the Site will have residual contamination remaining in place. Engineering Controls (ECs) for the residual contamination have been incorporated into the remedy to render the overall Site remedy protective of public health and the environment. Two elements have been designed to ensure continual and proper management of residual contamination in perpetuity: an Environmental Easement and a Site Management Plan. These elements are described in this Section. A Site -specific Environmental Easement will be recorded with Queens County to provide an enforceable means of ensuring the continual and proper management of residual contamination and protection of public health and the environment in perpetuity or until released in writing by NYSDEC. It requires that the grantor of the Environmental Easement and the grantor's successors and assigns adhere to all Engineering and Institutional Controls (ECs/ICs) placed on this Site by this NYSDEC-approved remedy. ICs provide restrictions on Site usage and mandate operation, maintenance, monitoring and reporting measures for all ECs and ICs. The Site Management Plan (SMP) describes appropriate methods and procedures to ensure compliance with all ECs and ICs that are required by the Environmental Easement. Once the SMP has been approved by the NYSDEC, compliance with the SMP is required by the grantor of the Environmental Easement and grantor's successors and assigns.

9.1 ENVIRONMENTAL EASEMENT

An Environmental Easement, as defined in Article 71 Title 36 of the Environmental Conservation Law, is required when residual contamination is left on-Site after the Remedial Action is complete. As part of this remedy, an Environmental Easement approved by NYSDEC will be filed and recorded with the Queens County Office of the City Register. The Environmental Easement will be submitted as part of the Final Engineering Report.

The Environmental Easement renders the Site a Controlled Property. The Environmental Easement must be recorded with the Queens County Office of the City Register before the Certificate of Completion can be issued by NYSDEC. A series of Institutional Controls are required under this remedy to implement, maintain and monitor these Engineering Control systems, prevent future exposure to residual contamination by controlling disturbances of the subsurface soil and restricting the use of the Site to Residential use(s) only. These Institutional Controls are requirements or restrictions placed on the Site that are listed in, and required by, the Environmental Easement. Institutional Controls can, generally, be subdivided between controls that support Engineering Controls, and those that place general restrictions on Site usage or other requirements. Institutional Controls in both of these groups are closely integrated with the Site Management Plan, which provides all of the methods and procedures to be followed to comply with this remedy.

The Institutional Controls that support Engineering Controls are:

- Compliance with the Environmental Easement by the Grantee and the Grantee's successors and adherence of all elements of the SMP is required;
- All Engineering Controls must be operated and maintained as specified in this SMP;
- A soil vapor mitigation system consisting of SSD system must be inspected, certified, operated and maintained as required by the SMP;
- All Engineering Controls on the Controlled Property must be inspected and certified at a frequency and in a manner defined in the SMP;
- Groundwater~~, soil vapor,]~~ and other environmental or public health monitoring must be performed as defined in the SMP;
- Data and information pertinent to Site Management for the Controlled Property must be reported at the frequency and in a manner defined in the SMP;
- On-Site environmental monitoring devices, including but not limited to, groundwater monitor wells and ventilation system fans and alarms, must be protected and replaced as necessary to ensure proper functioning in the manner specified in the SMP;
- Engineering Controls may not be discontinued without an amendment or extinguishment of the Environmental Easement.

Institutional Controls may be modified, added or deleted from this list as warranted by Site conditions and deemed necessary by NYSDEC.

Adherence to these Institutional Controls for the Site is mandated by the Environmental Easement and will be implemented under the Site Management Plan (discussed in the next section). The Controlled Property (Site) will also have a series of Institutional Controls in the form of Site restrictions and requirements. The Site restrictions that apply to the Controlled Property are:

- Vegetable gardens and farming on the Controlled Property are prohibited;
- Use of groundwater underlying the Controlled Property is prohibited without treatment rendering it safe for intended purpose;
- All future activities on the Controlled Property that will disturb residual contaminated material are prohibited unless they are conducted in accordance with the soil management provisions in the Site Management Plan;
- The Controlled Property may be used residential, restricted residential, commercial or industrial use only, provided the long-term Engineering and Institutional Controls included in the Site Management Plan are employed;
- The Controlled Property may not be used for a higher level of use, such as unrestricted use without an amendment or extinguishment of this Environmental Easement;
- Grantor agrees to submit to NYSDEC a written statement that certifies, under penalty of perjury, that: (1) controls employed at the Controlled Property are unchanged from the previous certification or that any changes to the controls were approved by the NYSDEC; and, (2) nothing has occurred that impairs the ability of the controls to protect public health and environment or that constitute a violation or failure to comply with the SMP. NYSDEC retains the right to access such Controlled Property at any time in order to evaluate the continued maintenance of any and all controls. This certification shall be submitted annually, or an alternate period of time that NYSDEC may allow. This annual statement must be certified by an expert that the NYSDEC finds acceptable.

9.2 SITE MANAGEMENT PLAN

Site Management is the last phase of remediation and begins with the approval of the Final Engineering Report and issuance of the Certificate of Completion (COC) for the Remedial Action. The Site Management Plan is submitted as part of the FER but will be written in a manner that allows its removal and use as a complete and independent document. Site

Management continues in perpetuity or until released in writing by NYSDEC. The property owner is responsible to ensure that all Site Management responsibilities defined in the Environmental Easement and the Site Management Plan are performed.

The SMP is intended to provide a detailed description of the procedures required to manage residual contamination left in place at the Site following completion of the Remedial Action in accordance with the BCA with the NYSDEC. This includes: (1) development, implementation, and management of all Engineering and Institutional Controls; (2) development and implementation of monitoring systems and a Monitoring Plan; (3) development of a plan to operate and maintain any treatment, collection, containment, or recovery systems (including, where appropriate, preparation of an Operation and Maintenance Manual); (4) submittal of Site Management Reports, performance of inspections and certification of results, and demonstration of proper communication of Site information to NYSDEC; and (5) defining criteria for termination of treatment system operation.

To address these needs, this SMP will include four plans: (1) an Engineering and Institutional Control Plan for implementation and management of EC/ICs; (2) a Monitoring Plan for implementation of Site Monitoring; (3) an Operation and Maintenance Plan for implementation of remedial collection, containment, treatment, and recovery systems; and (4) a Site Management Reporting Plan for submittal of data, information, recommendations, and certifications to NYSDEC. The SMP will be prepared in accordance with the requirements in NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010, and the guidelines provided by NYSDEC.

Site management activities, reporting, and EC/IC certification will be scheduled on a certification period basis. The certification period will be annually. The Site Management Plan will be based on a calendar year and will be due for submission to NYSDEC by March 1 of the year following the reporting period.

The Site Management Plan in the Final Engineering Report will include a monitoring plan for groundwater at the down-gradient Site perimeter to evaluate the effectiveness of the remedy that is implemented.

No exclusions for handling of residual contaminated soils will be provided in the Site Management Plan (SMP). All handling of residual contaminated material will be subject to provisions contained in the SMP.

10.0 FINAL ENGINEERING REPORT

A Final Engineering Report (FER) and Certificate Of Completion (COC) will be submitted to NYSDEC following implementation of the Remedial Action defined in this RAWP. The FER provides the documentation that the remedial work required under this RAWP has been completed and has been performed in compliance with this plan. The FER will provide a comprehensive account of the locations and characteristics of all material removed from the Site including the surveyed map(s) of all sources. The Final Engineering Report will include as-built drawings for all constructed elements, certifications, manifests, bills of lading as well as the complete Site Management Plan (formerly the Operation and Maintenance Plan). The FER will provide a description of the changes in the Remedial Action from the elements provided in the RAWP and associated design documents. The FER will provide a tabular summary of all performance evaluation sampling results and all material characterization results and other sampling and chemical analysis performed as part of the Remedial Action. The FER will provide test results demonstrating that all mitigation and remedial systems are functioning properly. The FER will be prepared in conformance with DER-10.

Where determined to be necessary by NYSDEC, a Financial Assurance Plan will be required to ensure the sufficiency of revenue to perform long-term operations, maintenance and monitoring tasks defined in the Site Management Plan and Environmental Easement. This determination will be made by NYSDEC in the context of the Final Engineering Report review.

The Final Engineering Report will include written and photographic documentation of all remedial work performed under this remedy.

The FER will include an itemized tabular description of actual costs incurred during all aspects of the Remedial Action.

The FER will provide a thorough summary of all residual contamination left on the Site after the remedy is complete. Residual contamination includes all contamination that exceeds the Track 1 Unrestricted Use SCO in 6NYCRR Part 375-6. A table that shows exceedances from Track 1 Unrestricted SCOs for all soil/fill remaining at the Site after the Remedial Action and a map that shows the location and summarizes exceedances from Track 1 Unrestricted SCOs for all soil/fill remaining at the Site after the Remedial Action will be included in the FER.

The FER will provide a thorough summary of all residual contamination that exceeds the SCOs defined for the Site in the RAWP and must provide an explanation for why the material was not removed as part of the Remedial Action. A table that shows residual contamination in excess of Site SCOs and a map that shows residual contamination in excess of Site SCOs will be included in the FER.

The Final Engineering Report will include an accounting of the destination of all material removed from the Site, including excavated contaminated soil, historic fill, solid waste, hazardous waste, non-regulated material, and fluids. Documentation associated with disposal of all material must also include records and approvals for receipt of the material. It will provide an accounting of the origin and chemical quality of all material imported onto the Site.

Before approval of a FER and issuance of a Certificate of Completion, all project reports must be submitted in digital form on electronic media (PDF).

10.1 CERTIFICATIONS

The following certification will appear in front of the Executive Summary of the Final Engineering Report. The certification will be signed by the Remedial Engineer Ariel Czemerinski, who is a Professional Engineer registered in New York State   This certification will be appropriately signed and stamped. The certification will include the following statements:

I, Ariel Czemerinski, am currently a registered professional engineer licensed by the State of New York. I had primary direct responsibility for implementation of the remedial program for the 11-28 31st Drive Site (Site No.C241159).

I certify that the Site description presented in this FER is identical to the Site descriptions presented in the Environmental Easement, the Site Management Plan, and the Brownfield Cleanup Agreement for 11-28 31st Drive and related amendments.

I certify that the Remedial Action Work Plan dated [month day year] and Stipulations [if any] in a letter dated [month day year] and approved by the NYSDEC were implemented and that all requirements in those documents have been substantively complied with.

I certify that the remedial activities were observed by qualified environmental professionals under my supervision and that the remediation requirements set forth in the Remedial Action Work Plan and any other relevant provisions of ECL 27-1419 have been achieved.

I certify that all use restrictions, Institutional Controls, Engineering Controls, and all operation and maintenance requirements applicable to the Site are contained in an Environmental Easement created and recorded pursuant ECL 71-3605 and that all affected local governments, as defined in ECL 71-3603, have been notified that such easement has been recorded. A Site Management Plan has been submitted by the [Applicant / Volunteer / Participant] for the continual and proper operation, maintenance, and monitoring of all Engineering Controls employed at the Site, including the proper maintenance of all remaining monitoring wells, and that such plan has been approved by the NYSDEC.

I certify that the export of all contaminated soil, fill, water or other material from the property was performed in accordance with the Remedial Action Work Plan, and were taken to facilities licensed to accept this material in full compliance with all Federal, State and local laws.

I certify that all import of soils from off-Site, including source approval and sampling, has been performed in a manner that is consistent with the methodology defined in the Remedial Action Work Plan.

I certify that all invasive work during the remediation and all invasive development work were conducted in accordance with dust and odor suppression methodology and soil screening methodology defined in the Remedial Action Work Plan.

I certify that all information and statements in this certification are true. I understand that a false statement made herein is punishable as Class “A” misdemeanor, pursuant to Section 210.45 of the Penal Law.

It is a violation of Article 130 of New York State Education Law for any person to alter this document in any way without the express written verification of adoption by any New York State licensed engineer in accordance with Section 7209(2), Article 130, New York State Education Law.

11.0 SCHEDULE

Implementation of the Track 2 remedial activities are anticipated to take approximately 7 months. Within 2 months of completion of all remedial activities at the Site, a Final Engineering Report (FER) will be submitted to NYSDEC as detailed in Section 5.2. The FER will include a Site Management Plan (SMP), which will be implemented following the issuance of a Certificate of Completion. A chart showing a detailed project schedule is included in Appendix 14.

Figure 1 - Site Location Map

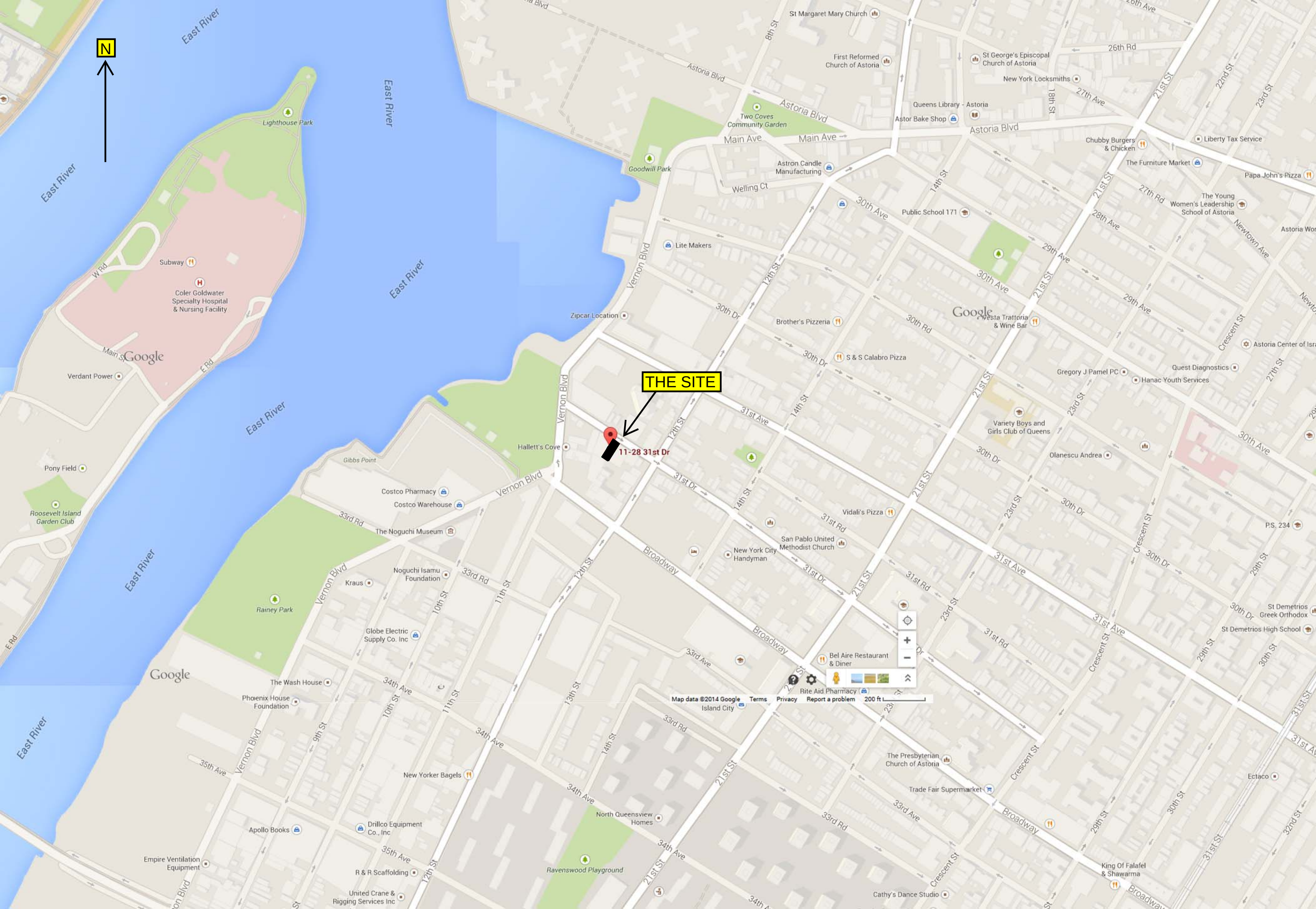
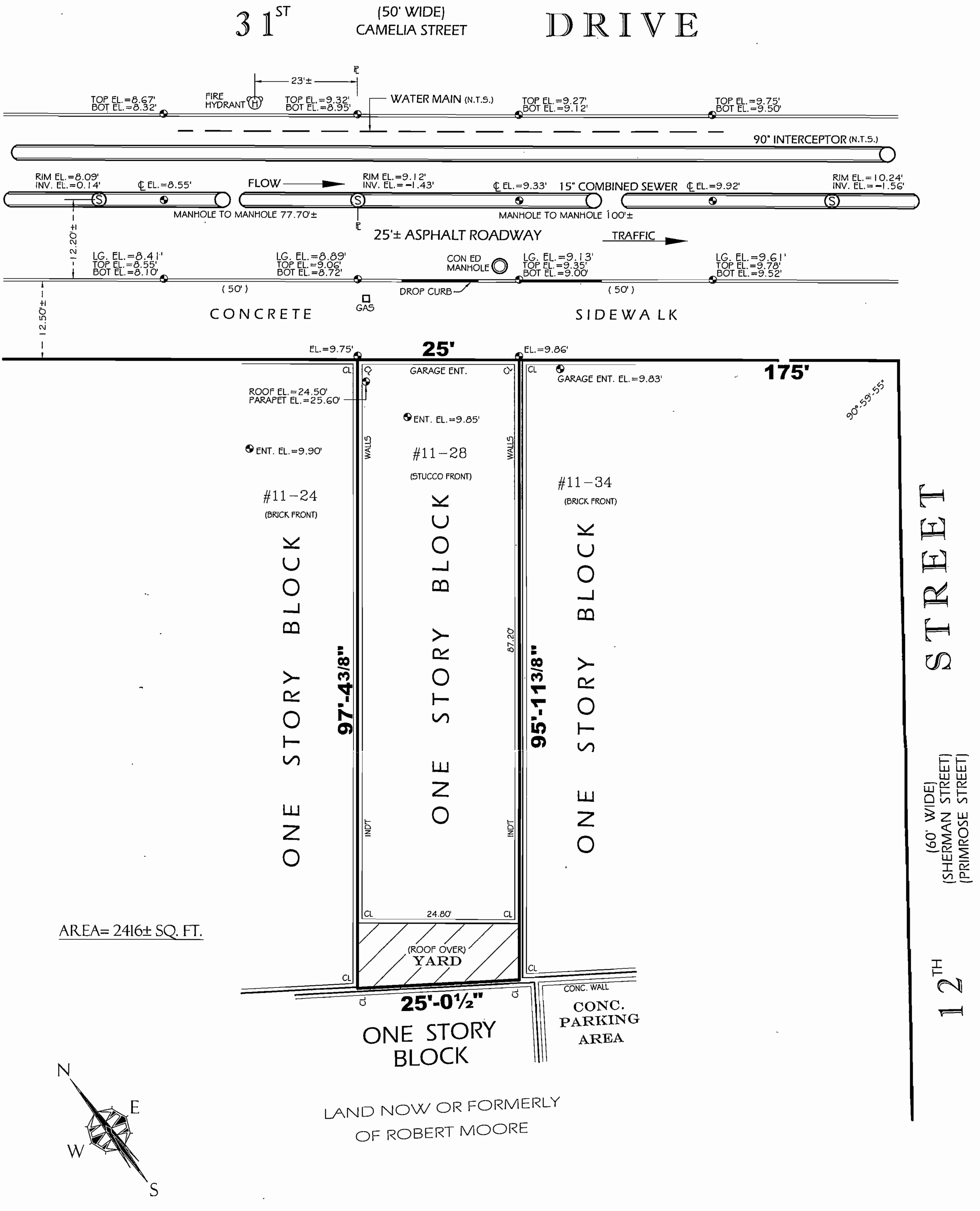

N
THE SITE
11-28 31st Dr
East River
Lighthouse Park
Subway
Coler Goldwater Specialty Hospital & Nursing Facility
W Rd
Main St
E Rd
Verdant Power
Pony Field
Roosevelt Island Garden Club
Google
Astoria Blvd
St Margaret Mary Church
First Reformed Church of Astoria
St George's Episcopal Church of Astoria
New York Locksmiths
26th Rd
27th Ave
Queens Library - Astoria
Astor Bake Shop
Two Coves Community Garden
Main Ave
Goodwill Park
Astron Candle Manufacturing
Welling Ct
Chubby Burgers & Chicken
Liberty Tax Service
The Furniture Market
Papa John's Pizza
30th Ave
Public School 171
The Young Women's Leadership School of Astoria
27th Rd
28th Ave
29th Ave
Newtown Ave
Astoria Wor
Lite Makers
Vernon Blvd
12th St
14th St
18th St
21st St
22nd St
23rd St
Zipcar Location
30th Dr
30th Rd
Brother's Pizzeria
Vesta Trattoria & Wine Bar
S & S Calabro Pizza
Crescent St
Astoria Center of Isra
Gregory J Pamel PC
Quest Diagnostics
Hanac Youth Services
27th St
31st Ave
Variety Boys and Girls Club of Queens
Olanescu Andrea
Hallett's Cove
Gibbs Point
31st Dr
31st Rd
Vidali's Pizza
P.S. 234
Costco Pharmacy
Costco Warehouse
33rd Rd
The Noguchi Museum
San Pablo United Methodist Church
New York City Handyman
Broadway
St Demetrios Greek Orthodox
St Demetrios High School
29th St
30th St
Noguchi Isamu Foundation
Kraus
Rainey Park
10th St
11th St
13th St
Globe Electric Supply Co. Inc
33rd Ave
Bel Aire Restaurant & Diner
Rite Aid Pharmacy
Island City
The Wash House
Phoenix House Foundation
34th Ave
9th St
35th Ave
New Yorker Bagels
The Presbyterian Church of Astoria
Trade Fair Supermarket
Ectaco
North Queensview Homes
Apollo Books
Drillco Equipment Co., Inc
Empire Ventilation Equipment
R & R Scaffolding
United Crane & Rigging Services Inc
Ravenswood Playground
King Of Falafel & Shawarma
Cathy's Dance Studio
31st St
32nd St
Map data ©2014 Google
Terms
Privacy
Report a problem
200 ft

Figure 2 - Site Boundary Map

BORO LAND SURVEYING, P.C.

12112032



ARCHITECTURAL SURVEY

(NOT FOR TITLE PURPOSES)
(NOT TO BE USED FOR THE STAKEOUT OF STRUCTURES.)

CAUTION: BEFORE PERFORMING ANY DIGGING OR DRILLING ON THIS SITE, IT IS REQUIRED THAT SUBSURFACE SERVICES, INCLUDING THE UNDERGROUND MAINS BE MARKED AND IDENTIFIED BY THE UTILITY INVOLVED IN COMPLIANCE WITH INDUSTRIAL CODE 53 OF NEW YORK STATE.

1)ALL ELEVATIONS REFER TO QUEENS TOPOGRAPHICAL DATUM WHICH IS 2.725 FEET ABOVE U.S. COASTAL & GEODETIC SURVEY DATUM AT SANDY HOOK NEW JERSEY.

2)UNDERGROUND UTILITY INFORMATION SHOWN WAS OBTAINED FROM VARIOUS COMPANIES AND CITY AGENCIES AND IS NOT GUARANTEED FOR ACCURACY OR COMPLETENESS. CONSULT CONSOLIDATED EDISON COMPANY AND KEYSPAN FOR DETAILED INFORMATION ON THEIR RESPECTIVE SERVICES.

3)THIS IS TO CERTIFY THAT THERE ARE NO APPARENT STREAMS NOR NATURAL WATER COURSES IN THE PROPERTY AS SHOWN ON THIS SURVEY.

SCALE: 1"=15'

UNAUTHORIZED ALTERATIONS OR ADDITIONS TO THIS SURVEY IS A VIOLATION OF SECTION 7209 OF THE NEW YORK STATE EDUCATION LAW. COPIES OF THIS SURVEY MAP NOT BEARING THE LAND SURVEYOR'S INKED SEAL OR EMBOSSED SEAL SHALL NOT BE CONSIDERED TO BE A VALID TRUE COPY. GUARANTEES OR CERTIFICATIONS INDICATED HEREON SHALL RUN ONLY TO THE PERSON FOR WHOM THE SURVEY IS PREPARED, AND ON HIS BEHALF TO THE TITLE COMPANY, GOVERNMENTAL AGENCY AND LENDING INSTITUTION LISTED HEREON, AND TO THE ASSIGNEES OF THE LENDING INSTITUTION. GUARANTEES OR CERTIFICATION ARE NOT TRANSFERABLE TO ADDITIONAL INSTITUTIONS OR SUBSEQUENT OWNERS.

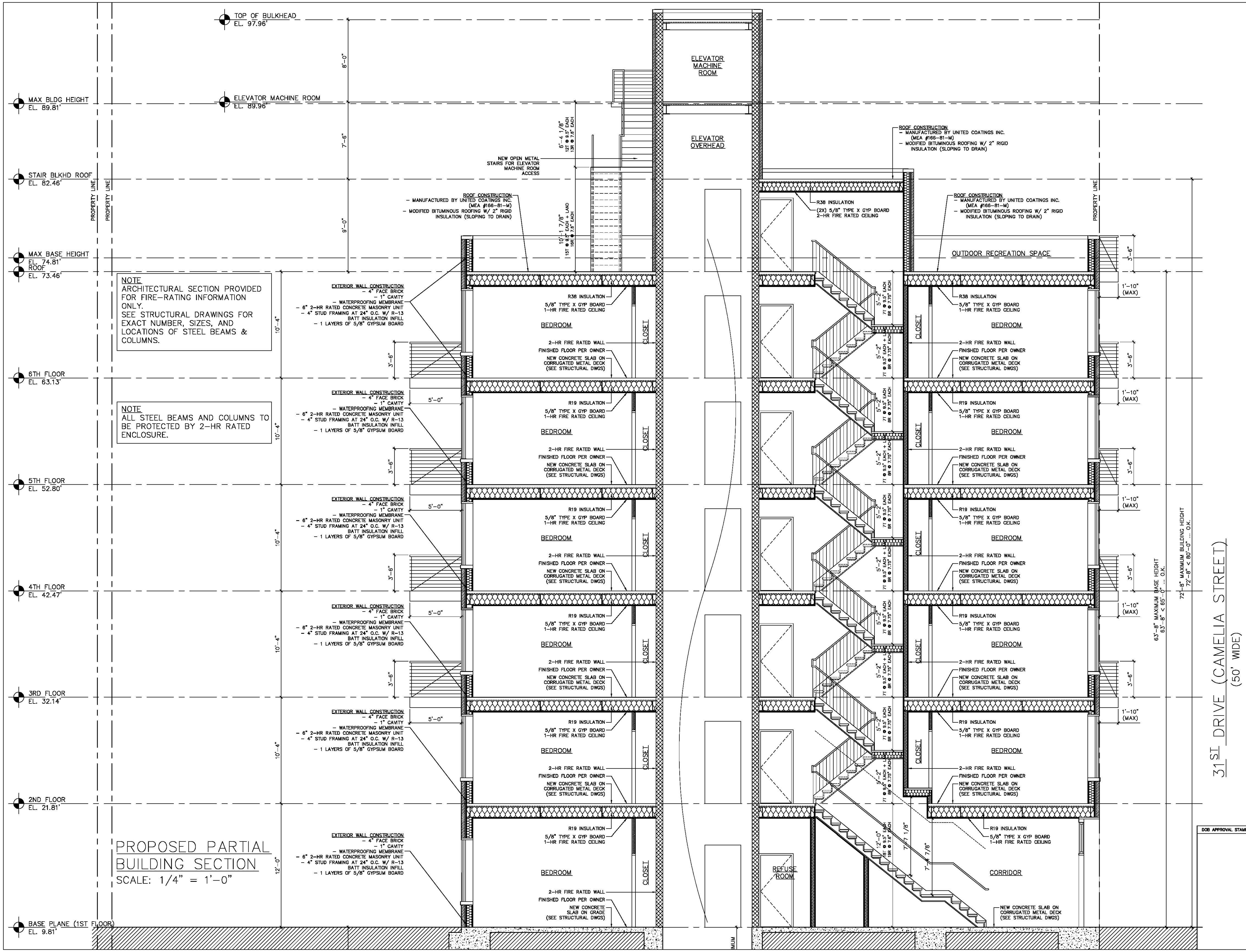
BLOCK: 502
LOT: 22
SECTION: 4
COUNTY: QUEENS
DWG BY: P.S.
CHK'D BY:

SURVEYED
NOVEMBER 9, 2012

VINCENT J. DICCE L.S.,Pres.

BORO LAND SURVEYING, P.C.
353 COURT STREET
BROOKLYN, N.Y. 11231
TEL. (718) 624-BORO (2676)

Figure 3 – Proposed Redevelopment Plan



NOTE
ARCHITECTURAL SECTION PROVIDED FOR FIRE-RATING INFORMATION ONLY.
SEE STRUCTURAL DRAWINGS FOR EXACT NUMBER, SIZES, AND LOCATIONS OF STEEL BEAMS & COLUMNS.

NOTE
ALL STEEL BEAMS AND COLUMNS TO BE PROTECTED BY 2-HR RATED ENCLOSURE.

PROPOSED PARTIAL BUILDING SECTION
SCALE: 1/4" = 1'-0"

DOB APPROVAL STAMP

ARCHITECT

TLI ARCHITECT, PLLC
957 56 STREET
BROOKLYN, NY 11219
(347) 838-0846
TLI.ARCHITECT@GMAIL.COM

CONSULTANTS

GENERAL NOTES

THESE PLANS ARE AN INSTRUMENT OF SERVICE AND ARE THE PROPERTY OF THE ARCHITECT. INFRINGEMENT WILL BE PROSECUTED.

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REVISIONS

REVISION NO.	REVISION DATE

PROJECT LOCATION
ALTERATION 1
11-28 31 DRIVE
QUEENS, NY 11106

DRAWING TITLE
PARTIAL BUILDING SECTION
(UPPER PORTION)

DESIGN APPLICANT
TIMOTHY LI
035356

NYC DOB NUMBER
420605964

DRAWN BY
TL

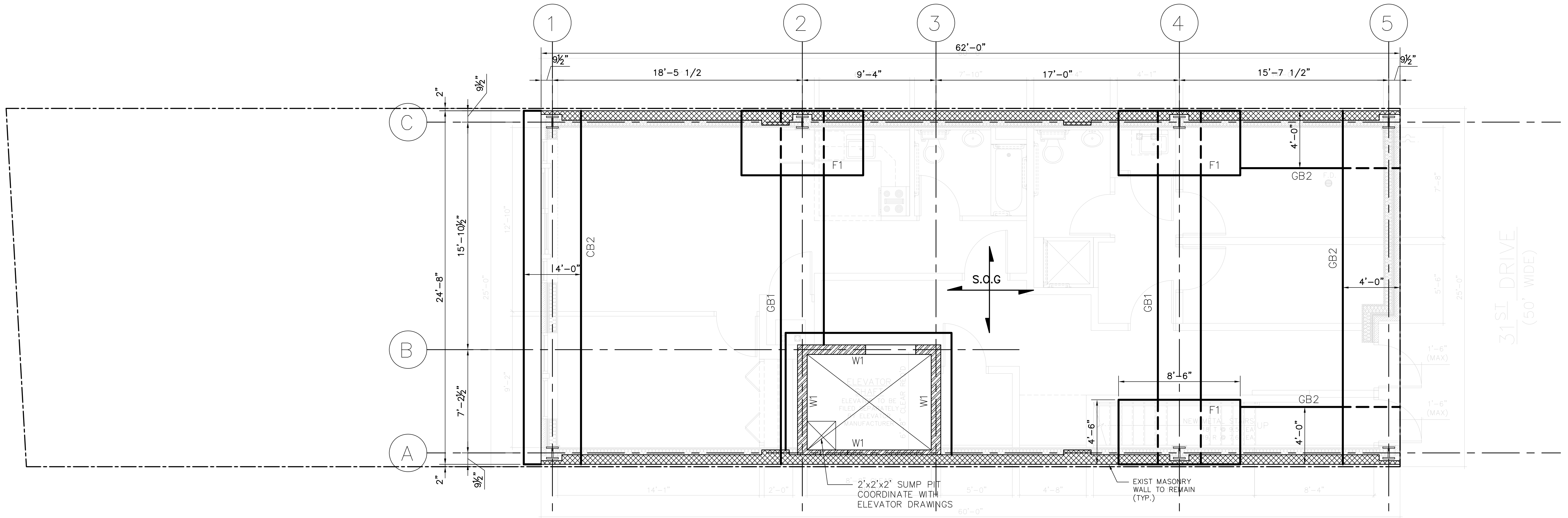
CHECKED BY
TL

PROJECT NO.
12-007

DATE
03-07-2013

DWG NO.
A-005.00

PAGE NO.
11 OF 22

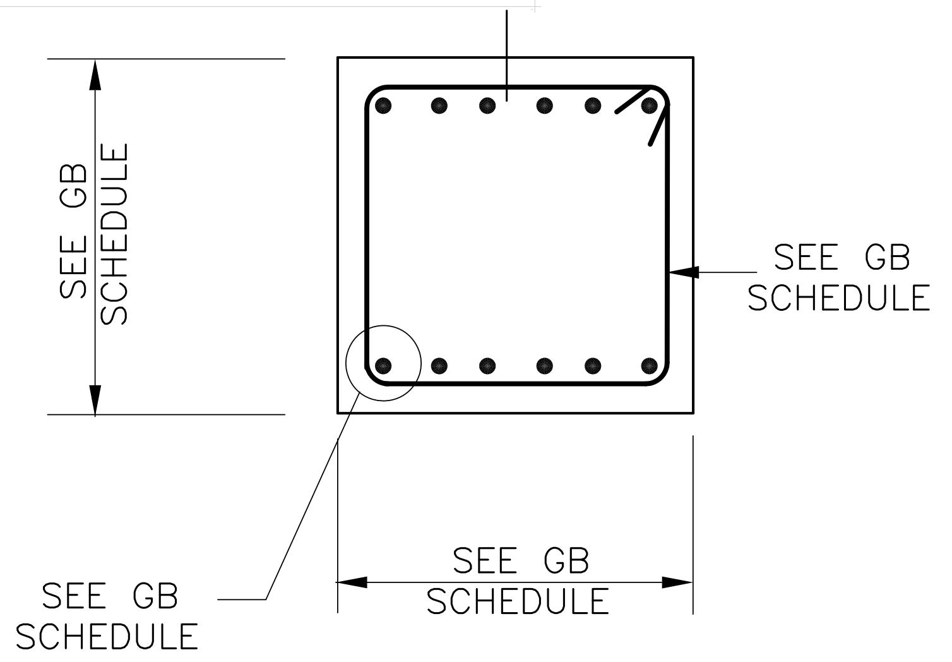


1ST FLOOR AND FOUNDATION PLAN

SCALE: 1/4"=1'-0"

FOUNDATION NOTES:

1. TOP OF SLAB ELEVATION TO BE -0.81', SEE ARCH PLAN FOR FLOOR FINISH.
2. SLAB ON GRADE TO BE 6" THICK REINFORCED WITH 6X6-W2.9xW2.9 WELDED WIRE FABRIC.
3. TOP OF FOOTING ELEVATION TO BE 6" BELOW TOP OF S.O.G, U.N.O; TOP OF GRADE BEAM ELEVATION TO MATCH TOP OF FOOTING, U.N.O;
4. PIER LONGITUDINAL REINFORCING TO BE 8-#7, TIE SPACING TO BE #4@12".
5. FOR GENERAL NOTES SEE DRAWING S-100.
6. FOR TYPICAL DETAILS SEE DRAWING S-201 & S-202.
7. FOR COLUMN SCHEDULE SEE DRAWING S-104.
8. ALL WALL OPENINGS TO BE COORDINATED WITH ARCHITECTURAL DRAWINGS
9. ELEVATOR PIT RELATED INFORMATION SHALL BE COORDINATED WITH ARCHITECT AND ELEVATOR SUPPLIER
10. FOOTING DESIGN BASED ON ALLOWABLE SOIL BEARING PRESSURE OF 3.0 TSF.
11. SEE ARCH DWG FOR WATERPROOF REQUIREMENT.



GRADE BEAM REINF. DETAIL

MASONRY SHEAR WALL SCHEDULE

MARK	THICKNESS	VERTICAL REINF.	HORIZONTAL REINF.
W1	8"	#5@8"	#5@24"

WALL FOOTING SCHEDULE

MARK	WIDTH	DEPTH	BOTTOM REINF LONG BAR	BOTTOM REINF SHORT BAR	REMARKS
CF1	3'-0"	2'-0"	5-#5	#5@12"oc	

GRADE BEAM SCHEDULE*

MARK	WIDTH	DEPTH	BOTTOM BAR	TOP BAR	STIRRUP
GB1	36"	24"	6#6	8#8	#4@12"
GB2	48"	24"	8#6	10#8	#4@12"

*LONGITUDINAL REBAR TO BE EXTENDED AND HOOKED AT ENDS.

COLUMN FOOTING SCHEDULE

MARK	PLAN SIZE	DEPTH	BOTTOM REINF LONG BAR	BOTTOM REINF SHORT BAR	REMARKS
F1	8'-6" X 4'-6"	2'-0"	8-#6	14#6	

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CONSULTANTS

STRUCTURAL CONSULTANTS:
TIMES BUILDINGS, PC
ENGINEERING SERVICES
6928 174TH ST
FRESH MEADOWS, NY 11365
TEL: 646-515-6529
EMAIL: TB9009@GMAIL.COM

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REVISIONS

REVISION NO.	REVISION DATE

PROJECT LOCATION

11-28 31ST DRIVE
QUEENS, NY

DRAWING TITLE

1ST FLOOR AND FOUNDATION PLAN

DESIGN APPLICANT

ZHOU XU
No. 087007

NYC DOB NUMBER

DRAWN BY
PQ

CHECKED BY
XZ

PROJECT NO.
1208420

DATE
2-18-2013

DWG NO.
S-101.00

PAGE NO.
2 OF 9

GENERAL NOTES

1. CONFORM TO CONTRACT SPECIFICATIONS, AND TO THE GENERAL NOTES, CONSTRUCTION SEQUENCE, AND ALL OTHER REQUIREMENTS OF THIS SUBMISSION

2. VERIFY THE LOCATION AND ELEVATIONS OF ALL UTILITIES. EXISTING FOUNDATIONS, ETC. PRIOR TO INSTALLING SOLDIER PILES.

3. REPORT LOCATIONS AND ELEVATIONS OF UTILITIES, STRUCTURES AND OBSTRUCTIONS WHICH CONFLICT WITH THE DESIGN LOCATIONS OF SOLDIER PILES, LAGGING, ANCHORS. ETC. SC THAT THE DESIGN CAN BE MODIFIED AS REQUIRED.

4. REPORT CHANGE IN CONTRACT DOCUMENTS, SUBSURFACE CONDITIONS, AND DESIGN ASSUMPTIONS TO THE TIMES BUILDINGS ENGINEERING SERVICES PC SO THE EXCAVATION SUPPORT SYSTEM DESIGN CAN BE MODIFIED ACCORDINGLY.

5. TOLERANCES FOR INSTALLATION OF STRUCTURAL ELEMENTS ARE AS FOLLOWS :
   - VERTICALITY OF SOLDIER PILES TO BE WITHIN TWO PERCENT OF PLUMB.
   - SOLDIER PILES SHALL BE WITHIN 3-INCHES OF PLAN LOCATION,

MONITORY AND INSPECTION

MONITORING AND INSPECTION:

1. SURVEY MONITORING POINTS ON THE SPECIFIED LOCATIONS HAVE TO BE SET UP TO MONITOR ITS MOVEMENT IN BOTH DIRECTIONS, I.E. VERTICAL AND HORIZONTAL. IF 1/8' MOVEMENT IS DETECTED IN EITHER DIRECTION, THE CONSTRUCTION MANAGER AND THE ENGINEER ON SITE SHALL BE INFORMED IMMEDIATELY FOR FURTHER INVESTIGATION AND PREVENTIVE WORK SHALL BE IMPLEMENTED. IF 1/4" MOVEMENT IS DETECTED IN EITHER DIRECTION, THE CONSTRUCTION ENGINEER AND ENGINEER ON SITE SHALL BE INFORMED AND ALL RELATED UNDERPINNING WORK SHALL BE STOPPED IMMEDIATELY. SUCH WORK CAN BE RESUMED ONCE REMEDIAL MEASURE IS IN PLACE.

2. UNTIL THE FOUNDATION WALL IS PERMANENTLY BRACED BY THE NEW INTERIOR STEEL FRAME (OR CONCRETE STRUCTURE) ONE READINGS MINIMUM HAVE TO BE TAKEN PER WEEK AND SUBMITTED TO ENGINEERING FOR REVIEW.

3. DURING THE INSTALLATION OF THE BRACING SYSTEM, AN ENGINEER WILL BE ON SITE CONDUCTING AN INSPECTION TO ENSURE THAT ALL NECESSARY PRECAUTIONS ARE TAKEN AND ESTABLISHED CONSTRUCTION SEQUENCE IS FOLLOWED. IT SHOULD BE NOTED THAT SUCH INSPECTION DOES NOT RELIEF THE CONTRACTOR FROM ITS RESPONSIBILITIES OF PROTECTING THE INTEGRITY OF THE FOUNDATION, AND SAFETY OF THE PERSONNEL WORKING AROUND IT.

4. PRIOR TO UNDERPINNING, A PRE-CONSTRUCTION SURVEY OF ADJACENT BUILDINGS MUST BE PERFORMED.

5. SPECIFY MONITORING SYSTEM.

6. PRIOR TO UNDERPINNING, A PRE-CONSTRUCTION MEETING SHALL BE HELD.

UNDERPINNING NOTES

1. REFER TO THE PROJECT SPECIFICATIONS FOR ADDITIONAL UNDERPINNING REQUIREMENTS IF APPLICABLE.

2. THE UNDERPINNING DETAILS SHOWN HEREWITH ARE A GENERAL GUIDELINE FOR THE CONTRACTOR. THE CONTRACTOR SHALL RETAIN A LICENSED PROFESSIONAL ENGINEER TO DESIGN AND DETAIL THE REQUIRED UNDERPINNING, SHEETING AND SHORING SPECIFIC TO THE EXISTING FIELD CONDITIONS. THE CONTRACTOR IS RESPONSIBLE TO SUBMIT SIGNED AND SEALED DRAWINGS AND CALCULATIONS SEQUENCING AND MEANS TO BE USED SPECIFIC TO THE EXISTING CONDITIONS.

3. THE CONTRACTOR SHALL COMPLY WITH ALL RELEVANT PROVISION OF THE NEW YORK CITY BUILDING CODE.

4. ALL FOUNDATIONS AND EARTHWORK OPERATIONS SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF THE NEW YORK CITY BUILDING CODE AND ALL LOTS, BUILDINGS AND SERVICE FACILITIES ADJOINING THC FOUNDATION AND EARTHWORK AREA SHALL BE PROTECTED AND SUPPORTED.

5. ALL TEST PITS, BORINGS AND UNDERPINNING OPERATIONS ARE SUBJECT TO CONTROLLED INSPECTION.

6. THE OWNER SHALL RETAIN A LICENSED SURVEYOR TO SURVEY ALL LOAD BEARING WALL, PIERS AND COLUMNS TO BE UNDERPINNED. THE SURVEYOR SHALL CHECK THE DATUM OF SUCH STRUCTURAL ELEMENTS EVERY TWO WEEKS FOR THE DURATION OF THE WORK. LANDMARK BUILDINGS SHALL BE CHECKED EVERY FIVE WORKING DAYS.

7. THE CONTRACTOR AND/OR SUB-CONTRACTOR(S) SHALL HAVE COMPLETED NO LESS THAN FIVE (5) UNDERPINNING PROJECTS OF A COMPARABLE SIZE AND TYPE TO THE PROJECT, AND MUST HAVE AT LEAST FIVE (5) YEARS EXPERIENCE IN THE WORK AND/OR APPLICABLE TRACE. SUBMIT EVIDENCE OF SUCH EXPERIENCE FOR REVIEW.

8. THERE SHALL BE A PRE-CONSTRUCTION MEETING WITH THE OWNER, ARCHITECT, ENGINEER OF RECORD, GENERAL CONTRACTOR AND SUB-CONTRACTOR(S) PRIOR TO WORK COMMENCING.

9. ALL ADJACENT PROPERTIES, INCLUDING BUT NOT LIMITED TO EXTERIOR WALLS AND FOOTINGS ARE TO BE OBSERVED BY THE ENGINEER OF RECORD PRIOR TO WORK COMMENCING.

I0. THE CONTRACTOR SHALL REQUEST PERMISSION TO ENTER BUILDINGS DIRECTLY ADJACENT TO THC AREAS OF PROPOSED UNDERPINNING.

II. NO FOUNDATION OR EARTHWORK PERMIT SHALL BE ISSUED UNTIL AT LEAST FIVE DAYS AFTER A WRITTEN NOTICE OF THE PERMIT APPLICATION HAS BEEN PROVIDED BY THE APPLICANT TO THE OWNERS Of ALL ADJOINING LOTS, BUILDINGS AND SERVICE UTILITIES, AND WHOM MAY BE AFFECTED BY THE PROPOSED FOUNDATION WORK OR EARTHWORK OPERATIONS.

12.THE UNDERPINNING FOUNDATIONS SHALL BEAR ON SUBGRADE HAVING BEARING CAPACITY EQUAL TO OR GREATER THAN THE SUBGRADE OF THE EXISTING FOUNDATION. THE SUBGRADE AT THE LEVEL OF THE EXISTING FOUNDATION SHALL BE INSPECTED BY A LICENSED PROFESSIONAL ENGINEER RETAINED BY THE OWNER TO VERIFY THE BEARING CAPACITY AND DEFICIENCIES BROUGHT TO THE ATTENTION OF THE ENGINEER OF RECORD.

GENERAL EXISTING WALL UNDERPINNING SEQUENCE

I . STARTING WITH SEGMENTS A1 (FOR ADJACENT FOOTING) ONLY, EXCAVATE TO BOTTOM OF EXISTING FOOTING ELEVATION AND EXTEND EXCAVATION LATERALLY TO ALLOW UNDERPINNING EXCAVATION TO BE CONDUCTED IN ACCORDANCE WITH OSHA REQUIREMENTS.

2. EXCAVATE UNDERPINNING PIT, 4'-0" WIDE MAXIMUM, AND INSTALL TIMBER LAGGING AS REQUIRED AND AS SHOWN ON DRAWINGS. ALL PITS TO BE SHEETED ON ALL FOUR SIDES. PACK VOIDS BETWEEN SHEETING AND SOIL WITH SOIL CEMENT. LEAVE A MINIMUM OF 12'-0" OF EXISTING SOIL BETWEEN PITS. EACH UNDERPINNING PIT EXCAVATION SHALL BE PROTECTED FROM ADVERSE WEATHER AND UNDER NO CIRCUMSTANCES SHALL UNDERPINNING PIT EXCAVATION BE LEFT OPEN OVER NIGHT.

3. CLEAN BOTTOM OF EXISTING FOOTING AND RECOMPACT DISTURBED SOIL AT BOTTOM OF PIT WITH MECHANICAL PAN TAMPERS. COMPACT TO 95% OF THE MAXIMUM DENSITY OF THE SOIL LOSS OF GROUND SHOULD BE KEPT TO A MINIMUM BY BACKFILLING BEHIND THE BOARDS WHERE AND WHEN POSSIBLE WITH GROUT PUMPED INTO THE VOIDS.

4. POUR CONCRETE INTO UNDERPINNING PIT WITHIN 2 IN NEW CONCRETE FOR THE UNDERPINNING PITS. ALLOW CONCRETE TO CURE FOR AT LEAST 24 HOURS.

5. DRYPACK SOLID WITH NONSHRINK DRYPACK INTO SPACE BETWEEN TOP OF UNDERPINNING AND BOTTOM OF EXISTING FOOTING NO SOONER THAN 24 HOURS AFTER THE UNDERPINNING ELEMENT HAS COMPLETED AND ALLOW DRYPACK MORTAR TO CURE FOR AT LEAST 48 HOURS.

6. THE CONTRACTOR SHALL INSTALL ADEQUATE LATERAL BRACING SYSTEM(S) TO PREVENT MOVEMENT IN THE EXISTING STRUCTURE(S) AND IN THE NEW UNDERPINNING DURING THIS PROCESS.

7A. REPEAT 1~5 FOR SECTION A2 (FOR PROPOSED NEW BUILDING SIDE). INSTALL 2" BOND BREAK BETWEEN A1 AND A2 BEFORE CONCRETE POUR.

7B. REPEAT 1~5 FOR SECTION B,C,D,E. (SEE PLAN)

8. WHEN BOTTOM OF ADJACENT UNDERPINNING PITS ARE AT DIFFERENT ELEVATION, THE DEEPER PIT SHALL BE INSTALLED FIRST.

9. UNDERPINNING PITS CLOSER THAN 12' APART SHALL NOT BE EXCAVATED AT THE SAME TIME.

10. ALL CONCRETE SHALL BE NORMAL WEIGHT CONCRETE WITH A MINIMUM ULTIMATE COMPRESSIVE STRENGTH OF 4,000 PSI AT 28 DAYS.

11. ALL GROUT SHALL BE NON-SHRINK WITH A MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI.

12. ALL DRYPACK SHALL BE MIXTURE OF I PART CEMENT AND 2 PARTS DAMP SAND, WITH 0'" SLUMP.

13. ALL UNDERPINNING SHEETING AND BRACING TO REMAIN SHALL BE PRESSURE TREATED LUMBER AND/OR OTHER APPROVED MATERIAL.

14. THE EXTENT OF THE THE UNDERPINNING SHALL BE DETERMINED UPON VIEW OF THE SOILS REPORT, TEST PIT DATA AND EXISTING CONDITION BY A LICENSED PROFESSIONAL ENGINEER RETAINED AS REVIEWED AND REPORTED UPON TO THE ARCHITECT.

15. EXCAVATION BELOW THE WATER TABLE SHOULD BE AVOIDED, IF POSSIBLE. DEWATER THE SITE PRIOR TO EXCAVATION. EXCAVATION MAY ONLY PROCEED AFTER REVIEW BY THE ENGINEER OF RECORD.

16 . IF WATER IS ENCOUNTERED IN THE PIT, PROVIDE A WELL POINT NEAR THE PIT. THE CONTRACTOR'S LICENSE PROFESSIONAL ENGINEER SHALL DETERMINE THE LOCATION(S) OF THE WELL POINT(S) AND THE METHOD(S) OF REMOVING WATER PROM THE PIT.

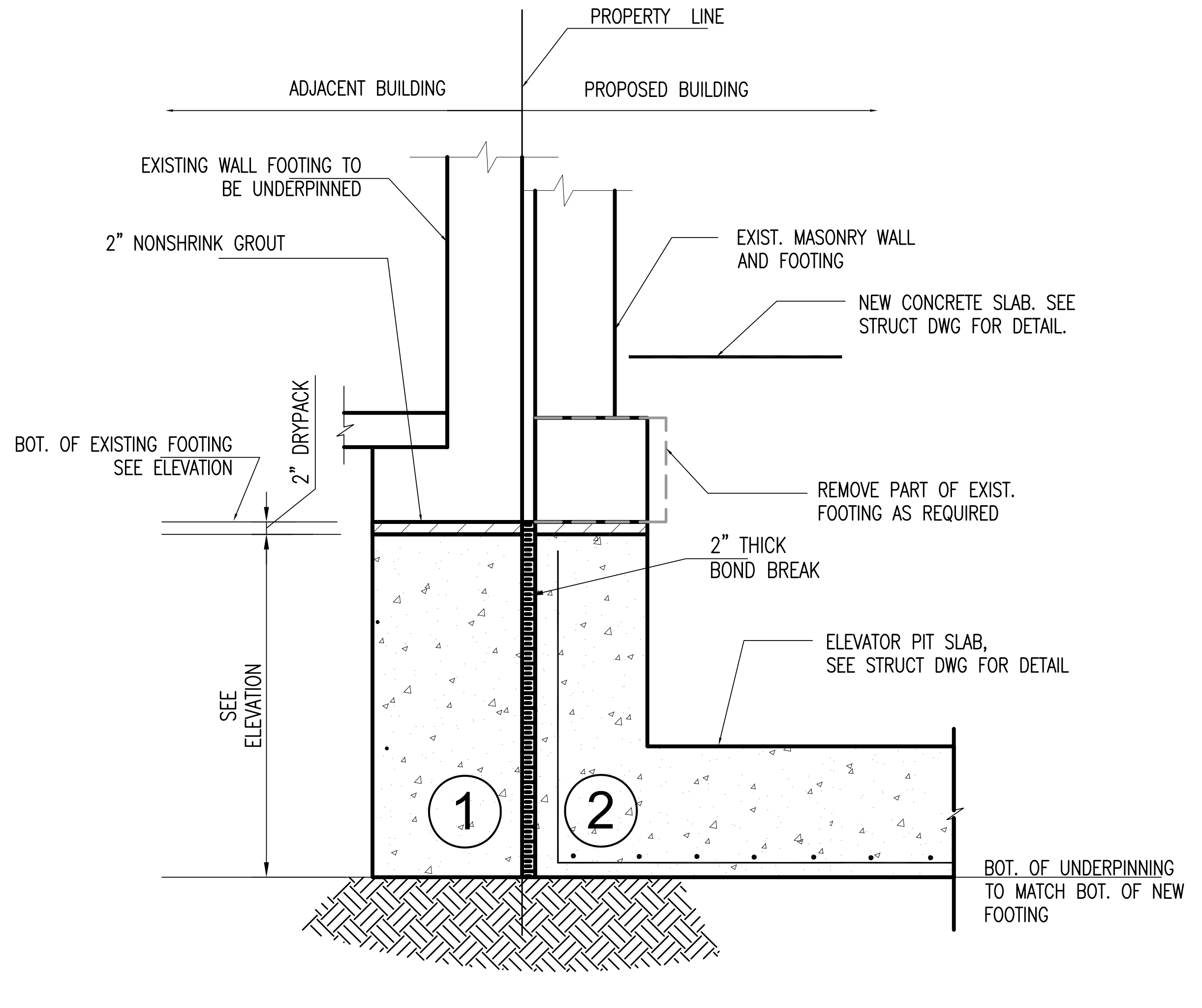
17. ALL SIDES OR SLOPES OF EXCAVATIONS OR EMBANKMENTS SHALL BE INSPECTED AFTER RAINSTORMS,

18. EXCAVATED MATERIAL AND SUPERIMPOSED LOADS SUCH AS EQUIPMENT AND TRACK SHALL NOT BE PLACED CLOSER TO THE EDGE OF THE EXCAVATION THAN A DISTANCE EQUAL TO ONE AND ONE-HALT TIMES THE DEPTH OF SUCH EXCAVATION.

19. THE UNDERPINNING SHALL BE INSTALLED IN A MANNER SUCH THAT THE EXPOSED PACE OP THE CONCRETE IS VERTICAL (OR AS OTHERWISE SPECIFIED), CLEAN AND NEAT.

20 EXISTING STONE/RUBBLE WALE TO BE UNDERPINNED SHALL BE TREATED BY PRESSURE INJECTED GROUT AT THE DIRECTION OF THE ENGINEER OF RECORD.

21. THE DEPTH OF THE UNDERPINNING PITS SHALL BE A MAXIMUM OF ONE LIFT. THE LIFT SHALL BE WITHOUT INTERMEDIATE HORIZONTAL CONSTRUCTION JOINTS (COLD JOINTS). MULTIPLE (VERTICAL) LEVELS OF UNDERPINNING SHALL NOT BE PERMITTED.

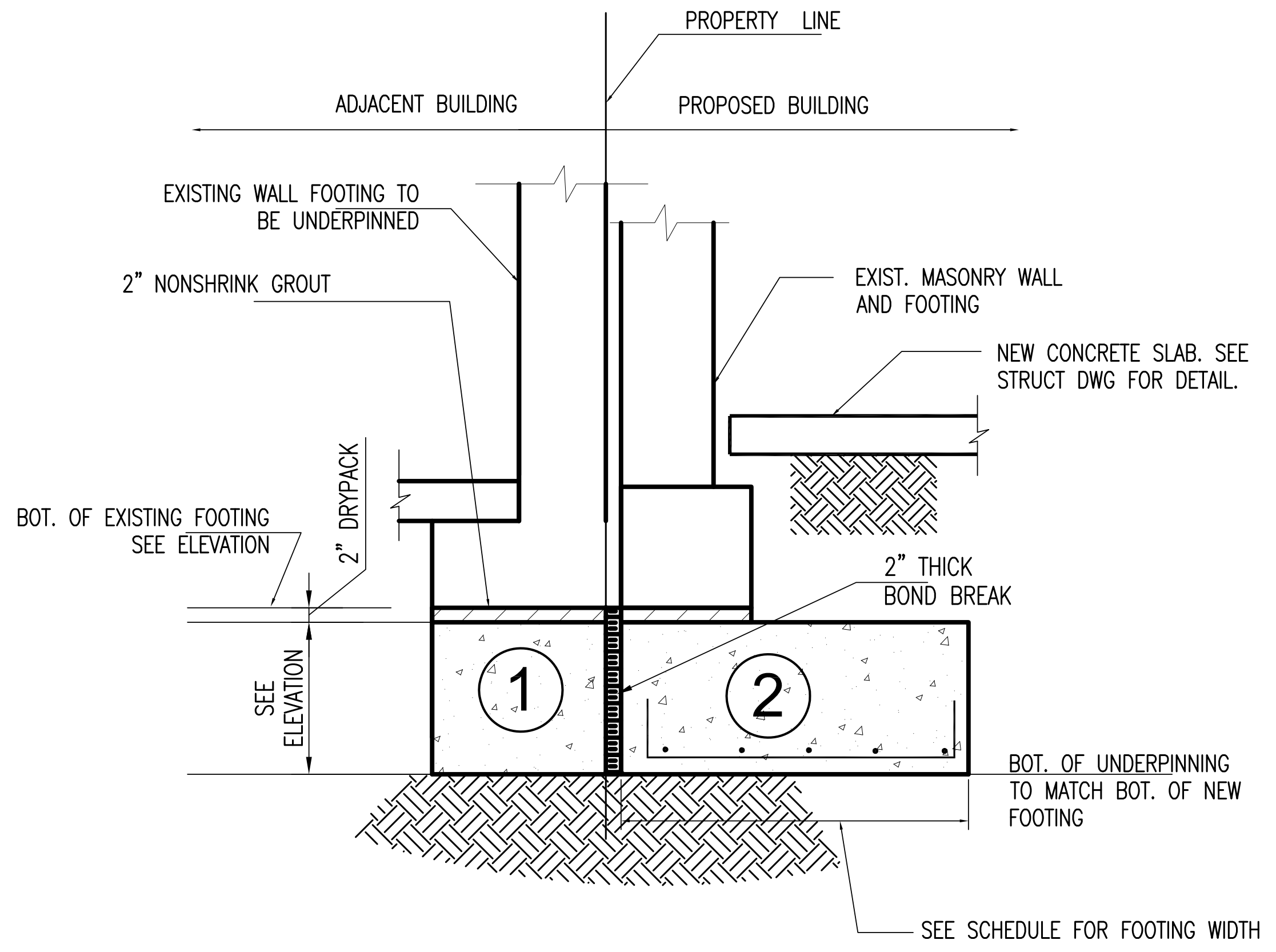


2 — UNDERPIINNING SECTION

N.T.S.

NOTE:

ELEVATION OF ADJACENT FOOTING TO BE VERIFIED IN FIELD.



1 — UNDERPIINNING SECTION

N.T.S.

NOTE:

ELEVATION OF ADJACENT FOOTING TO BE VERIFIED IN FIELD.

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ARCHITECT

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REVISIONS

REVISION NO.	REVISION DATE

PROJECT LOCATION

11-28 31ST DRIVE
QUEENS, NY

DRAWING TITLE

SHORING NOTES
AND DETAILS

DESIGN APPLICANT

STATE OF NEW YORK
ZHOU XU
No. 087007
LICENSED PROFESSIONAL ENGINEER

NYC DOB NUMBER

DRAWN BY
PQ

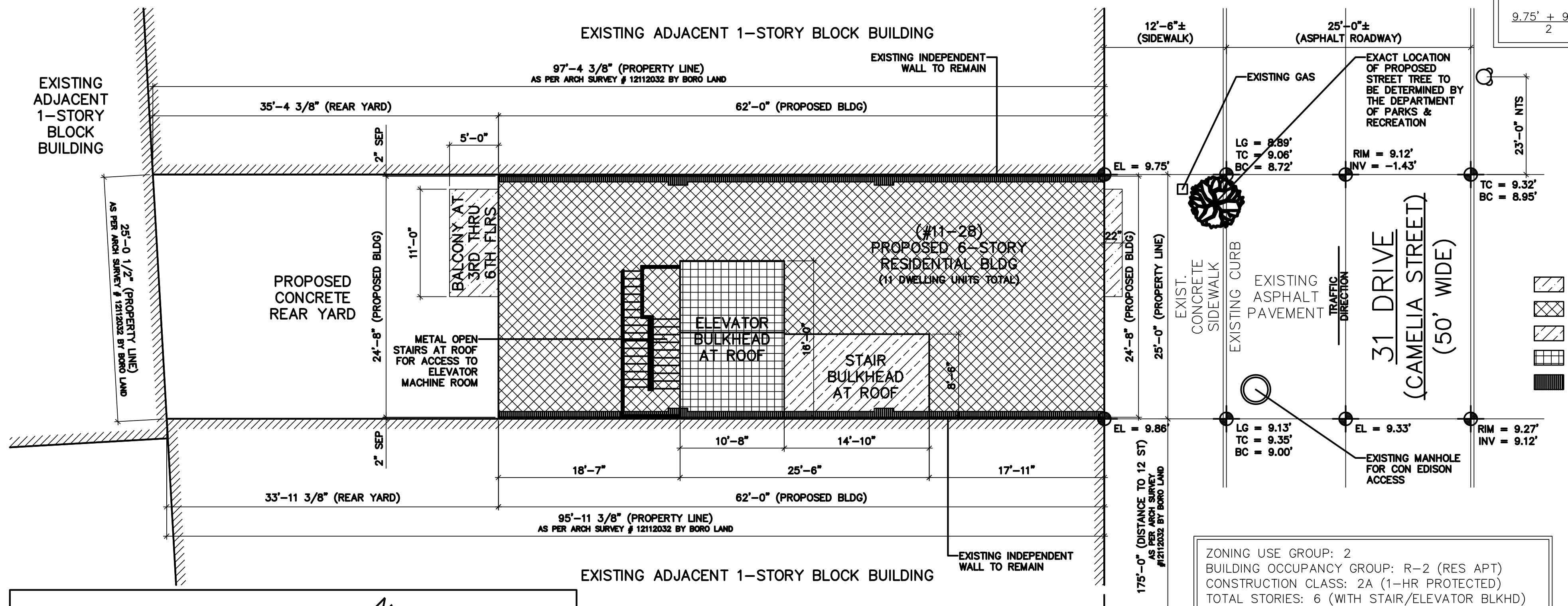
CHECKED BY
XZ

PROJECT NO.
1208420

DATE
2-18-2013

DWG NO.
SOE-100.00

PAGE NO.
8 OF 9



BASE PLANE CALCULATION:

$\frac{9.75' + 9.86'}{2} = \frac{19.61'}{2} = 9.81'$ (BASE PLANE)

ZONING USE GROUP: 2
BUILDING OCCUPANCY GROUP: R-2 (RES APT)
CONSTRUCTION CLASS: 2A (1-HR PROTECTED)
TOTAL STORIES: 6 (WITH STAIR/ELEVATOR BLKHD)

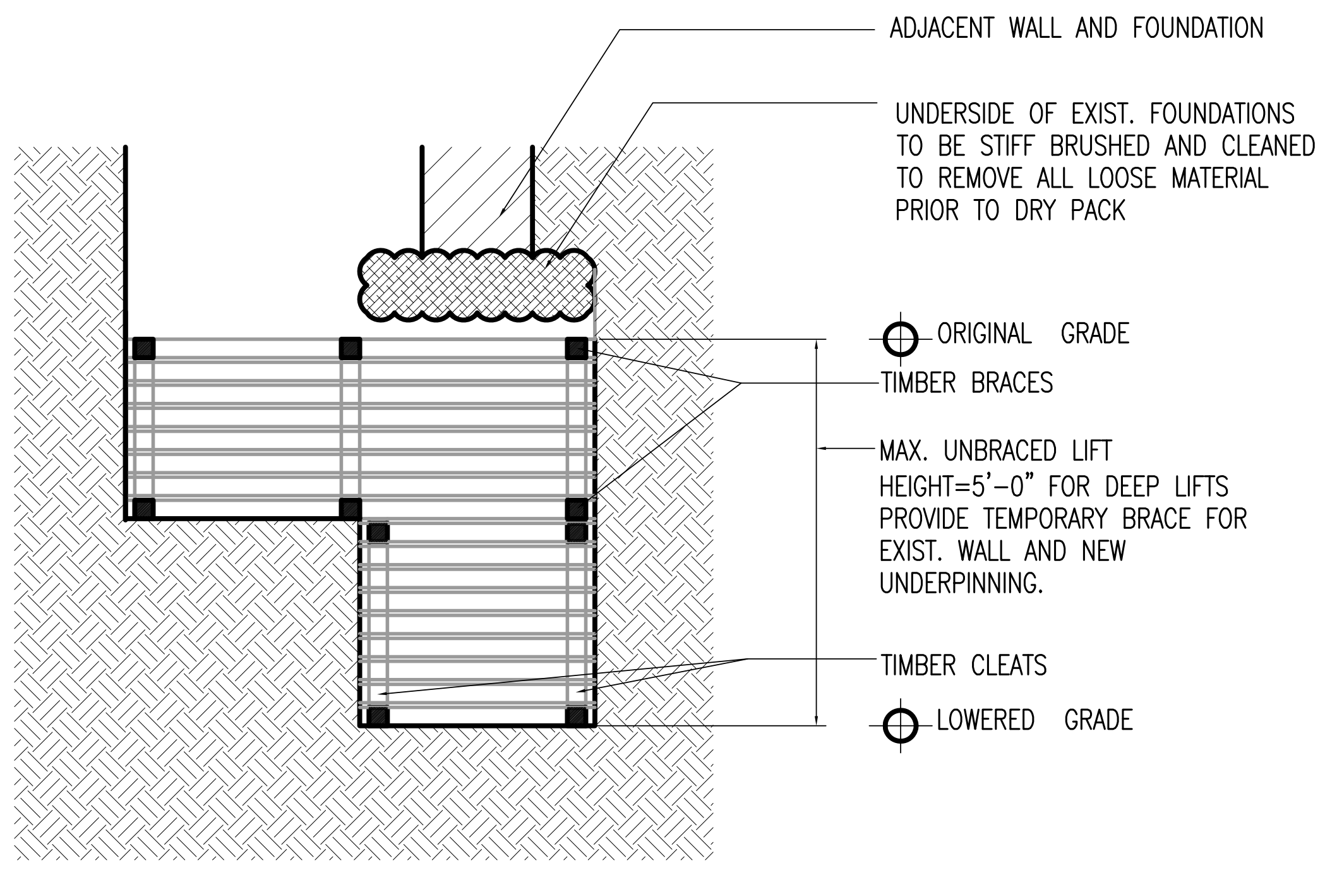
REMOVAL OF EXISTING CURB CUT IS NOT PART OF THIS APPLICATION.

PLOT PLAN

NOT TO SCALE

BLOCK: 502
LOT: 22
ZONE: R7A
MAP#: 9A

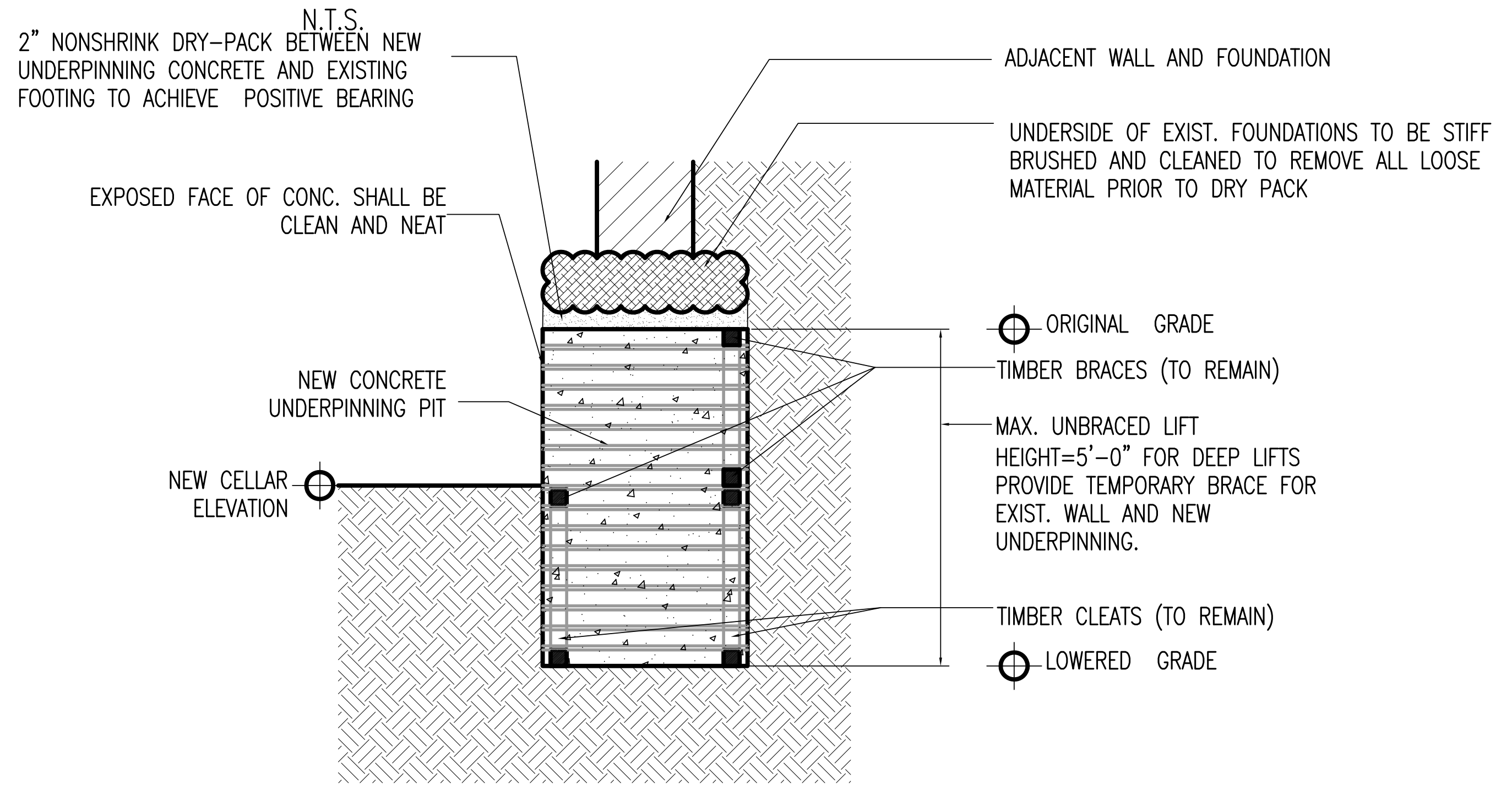
12 STREET
(SHERMAN STREET/ PRIMROSE STREET)
(60' WIDE)



NOTE: ALL SHEETING CLEATS AND BRACING SHALL BE PRESSURE TREATED LUMBER, SIZED IN ACCORDANCE WITH NEW YORK CITY BUILDING CODE.

SECTION OF WOOD SHEETING/BRACING

N.T.S.



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SECTION OF WOOD SHEETING/BRACING

N.T.S.

TYPICAL PIT BOX DETAILS

N.T.S.

NOTES:

1. ALL DIMENSIONS AND ELEVATIONS SHALL BE VERIFIED WITH ARCHITECT AND IN FIELD.

2. ALL EXCAVATION WORK SHALL CONFORM TO THE REQUIREMENT OF NEW YORK CITY BUILDING CODE.

3. THE UNDERPINNING SYSTEMS WILL CONSIST OF HAND-DUG REINFORCED CONCRETE PIERS WITH BRACING SYSTEM AS REQUIRED.

4. THE UNDERPINNING WORK REQUIRED CAREFUL STAGE CONSTRUCTION AND TEMPORARY BRACING OF STRUCTURES. THE CONTRACTOR SHALL ENSURE THE SAFETY AND STABLITY OF THE ADJACENT STRUCTURES AT ANYTIME THROUGHOUT THE CONSTRUCTION.

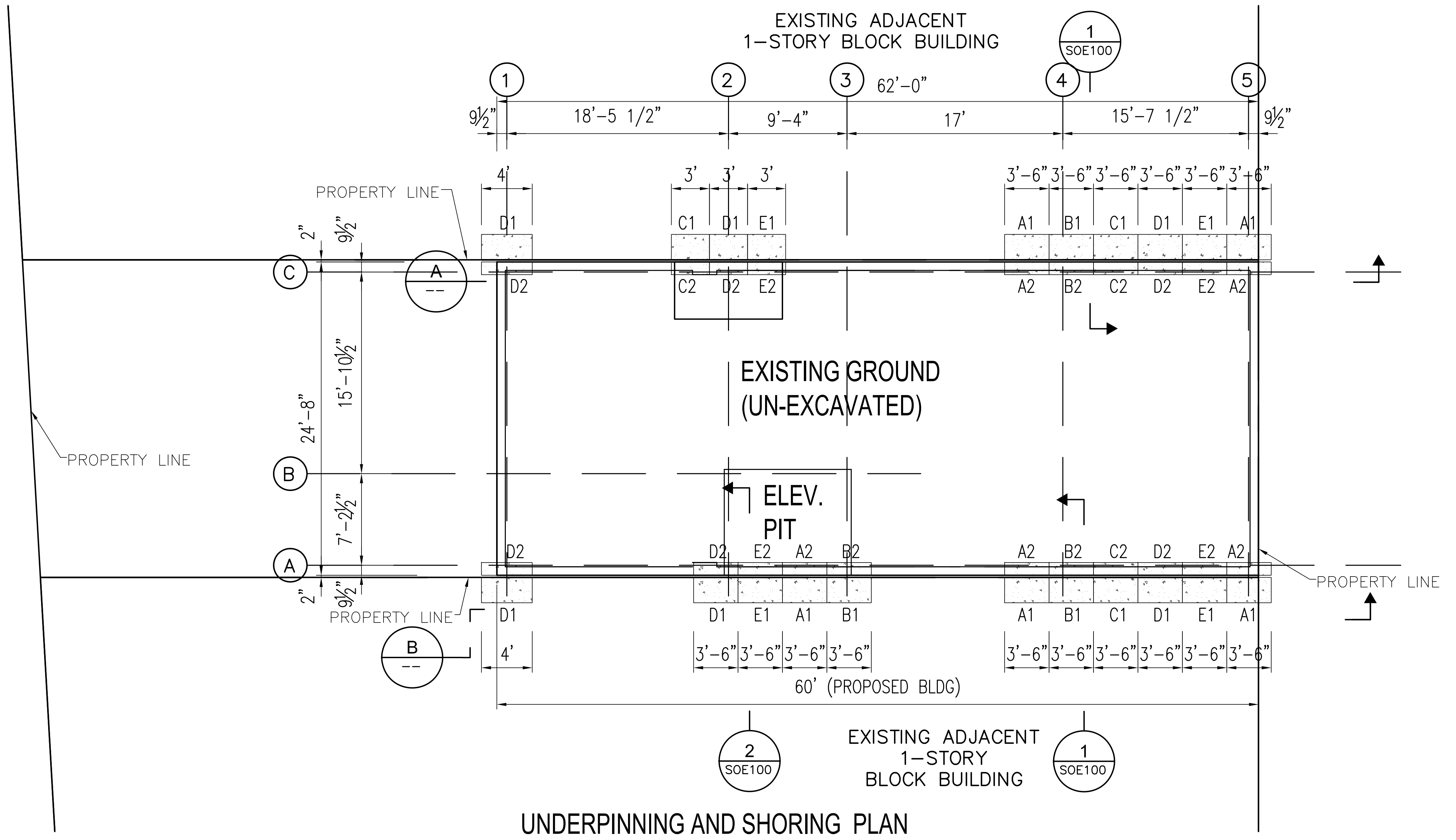
5. FOR UNDERPINNING SEQUENCE AND BALANCE INFORMATION, SEE GENERAL NOTES SOE-100

ECCCNYS STATEMENT:

"TO THE BEST OF MY KNOWLEDGE, BELIEF AND PROFESSIONAL JUDGMENT, THESE PLANS AND SPECIFICATIONS ARE EXEMPT FROM THE 2011 ENERGY CONSERVATION CODE OF NEW YORK STATE PER CHAPTER 1, SECTION 101.4.3"

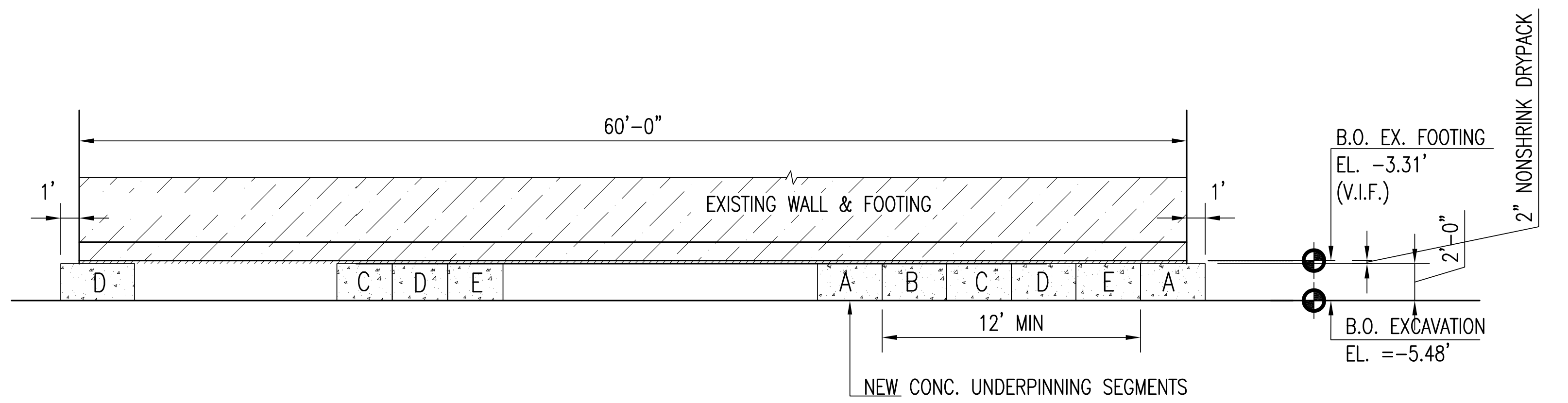
TR1 SPECIAL INSPECTION:

1. CONCRETE CAST IN PLACE
2. EXCAVATION
3. CONCRETE TEST CYLINDERS
4. CONCRETE DESIGN MIX
5. SOIL- SITE PREPARATION



UNDERPINNING AND SHORING PLAN

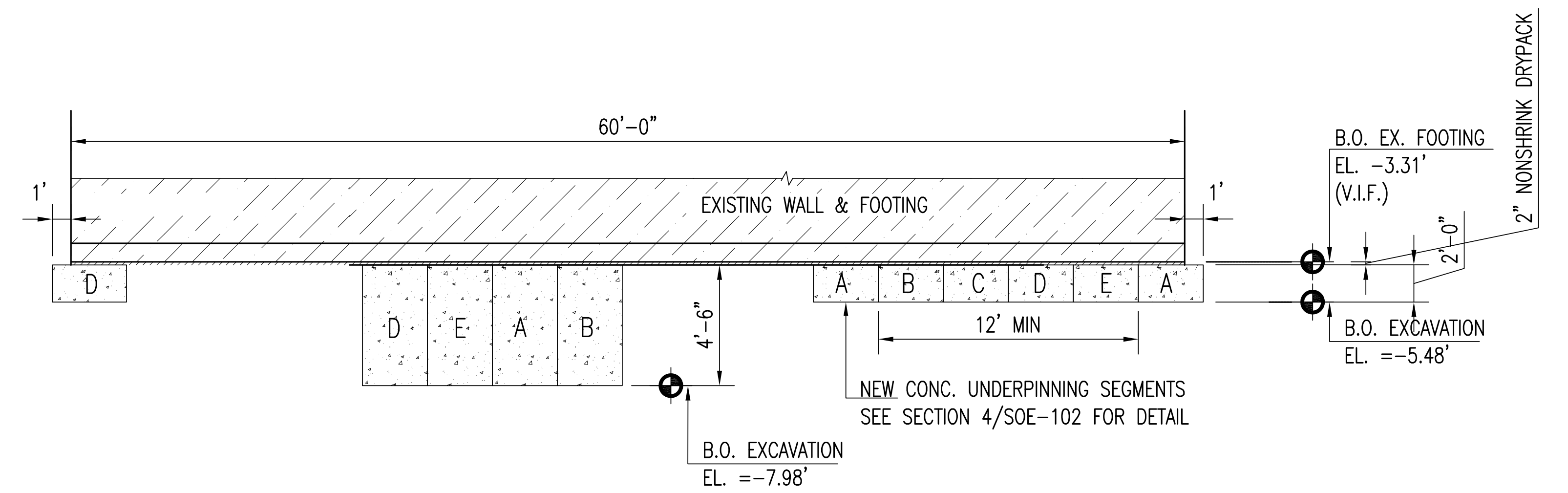
SCALE: $\frac{1}{8}$"=1'-0"



A UNDERPINNING ELEVATION

SCALE: $\frac{1}{8}$"=1'-0"

NOTE:
1) ALL DIM. TO BE V.I.F
2) SEE PLAN FOR SEGMENT LENGTH
3) SEE SECTION FOR SEGMENT WIDTH



A UNDERPINNING ELEVATION

SCALE: $\frac{1}{8}$"=1'-0"

DOB APPROVAL STAMP

ARCHITECT

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CONSULTANTS

STRUCTURAL CONSULTANTS:

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ENGINEERING SERVICES

6928 174TH ST
FRESH MEADOWS, NY 11365
TEL: 646-515-6529
EMAIL: TB9009@GMAIL.COM

GENERAL NOTES

THESE PLANS ARE AN INSTRUMENT OF SERVICE AND ARE THE PROPERTY OF THE ARCHITECT. INFRINGEMENT WILL BE PROSECUTED.

CONTRACTOR SHALL VERIFY ALL FIELD CONDITIONS AND BE RESPONSIBLE FOR FIELD FIT AND QUANTITY OF WORK. NO ALLOWANCES SHALL BE MADE ON BEHALF OF THE CONTRACTOR FOR ANY ERROR OR NEGLECT ON HIS/HER PART.

THE ARCHITECT SHALL NOT HAVE CONTROL OF NOR BE RESPONSIBLE FOR CONSTRUCTION MEANS, METHODS, DEVIATIONS, TECHNIQUES, SEQUENCES, OR SAFETY PRECAUTIONS IN CONNECTION WITH THE WORK.

THE ARCHITECT SHALL NOT BE RESPONSIBLE FOR THE ACTS OR OMISSIONS OF THE CONTRACTOR, SUBCONTRACTORS, OR ANY OTHER PERSONS PERFORMING ANY OF THE WORK, OR FOR THE FAILURE OF ANY OF THEM TO CARRY OUT THE WORK IN ACCORDANCE TO THE CONTRACT DOCUMENTS.

REVISIONS

REVISION NO.	REVISION DATE

PROJECT LOCATION

11-28 31ST DRIVE
QUEENS, NY

DRAWING TITLE

PLOT PLAN AND
EXCAVATION PLAN

DESIGN APPLICANT

ZHOU XU
No. 087007

NYC DOB NUMBER

DRAWN BY
PQ

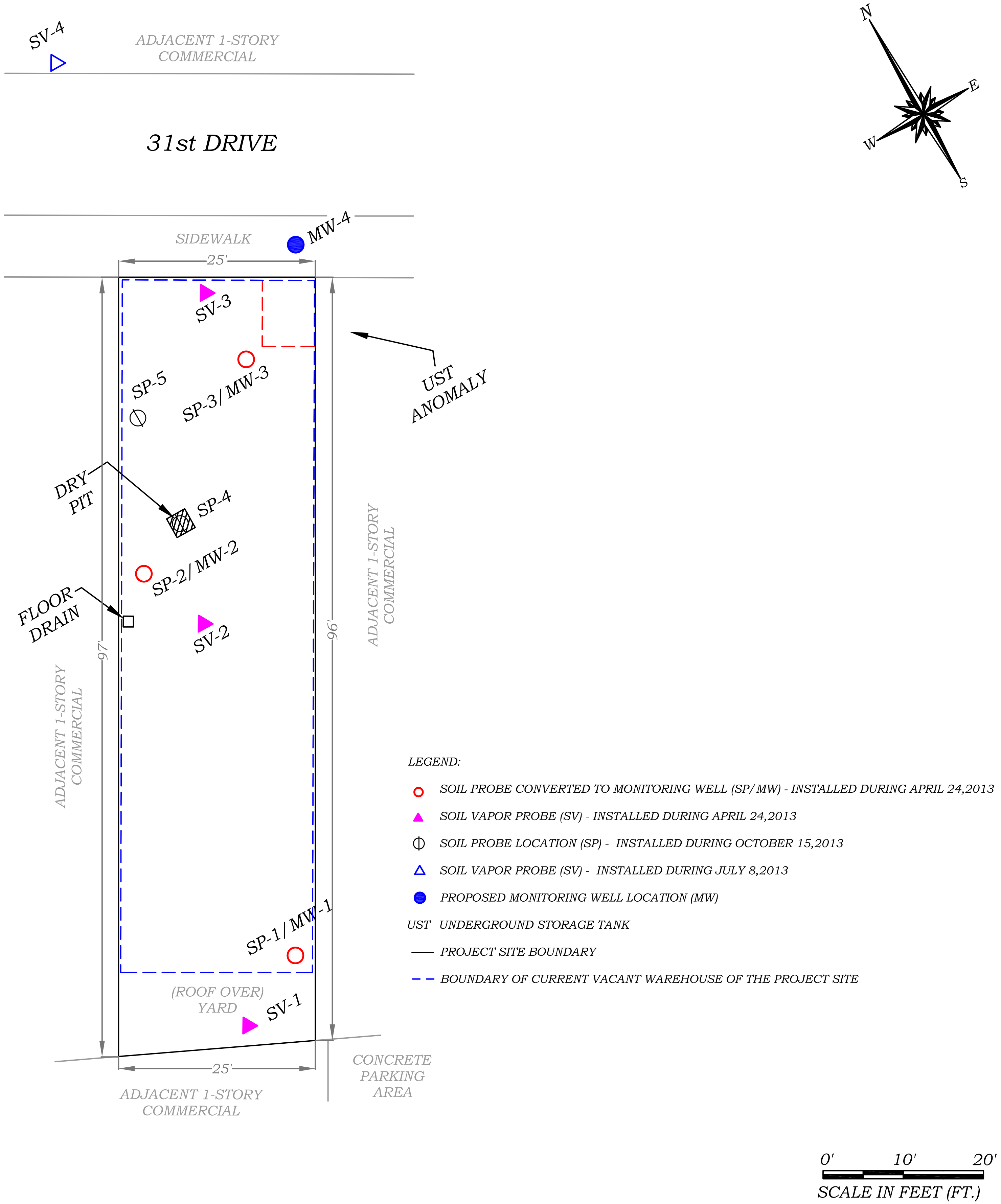
CHECKED BY
XZ

PROJECT NO.
1208420

DATE
2-18-2013

DWG NO.
SOE-101.00

PAGE NO.
9 OF 9



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Reviewed By: P.M.
Approved By: M.R
Date: 04/22/16
Scale: AS NOTED

TITLE:

FIGURE 4A: SAMPLING PLAN ON-SITE

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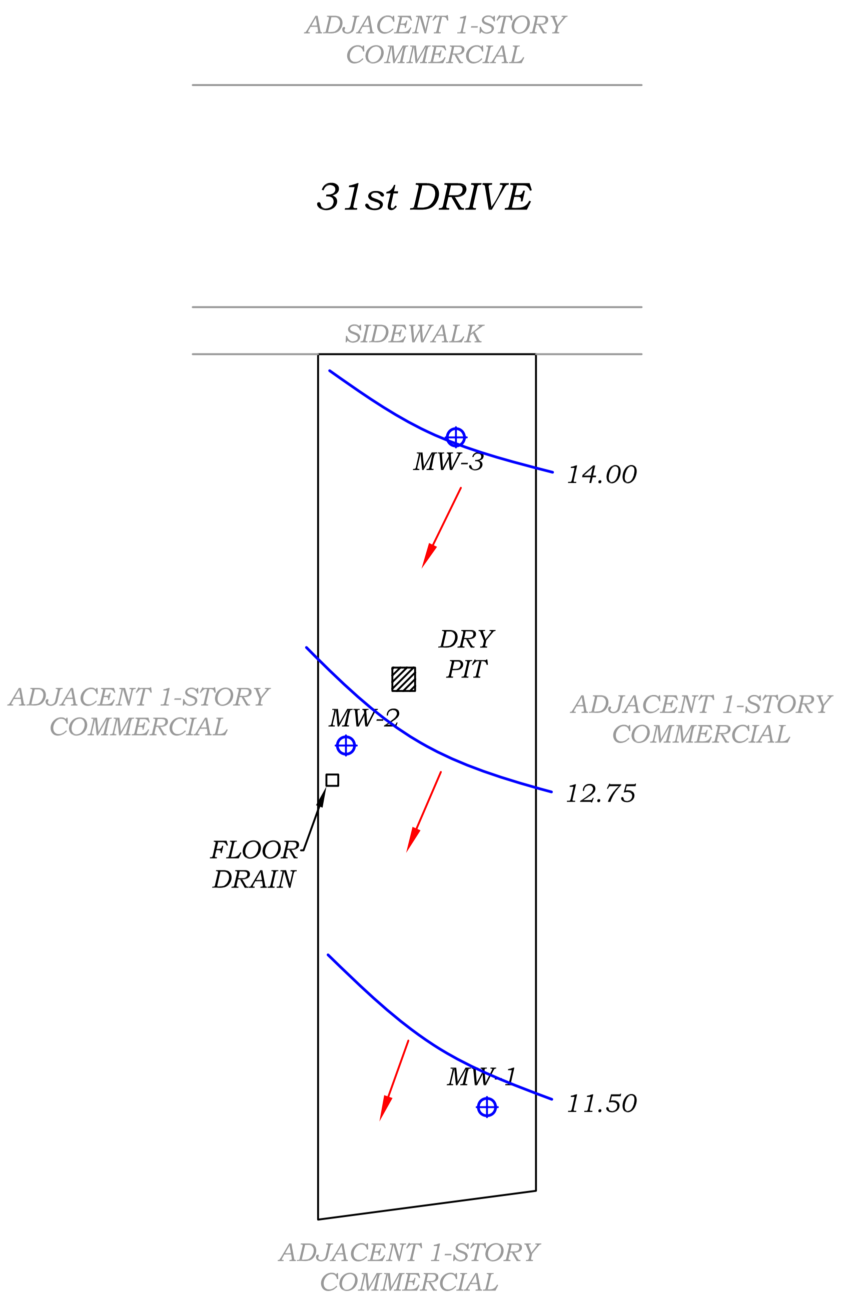
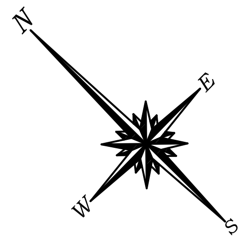
TITLE:

FIGURE 4B: SAMPLING PLAN OFF-SITE





LEGEND:

⊕ MONITORING WELL LOCATIONS (MW)

∿ CONTOUR LINES

C.I. CONTOUR INTERVAL

C.I. = 1.25 FEET	
Monitoring Well IDs	Monitoring Well IDs
MW-1	11.47
MW-2	11.8
MW-3	14.17

SCALE IN FEET (FT.)

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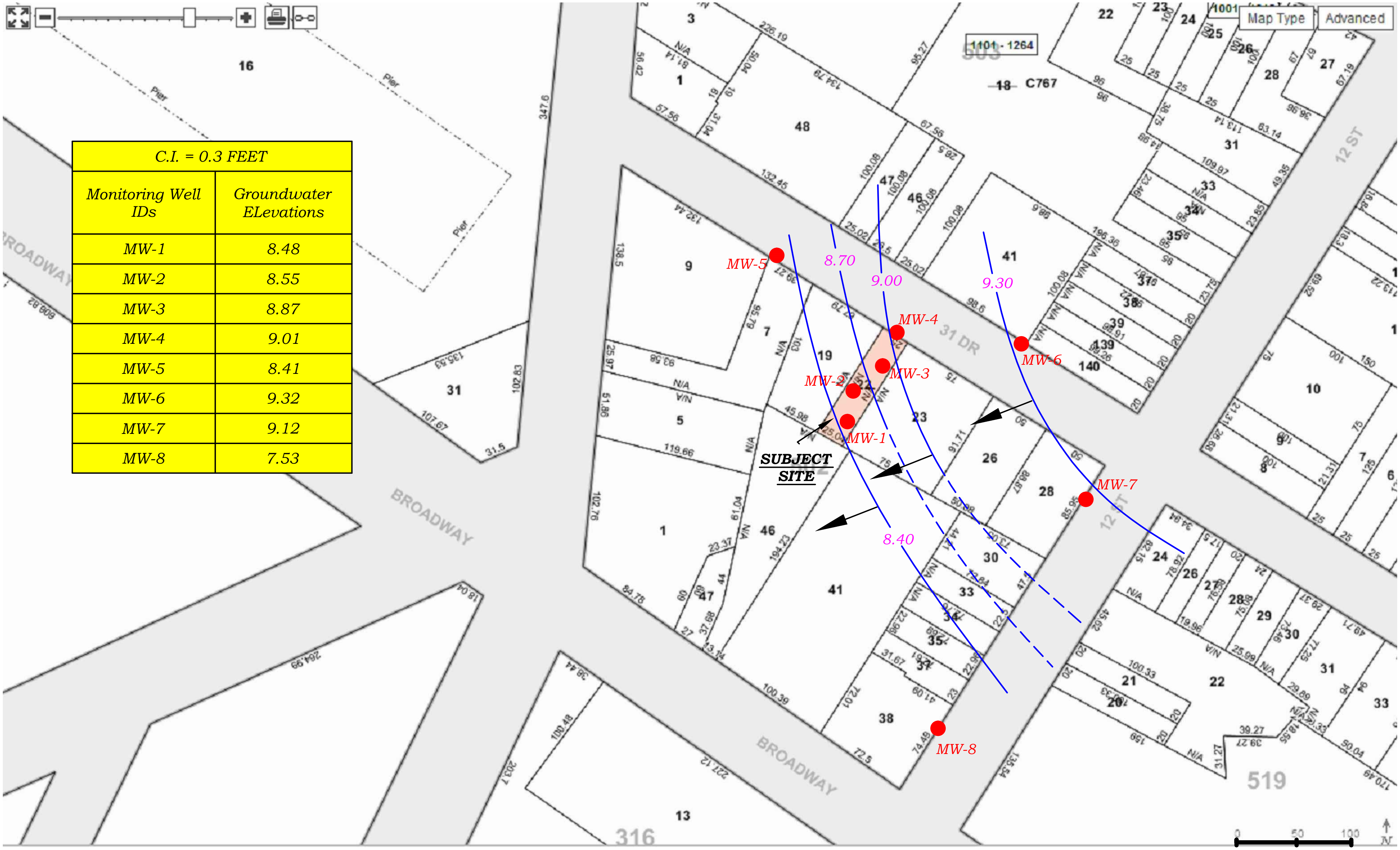
FIGURE 5a: GROUNDWATER FLOW MAP - APRIL 25, 2015



C.I. = 0.3 FEET	
Monitoring Well IDs	Groundwater ELevations
MW-1	8.48
MW-2	8.55
MW-3	8.87
MW-4	9.01
MW-5	8.41
MW-6	9.32
MW-7	9.12
MW-8	7.53

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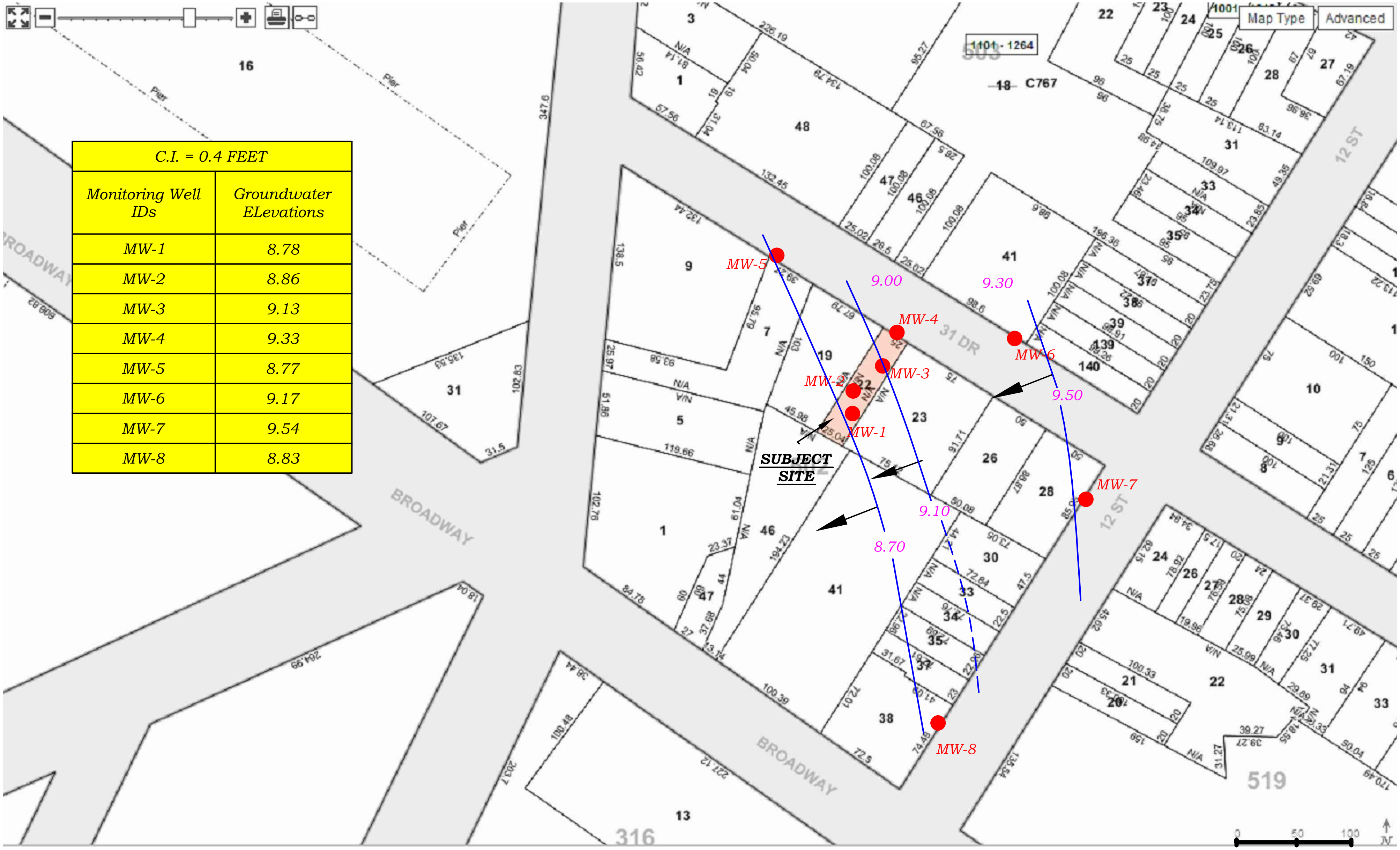
TITLE:

FIGURE 5b: GROUNDWATER FLOW CONTOUR DIAGRAM- JANUARY 13, 2015



C.I. = 0.4 FEET

Monitoring Well IDs	Groundwater ELevations
MW-1	8.78
MW-2	8.86
MW-3	9.13
MW-4	9.33
MW-5	8.77
MW-6	9.17
MW-7	9.54
MW-8	8.83

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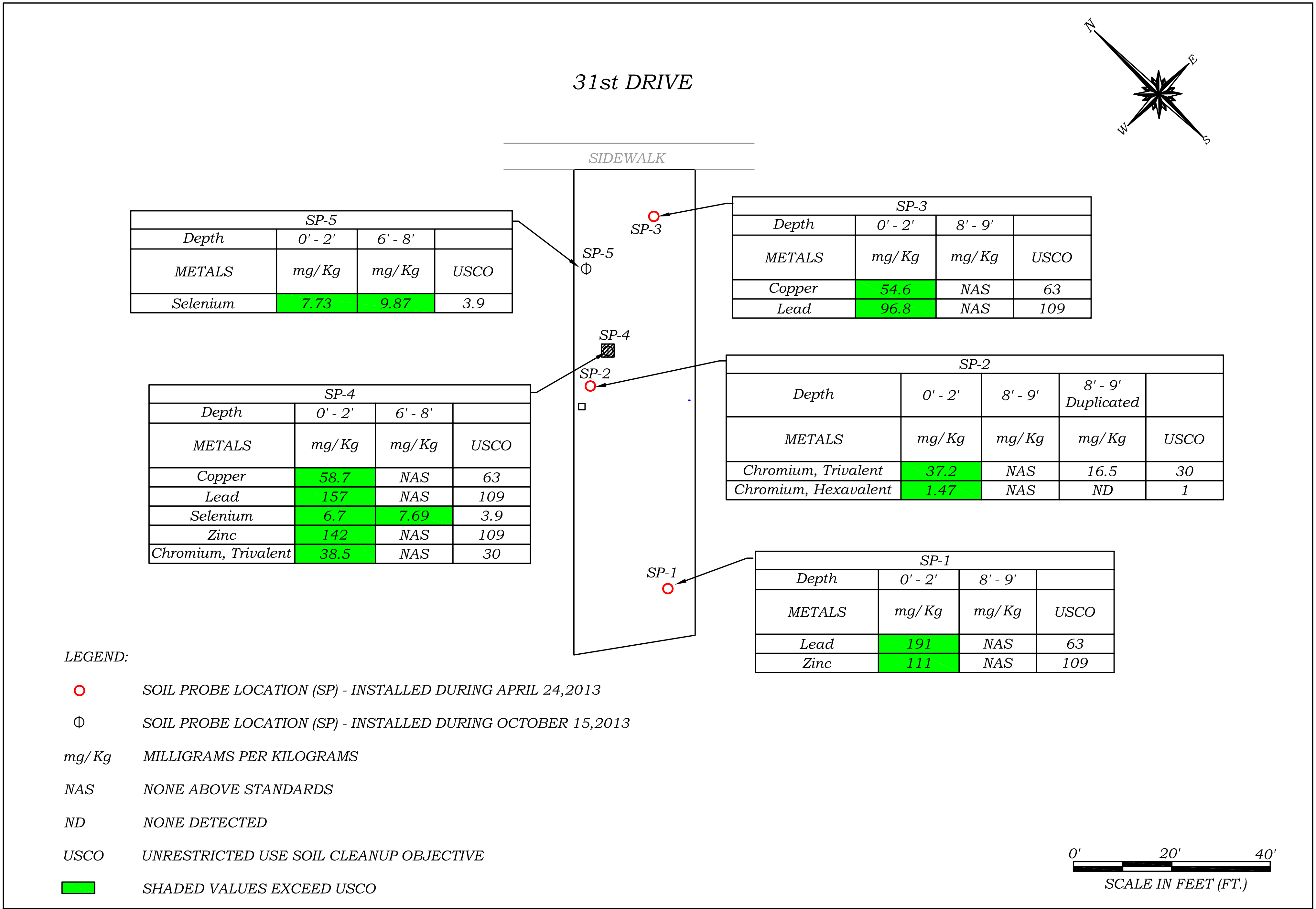
TITLE:

FIGURE 5c: GROUNDWATER FLOW CONTOUR DIAGRAM - MARCH 11, 2015



SP-5			
Depth	0' - 2'	6' - 8'	
METALS	mg/Kg	mg/Kg	USCO
Selenium	7.73	9.87	3.9

SP-3			
Depth	0' - 2'	8' - 9'	
METALS	mg/Kg	mg/Kg	USCO
Copper	54.6	NAS	63
Lead	96.8	NAS	109

SP-4			
Depth	0' - 2'	6' - 8'	
METALS	mg/Kg	mg/Kg	USCO
Copper	58.7	NAS	63
Lead	157	NAS	109
Selenium	6.7	7.69	3.9
Zinc	142	NAS	109
Chromium, Trivalent	38.5	NAS	30

SP-2				
Depth	0' - 2'	8' - 9'	8' - 9' Duplicated	
METALS	mg/Kg	mg/Kg	mg/Kg	USCO
Chromium, Trivalent	37.2	NAS	16.5	30
Chromium, Hexavalent	1.47	NAS	ND	1

SP-1			
Depth	0' - 2'	8' - 9'	
METALS	mg/Kg	mg/Kg	USCO
Lead	191	NAS	63
Zinc	111	NAS	109

LEGEND:

○	SOIL PROBE LOCATION (SP) - INSTALLED DURING APRIL 24,2013
Φ	SOIL PROBE LOCATION (SP) - INSTALLED DURING OCTOBER 15,2013
mg/Kg	MILLIGRAMS PER KILOGRAMS
NAS	NONE ABOVE STANDARDS
ND	NONE DETECTED
USCO	UNRESTRICTED USE SOIL CLEANUP OBJECTIVE
🟩	SHADED VALUES EXCEED USCO

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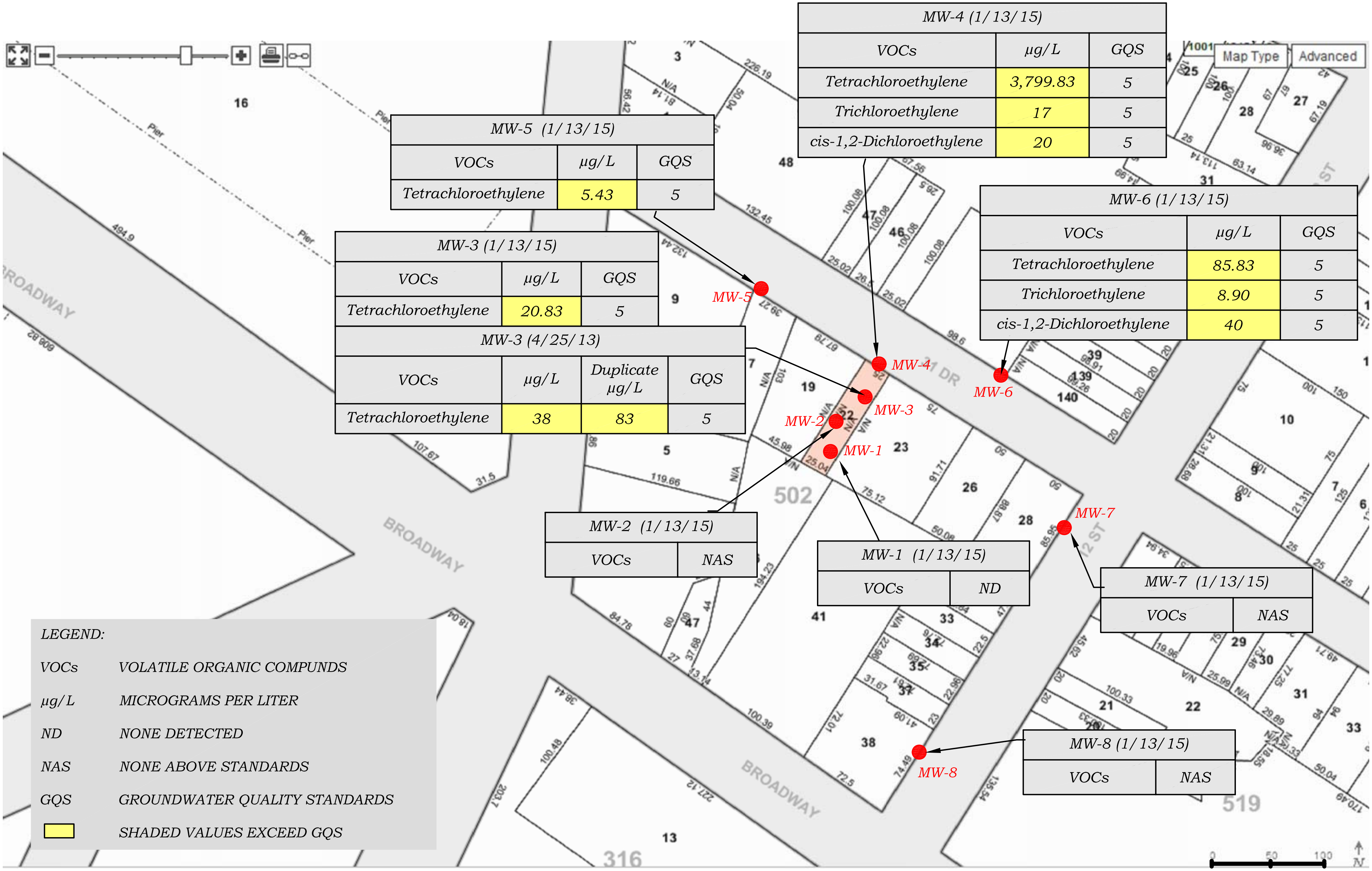
Scale:	AS NOTED

TITLE:

FIGURE 6: SPIDER MAP OF METALS EXCEEDANCES OF TRACK 1 SCOs IN SOIL



MW-4 (1/13/15)		
VOCs	µg/L	GQS
Tetrachloroethylene	3,799.83	5
Trichloroethylene	17	5
cis-1,2-Dichloroethylene	20	5

MW-5 (1/13/15)		
VOCs	µg/L	GQS
Tetrachloroethylene	5.43	5

MW-6 (1/13/15)		
VOCs	µg/L	GQS
Tetrachloroethylene	85.83	5
Trichloroethylene	8.90	5
cis-1,2-Dichloroethylene	40	5

MW-3 (1/13/15)		
VOCs	µg/L	GQS
Tetrachloroethylene	20.83	5

MW-3 (4/25/13)			
VOCs	µg/L	Duplicate µg/L	GQS
Tetrachloroethylene	38	83	5

MW-2 (1/13/15)	
VOCs	NAS

MW-1 (1/13/15)	
VOCs	ND

MW-7 (1/13/15)	
VOCs	NAS

MW-8 (1/13/15)	
VOCs	NAS

LEGEND:

VOCs	VOLATILE ORGANIC COMPUNDS
µg/L	MICROGRAMS PER LITER
ND	NONE DETECTED
NAS	NONE ABOVE STANDARDS
GQS	GROUNDWATER QUALITY STANDARDS
🟨	SHADED VALUES EXCEED GQS

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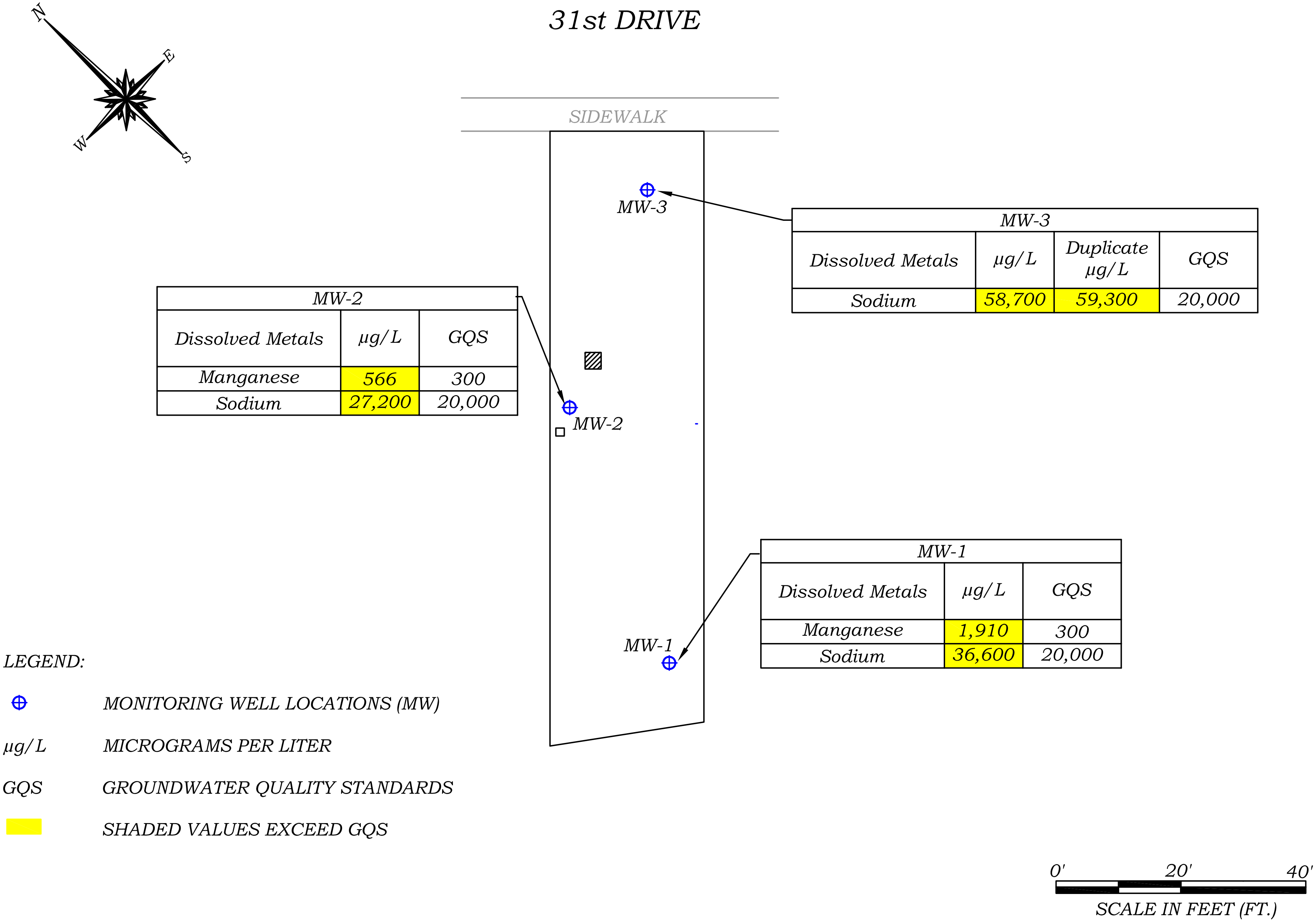
Approved By: M.R
Date: 07/09/14
Scale: AS NOTED

TITLE:

FIGURE 7: SPIDER MAP OF PCE AND ITS DERIVATIVES IN EXCEEDANCES IN GROUNDWATER



MW-3			
Dissolved Metals	µg/L	Duplicate µg/L	GQS
Sodium	58,700	59,300	20,000

MW-2		
Dissolved Metals	µg/L	GQS
Manganese	566	300
Sodium	27,200	20,000

MW-1		
Dissolved Metals	µg/L	GQS
Manganese	1,910	300
Sodium	36,600	20,000

LEGEND:

⊕	MONITORING WELL LOCATIONS (MW)
µg/L	MICROGRAMS PER LITER
GQS	GROUNDWATER QUALITY STANDARDS
🟨	SHADED VALUES EXCEED GQS

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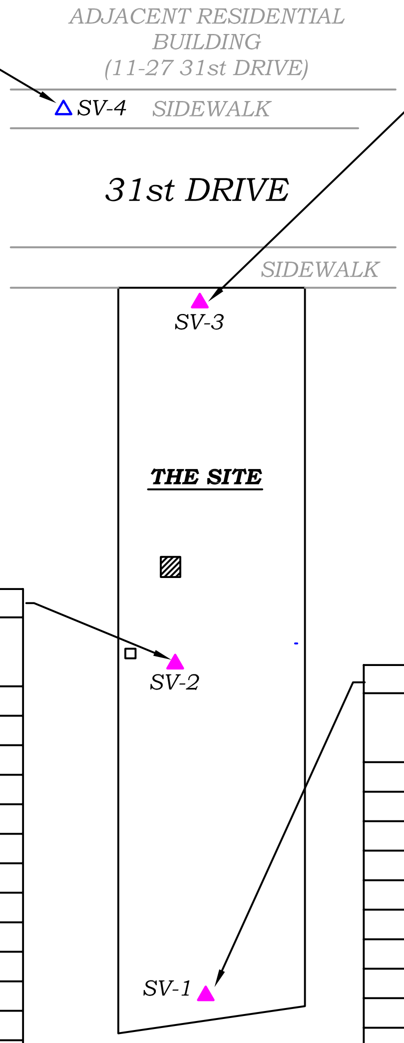
Approved By: M.R
Date: 04/29/16
Scale: AS NOTED

TITLE:

FIGURE 8: SPIDER MAP OF DISSOLVED METALS IN EXCEEDANCES OF GROUNDWATER



SV-4	
VOCs	$\mu g/m^3$
1,2,4-Trimethylbenzene	18
Ethyl Benzene	10
Benzene	14
n-Heptane	8.1
n-Hexane	30
o-Xylene	13
p- & m- Xylenes	45
Toluene	46
Isopropanol	20
2-Butanone	17
Carbon disulfide	41
Acetone	91
Methylene chloride	23
Tetrachloroethylene	1,600
Trichloroethylene	130

SV-3	
VOCs	$\mu g/m^3$
1,2,4-Trimethylbenzene	29
Toluene	22
Ethyl Benzene	9.8
n-Heptane	32
o-Xylene	12
p- & m- Xylenes	41
Cyclohexane	44
Carbon disulfide	7.0
Isopropanol	79
Tetrahydrofuran	20
Acetone	82
Chloroform	18
Methylene chloride	9.4
Tetrachloroethylene	1,400
Trichloroethylene	15

SV-2	
VOCs	$\mu g/m^3$
1,2,4-Trimethylbenzene	35
Toluene	33
Ethyl Benzene	12
n-Heptane	55
o-Xylene	15
p- & m- Xylenes	50
2-Butanone	15
Carbon disulfide	8.4
Isopropanol	210
Tetrahydrofuran	25
Acetone	520
Methylene chloride	29
Tetrachloroethylene	1,600
Trichloroethylene	9.3

SV-1	
VOCs	$\mu g/m^3$
Toluene	48
Ethyl Benzene	10
n-Heptane	820
n-Hexane	9.0
o-Xylene	14
p- & m- Xylenes	43
2-Butanone	40
Ethyl acetate	230
Isopropanol	2,200
Tetrahydrofuran	23
Acetone	90
Methylene chloride	17
Tetrachloroethylene	140

LEGEND:

▲	SOIL VAPOR SAMPLE (SV) - COLLECTED ON APRIL 25, 2013
△	SOIL VAPOR SAMPLE (SV) - COLLECTED ON JULY 8, 2013
$\mu g/m^3$	MICROGRAMS PER CUBIC METER
VOC	VOLATILE ORGANIC COMPOUNDS

0' 20' 40'
SCALE IN FEET (FT.)

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Approved By: M.R
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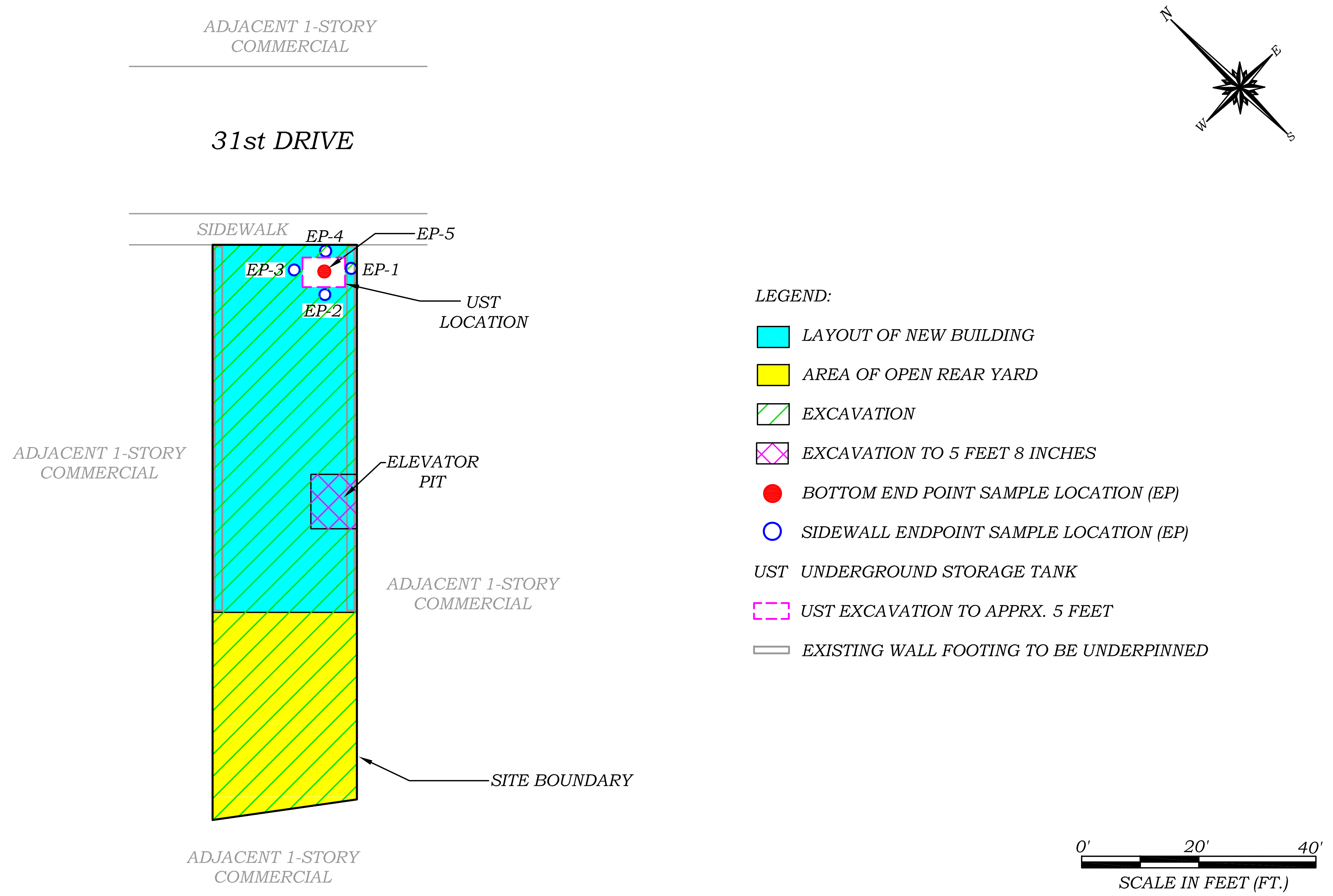
TITLE:
FIGURE 9: SPIDER MAP OF SOIL VAPOR DATA



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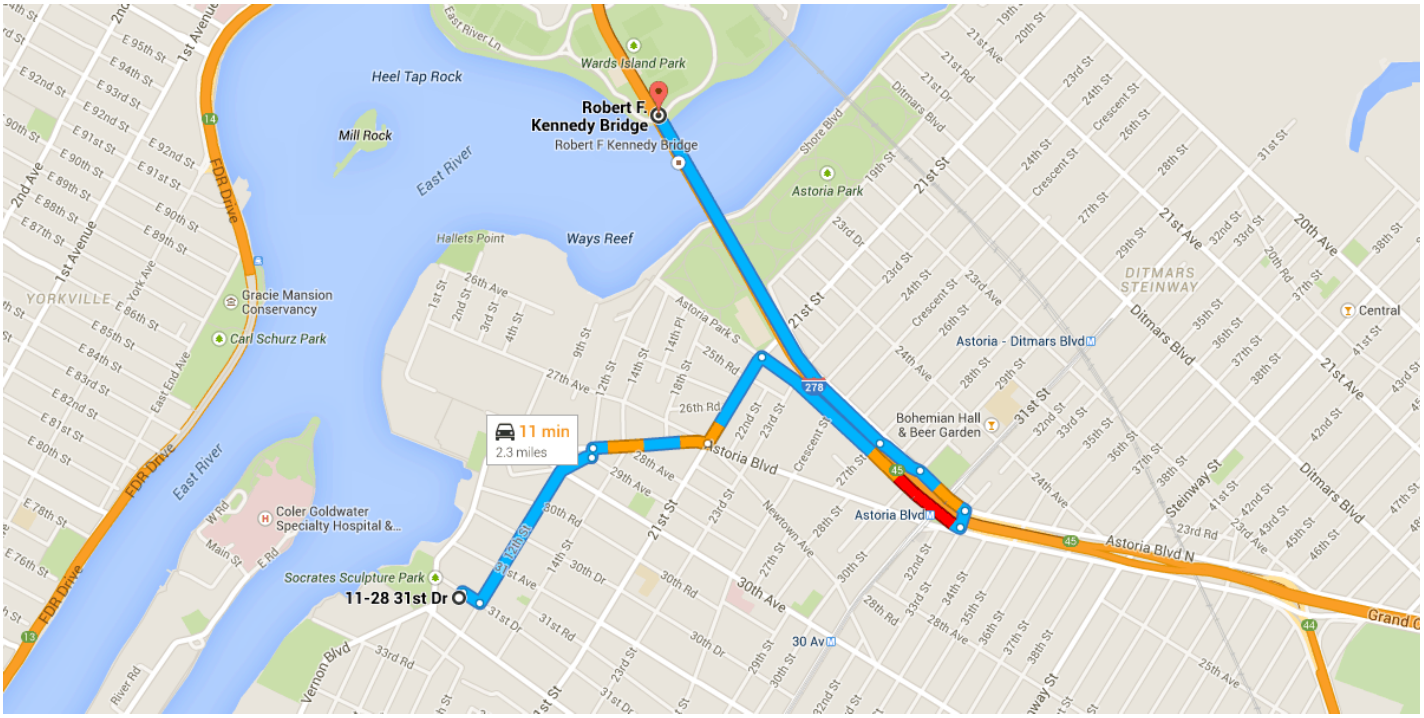
TITLE:

FIGURE 10: ENDPOINT SAMPLING PLAN

Figure 11 - Truck Routes

Drive 2.3 miles, 8 min

Directions from **11-28 31st Dr** to **Robert F. Kennedy Bridge**



○ **11-28 31st Dr**

Long Island City, NY 11106

Follow **12th St** to **Astoria Blvd**

0.4 mi / 3 min

↑ 1. Head **southeast** on **31st Dr** toward **12th St**

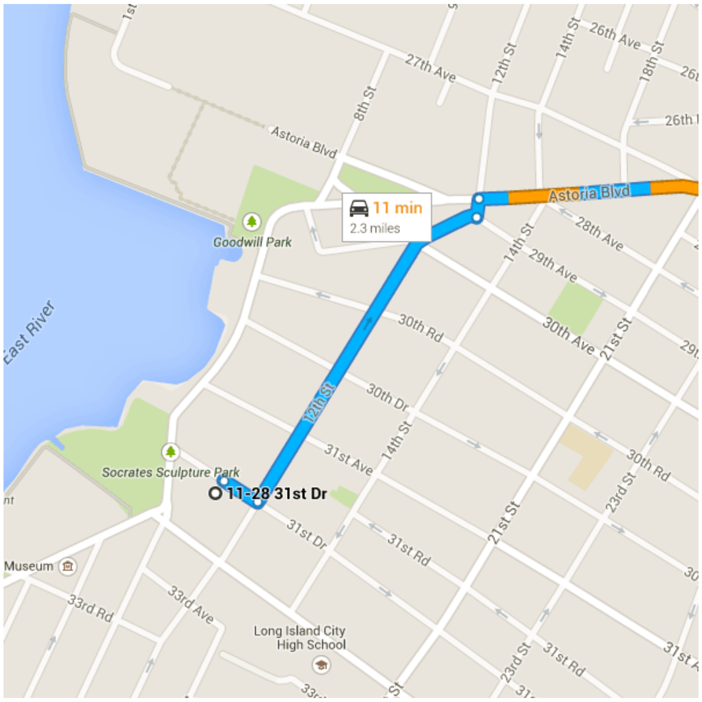
207 ft

↰ 2. Turn **left** at the 1st cross street onto **12th St**

0.4 mi

↰ 3. Turn **left** to stay on **12th St**

95 ft



Take **Hoyt Ave S** to **I-278 E/Robert F. Kennedy Bridge** in Manhattan

1.9 mi / 5 min

4. Turn **right** at the 1st cross street onto **Astoria Blvd**

0.2 mi

5. Turn **left** onto **21st St**

0.2 mi

6. Turn **right** onto **Hoyt Ave S**

0.5 mi

7. Turn **left** at **33rd St**

184 ft

8. Turn **left** onto **Hoyt Ave N**

0.1 mi

9. Take the **Interstate 278 E/Robert F Kennedy Bridge** ramp on the **left** to **Manhattan/Bronx/Randalls Island**

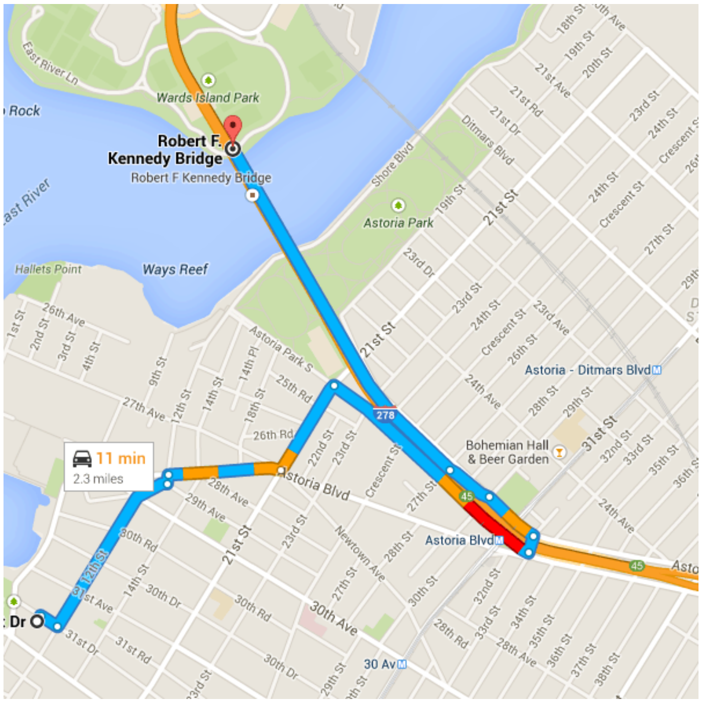
⚠ Toll road

492 ft

10. Merge onto **I-278 E/Robert F. Kennedy Bridge**

⚠ Toll road

0.8 mi



Robert F. Kennedy Bridge

New York, NY

Tables

Table 1 - Summary of Soil Sampling Locations, Depth and Analyses

Soil Probe	Physical Location	Specific Location	Depth of Boring (Feet)	Samples Chosen For Analysis (Feet)	Sample Selection Criteria	Analytical Methods
SP-1	On-Site	South portion	9	0-2	Shallow	*TCL VOCs via EPA Method 8260 *TCL SVOCs via EPA Method 8270 BNA * Pesticides via EPA Method 8081 * Herbicides via EPA Method 8151 * Polychlorinated biphenyls via EPA Method 8082 *TAL Metals via EPA Method 6010
				9-8	Deep at capillary fringe	
SP-2		Vicinity of dry pit in the western portion	9	0-2	Shallow	
				9-8	Deep at capillary fringe	
SP-3		Vicinity of UST in the northeastern portion	9	0-2	Shallow	
				9-8	Deep at capillary fringe	
SP-4		Within dry pit in the western portion	8	2-4	Shallow	
				6-8	Deep at capillary fringe	
SP-5		Northwestern portion	8	0-2	Shallow	
				6-8	Deep at capillary fringe	

Table 2 - Summary of Groundwater Monitoring Well Sampling Locations and Analyses

Monitoring Well (MW)	Physical Location	Speific Location	Analysis
MW-1	On-Site	Southern portion	*TCL VOCs via EPA Method 8260 *TCL SVOCs via EPA Method 8270 BNA * Pesticides via EPA Method 8081 * Herbicides via EPA Method 8151 * Polychlorinated biphenyls via EPA Method 8082 *TAL Metals (Diss/Total) via EPA Method 6010
MW-2		Vicinity of dry pit in the western portion	
MW-3		Vicinity of UST in the northeastern portion	
MW-4	Of-Site	North-adjacent sidewalk	TCL VOCs via EPA Method 8260
MW-5		Within 100 feet in the western vicinity	
MW-6		Within 70 feet in the northern and eastern vicinity	
MW-7		Within 180 feet in the southeastern vicinity	
MW-8		Within 260 feet in the southern vicinity	

Table 3 - Summary of Soil Vapor Sampling Locations and Analyses

Soil Vapor Point	Physical Location	Speific Location	Sample Collection Depth	Analysis
SV-1	On-Site	Southern portion	Sub-slab	*VOCs and via EPA Method TO-15
SV-2		Vicinity of dry pit in the western portion	Sub-slab	
SV-3		Vicinity of UST in the northeastern portion	Sub-slab	
SV-4	Off-Site	Northern vicinity	7 Feet	

Table 4
Groundwater Monitoring Results
11-28 31st Drive, Queens, NY

Well ID	Well Diameter	Pipe Elevation	April 25, 2013			January 13, 2015			March 11, 2015		
			DTP	DTW	Water Table Elevation (ft)	DTP	DTW	Water Table Elevation (ft)	DTP	DTW	Water Table Elevation (ft)
MW-1	1-inch	9.92	ND	8.45	11.47	ND	11.44	8.48	ND	11.14	8.78
MW-2	1-inch	9.89	ND	5.09	14.8	ND	11.34	8.55	ND	11.03	8.86
MW-3	1-inch	9.52	ND	5.35	14.17	ND	10.65	8.87	ND	10.39	9.13
MW-4	2-inch	9.06	NA	NA	NA	ND	10.05	9.01	ND	9.73	9.33
MW-5	2-inch	7.46	NA	NA	NA	ND	9.05	8.41	ND	8.69	8.77
MW-6	2-inch	9.47	NA	NA	NA	ND	10.15	9.32	ND	10.3	9.17
MW-7	2-inch	10.26	NA	NA	NA	ND	11.14	9.12	ND	10.72	9.54
MW-8	2-inch	7.31	NA	NA	NA	ND	9.78	7.53	ND	8.48	8.83

All values reported in feet.

Surface pipe vertical elevation was surveyed during February 2015 and refers to North American Datum of 1988 (NADV88)

Water Tabel elevationsare standardized by a benchmark of 10

DTW…Depth to Water

DTP…Depth to Product

ND…None Detected

NA…Not Available

Table 5
Soil Samples Analytical Results for VOCs
11-28 31st Drive, Queens, NY

Sample ID	SP-1	SP-1	SP-2	SP-2	SP-2	SP-3	SP-3	SP-4	SP-4	SP-5	SP-5	NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives mg/kg dry	Restricted Use Soil Cleanup Objectives (6 NYC RR Pt.375-6.8b) - Restricted Residential mg/kg dry
Sampling Depth (ft)	0'-2'	8'-9'	0'-2'	8'-9'	8'-9'	0'-2'	8-9'	2'-4'	6'-8'	0'-2'	6'-8'		
Sampling Date	4/24/2013	4/24/2013	4/24/2013	4/24/2013	4/24/2013	4/24/2013	4/24/2013	10/15/2013	10/15/2013	10/15/2013	10/15/2013		
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Units	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry		
Volatile Organics, 8260 List													
1,1,1,2-Tetrachloroethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00025	<0.00024	<0.00022	NS	NS
1,1,1-Trichloroethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00052	<0.00049	<0.00046	0.68	100
1,1,2,2-Tetrachloroethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00048	<0.00045	<0.00042	NS	NS
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	NA	NA	NA	NS	NS
1,1,2-Trichloroethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00044	<0.00042	<0.00039	NS	NS
1,1-Dichloroethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00073	<0.00069	<0.00064	0.27	26
1,1-Dichloroethylene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00053	<0.0005	<0.00047	0.33	100
1,1-Dichloropropylene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	NA	NA	NA	NS	NS
1,2,3-Trichlorobenzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00041	<0.00039	<0.00036	NS	NS
1,2,3-Trichloropropane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00043	<0.00041	<0.00038	NS	NS
1,2,4-Trichlorobenzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	NA	NA	NA	NS	NS
1,2,4-Trimethylbenzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00042	<0.0004	<0.00037	3.6	52
1,2-Dibromo-3-chloropropane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00068	<0.00064	<0.0006	NS	NS
1,2-Dibromoethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00042	<0.0004	<0.00037	NS	NS
1,2-Dichlorobenzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00036	<0.00034	<0.00032	1.1	100
1,2-Dichloroethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00054	<0.00052	<0.00048	0.02	3.1
1,2-Dichloropropane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00024	<0.00023	<0.00021	NS	NS
1,3,5-Trimethylbenzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.0014	<0.0013	<0.0012	8.4	52
1,3-Dichlorobenzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00027	<0.00026	<0.00024	2.4	49
1,3-Dichloropropane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00043	<0.00041	<0.00038	NS	NS
1,4-Dichlorobenzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00027	<0.00026	<0.00024	1.8	13
1,4-Dioxane	<0.056	<0.031	<0.060	<0.034	<0.059	<0.0025	<0.047	<0.047	NA	NA	NA	0.1	13
2,2-Dichloropropane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00043	<0.00041	<0.00038	NS	NS
2-Butanone	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	NA	NA	NA	NS	NS
2-Chlorotoluene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.0014	<0.0013	<0.0012	NS	NS
4-Chlorotoluene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.0006	<0.00057	<0.00053	NS	NS
Acetone	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	**0.0031** J	0.0031	<0.0014	<0.0013	<0.0012	0.05	100
Benzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00037	<0.00035	<0.00033	0.06	4.8
Bromobenzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00043	<0.00041	<0.00038	NS	NS
Bromochloromethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.0004	<0.00038	<0.00035	NS	NS
Bromodichloromethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00035	<0.00033	<0.00031	NS	NS
Bromoform	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00066	<0.00062	<0.00058	NS	NS
Bromomethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.0019	<0.0018	<0.0017	NS	NS
Carbon tetrachloride	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00049	<0.00046	<0.00043	0.76	2.4
Chlorobenzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00025	<0.00024	<0.00022	1.1	100
Chloroethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.0005	<0.00047	<0.00044	NS	NS
Chloroform	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00043	<0.00041	<0.00038	0.37	49
Chloromethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.0022	<0.0021	<0.002	NS	NS
cis-1,2-Dichloroethylene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00049	<0.00046	<0.00043	0.25	100
cis-1,3-Dichloropropylene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00024	<0.00023	<0.00021	NS	NS
Dibromochloromethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00057	<0.00054	<0.0005	NS	NS
Dibromomethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00043	<0.00041	<0.00038	NS	NS
Dichlorodifluoromethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00035	<0.00033	<0.00031	NS	NS
Ethyl Benzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00025	<0.00024	<0.00022	1	41
Hexachlorobutadiene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00039	<0.00037	<0.00034	0.33	1.2
Isopropylbenzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00025	<0.00024	<0.00022	NS	NS
Methyl tert-butyl ether (MTBE)	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00078	<0.00074	<0.00069	0.93	100
Methylene chloride	**0.0099** J,B	**0.0024** J,B	**0.0052** J,B	**0.0036** J,B	<0.0029	**0.0035** J,B	<0.0023	<0.0023	<0.0029	<0.0028	<0.0026	0.05	100
n-Butylbenzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00027	<0.00026	<0.00024	12	NS
n-Propylbenzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00049	<0.00046	<0.00043	3.9	100
Naphthalene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	NA	NA	NA	NS	NS
o-Xylene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00034	<0.00032	<0.0003	0.26	100
p- & m- Xylenes	<0.0028	<0.0015	<0.0030	<0.0017	<0.0059	<0.0050	<0.0047	<0.0047	<0.00061	<0.00058	<0.00054	0.26	100
p-Isopropyltoluene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	NA	NA	NA	NS	NS
sec-Butylbenzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00042	<0.0004	<0.00037	11	100
Styrene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00031	<0.00029	<0.00027	NS	NS
tert-Butylbenzene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00034	<0.00032	<0.0003	5.9	100
Tetrachloroethylene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	**0.0039** J	<0.0023	**0.0042**	<0.001	0.0042	<0.0009	1.3	19
Toluene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	**0.00863**	**0.0075**	0.0086	<0.00035	0.7	100
trans-1,2-Dichloroethylene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00078	<0.00074	<0.00069	0.19	100
trans-1,3-Dichloropropylene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00037	<0.00035	<0.00033	NS	NS
Trichloroethylene	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.00025	<0.00024	<0.00022	0.47	21
Trichlorofluoromethane	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.0004	<0.00038	<0.00035	NS	NS
Vinyl acetate	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	NA	NA	NA	NS	NS
Vinyl Chloride	<0.0028	<0.0015	<0.0030	<0.0017	<0.0029	<0.0025	<0.0023	<0.0023	<0.0011	<0.0011	<0.00099	0.02	0.9
Total VOCs	**0.0099**	**0.0024**	**0.0052**	**0.0036**	**ND**	**0.0074**	**0.0031**	**0.01593**	**0.0075**	**ND**	**ND**	NS	NS

B=analyte found in the analysis batch blank

J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated

ND=analyte not detected at or above the level indicated

NS=this indicates that no regulatory limit has been established for this analyte

NA...this indicates the analyte was not a target for this sample

Table 5 (Cont.)

Soil Samples Analytical Results for SVOCs

11-28 31st Drive, Queens, NY

Sample ID	SP-1	SP-1	SP-2	SP-2	SP-2	SP-3	SP-3	SP-4	SP-4	SP-5	SP-5	NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives mg/kg dry	Restricted Use Soil Cleanup Objectives (6 NYC RR Pt.375-6.8b) - Restricted Residential mg/kg dry
Sampling Depth (ft)	0'-2'	8'-9'	0'-2'	8'-9'	8'-9'	0'-2'	8-9'	2'-4'	6'-8'	0'-2'	6'-8'		
Sampling Date	4/24/2013	4/24/2013	4/24/2013	4/24/2013	4/24/2013	4/24/2013	4/24/2013	10/15/2013	10/15/2013	10/15/2013	10/15/2013		
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Units	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry		
1,2,4-Trichlorobenzene	<0.101	<0.104	<0.104	<0.107	<0.106	<0.499	<0.0969	<0.294	<0.297	<0.034	<0.033	NS	NS
1,2-Dichlorobenzene	<0.183	<0.188	<0.187	<0.194	<0.191	<0.901	<0.175	<0.175	NA	NA	NA	NS	NS
1,3-Dichlorobenzene	<0.0884	<0.0908	<0.0906	<0.0938	<0.0925	<0.435	<0.0846	<0.0846	NA	NA	NA	NS	NS
1,4-Dichlorobenzene	<0.172	<0.177	<0.177	<0.183	<0.180	<0.849	<0.165	<0.165	NA	NA	NA	NS	NS
2,4,5-Trichlorophenol	<0.217	<0.223	<0.222	<0.230	<0.227	<1.07	<0.208	<0.208	<0.037	<0.036	<0.035	NS	NS
2,4,6-Trichlorophenol	<0.142	<0.146	<0.146	<0.151	<0.149	<0.700	<0.136	<0.136	<0.042	<0.041	<0.04	NS	NS
2,4-Dichlorophenol	<0.228	<0.234	<0.234	<0.242	<0.239	<1.12	<0.218	<0.218	<0.049	<0.048	<0.047	NS	NS
2,4-Dimethylphenol	<0.196	<0.201	<0.201	<0.208	<0.205	<0.965	<0.187	<0.187	<0.036	<0.035	<0.034	NS	NS
2,4-Dinitrophenol	<0.235	<0.241	<0.241	<0.249	<0.246	<1.16	<0.225	<0.225	<0.0059	<0.0059	<0.0057	NS	NS
2,4-Dinitrotoluene	<0.124	<0.127	<0.127	<0.131	<0.129	<0.609	<0.118	<0.118	<0.042	<0.041	<0.04	NS	NS
2,6-Dinitrotoluene	<0.144	<0.148	<0.147	<0.153	<0.150	<0.708	<0.138	<0.138	<0.042	<0.041	<0.04	NS	NS
2-Chloronaphthalene	<0.151	<0.155	<0.155	<0.160	<0.158	<0.744	<0.144	<0.144	<0.034	<0.034	<0.033	NS	NS
2-Chlorophenol	<0.0923	<0.0948	<0.0946	<0.0979	<0.0966	<0.455	<0.0883	<0.0883	<0.053	<0.053	<0.051	NS	NS
2-Methylnaphthalene	<0.215	<0.221	<0.220	<0.228	**0.386**	<1.06	<0.206	<0.206	<0.027	<0.027	<0.026	NS	NS
2-Methylphenol	<0.106	<0.109	<0.109	<0.113	<0.111	<0.524	<0.102	<0.102	<0.13	<0.12	<0.12	NS	NS
2-Nitroaniline	<0.244	<0.250	<0.250	<0.259	<0.255	<1.20	<0.233	<0.233	<0.03	<0.029	<0.029	NS	NS
2-Nitrophenol	<0.0761	<0.0781	<0.0780	<0.0807	<0.0796	<0.375	<0.0728	<0.0728	<0.053	<0.053	<0.051	NS	NS
3,3'-Dichlorobenzidine	<0.147	<0.151	<0.150	<0.156	<0.153	<0.722	<0.140	<0.140	<0.045	<0.045	<0.043	NS	NS
3- & 4-Methylphenols	<0.121	<0.125	<0.124	<0.129	<0.127	<0.598	<0.116	<0.116	<0.047	<0.047	<0.046	NS	NS
3-Nitroaniline	<0.278	<0.285	<0.285	<0.295	<0.291	<1.37	<0.266	<0.266	<0.059	<0.059	<0.057	NS	NS
4,6-Dinitro-2-methylphenol	<0.353	<0.362	<0.361	<0.374	<0.369	<1.74	<0.337	<0.337	<0.42	<0.41	<0.4	NS	NS
4-Bromophenyl phenyl ether	<0.135	<0.138	<0.138	<0.143	<0.141	<0.664	<0.129	<0.129	<0.062	<0.061	<0.059	NS	NS
4-Chloro-3-methylphenol	<0.189	<0.194	<0.193	<0.200	<0.197	<0.929	<0.180	<0.180	<0.043	<0.042	<0.041	NS	NS
4-Chloroaniline	<0.0727	<0.0747	<0.0745	<0.0772	<0.0761	<0.358	<0.0696	<0.0696	<0.03	<0.029	<0.029	NS	NS
4-Chlorophenyl phenyl ether	<0.164	<0.168	<0.168	<0.174	<0.172	<0.808	<0.157	<0.157	<0.036	<0.035	<0.034	NS	NS
4-Nitroaniline	<0.116	<0.119	<0.119	<0.123	<0.121	<0.571	<0.111	<0.111	<0.049	<0.048	<0.047	NS	NS
4-Nitrophenol	<0.105	<0.108	<0.108	<0.112	<0.110	<0.518	<0.101	<0.101	<0.34	<0.34	<0.33	NS	NS
Acenaphthene	<0.101	<0.104	<0.104	<0.107	<0.106	<0.499	<0.0969	<0.0969	<0.037	<0.036	<0.035	20	100
Acenaphthylene	<0.134	<0.138	<0.138	<0.142	<0.140	<0.661	<0.128	<0.128	<0.037	<0.036	<0.035	100	100
Aniline	<0.160	<0.164	<0.164	<0.170	<0.167	<0.788	<0.153	<0.153	NA	NA	NA	NS	NS
Anthracene	**0.184** J	<0.157	<0.156	<0.162	<0.160	<0.752	<0.146	<0.146	<0.027	<0.027	<0.026	100	100
Benzo(a)anthracene	**0.608**	<0.107	**0.195** J	<0.111	<0.109	<0.515	<0.100	<0.100	<0.015	<0.015	<0.015	1	1
Benzo(a)pyrene	**0.508**	<0.114	**0.126** J	<0.118	<0.116	<0.546	<0.106	<0.106	<0.027	<0.027	<0.026	1	1
Benzo(b)fluoranthene	**0.486**	<0.241	<0.240	<0.249	<0.245	<1.15	<0.224	<0.224	<0.058	<0.058	<0.056	1	1
Benzo(g,h,i)perylene	**0.194** J	<0.0954	<0.0952	<0.0985	<0.0972	<0.458	<0.0888	<0.0888	<0.022	<0.022	<0.022	100	100
Benzo(k)fluoranthene	**0.598**	<0.287	<0.287	<0.297	<0.293	<1.38	<0.268	<0.268	<0.019	<0.019	<0.018	0.8	3.9
Benzyl alcohol	<0.280	<0.287	<0.287	<0.297	<0.293	<1.38	<0.268	<0.268	NA	NA	NA	NS	NS
Benzyl butyl phthalate	<0.154	<0.159	<0.158	<0.164	<0.162	<0.761	<0.148	<0.148	<0.022	<0.022	<0.022	NS	NS
Bis(2-chloroethoxy)methane	<0.0962	<0.0988	<0.0986	<0.102	<0.101	<0.474	<0.0921	<0.0921	<0.04	<0.04	<0.039	NS	NS
Bis(2-chloroethyl)ether	<0.143	<0.146	<0.146	<0.151	<0.149	<0.703	<0.136	<0.136	<0.05	<0.049	<0.048	NS	NS
Bis(2-chloroisopropyl)ether	<0.0985	<0.101	<0.101	<0.104	<0.103	<0.485	<0.0942	<0.0942	<0.047	<0.047	<0.046	NS	NS
Bis(2-ethylhexyl)phthalate	<0.193	<0.198	<0.198	<0.205	<0.202	<0.951	<0.185	<0.185	<0.36	<0.35	<0.34	NS	NS
Chrysene	**0.635**	<0.132	**0.211** J	<0.137	<0.135	<0.634	<0.123	<0.123	<0.021	<0.021	<0.021	1	3.9
Di-n-butyl phthalate	<0.114	<0.117	<0.116	<0.121	<0.119	<0.559	<0.109	<0.109	<0.031	<0.031	<0.03	NS	NS
Di-n-octyl phthalate	<0.280	<0.287	<0.287	<0.297	<0.293	<1.38	<0.268	<0.268	<0.022	<0.022	<0.022	NS	NS
Dibenzo(a,h)anthracene	<0.112	<0.115	<0.115	<0.119	<0.118	<0.554	<0.108	<0.108	<0.031	<0.031	<0.03	0.33	0.33
Dibenzofuran	<0.130	<0.134	<0.134	<0.138	<0.136	<0.642	<0.125	<0.125	NA	NA	NA	NS	NS
Diethyl phthalate	<0.176	<0.180	<0.180	<0.186	<0.184	<0.865	<0.168	<0.168	<0.039	<0.039	<0.038	NS	NS
Dimethyl phthalate	<0.125	<0.128	<0.128	<0.132	<0.131	<0.615	<0.119	<0.297	<0.297	<0.297	<0.297	NS	NS
Dioxin Screen	<0.00	<0.00	<0.00	<0.00	<0.00	<0.00	<0.00	<0.00	NA	NA	NA	NS	NS
Fluoranthene	**1.09**	<0.168	**0.340**	<0.174	<0.172	<0.808	<0.157	<0.157	<0.026	<0.026	<0.025	100	100
Fluorene	<0.134	<0.138	<0.138	<0.142	<0.140	<0.661	<0.128	<0.128	<0.026	<0.026	<0.025	30	100
Hexachlorobenzene	<0.165	<0.169	<0.169	<0.175	<0.173	<0.813	<0.158	<0.158	<0.038	<0.038	<0.037	NS	NS
Hexachlorobutadiene	<0.0946	<0.0971	<0.0969	<0.100	<0.0989	<0.466	<0.0904	<0.0904	<0.058	<0.058	<0.056	NS	NS
Hexachlorocyclopentadiene	<0.208	<0.214	<0.213	<0.221	<0.218	<1.03	<0.199	<0.199	<0.53	<0.52	<0.51	NS	NS
Hexachloroethane	<0.0800	<0.0821	<0.0820	<0.0849	<0.0837	<0.394	<0.0765	<0.0765	<0.06	<0.06	<0.058	NS	NS
Indeno(1,2,3-cd)pyrene	**0.219** J	<0.131	<0.131	<0.135	<0.133	<0.628	<0.122	<0.122	<0.017	<0.017	<0.016	0.5	0.5
Isophorone	<0.0962	<0.0988	<0.0986	<0.102	<0.101	<0.474	<0.0921	<0.0921	<0.033	<0.033	<0.032	NS	NS
N-nitroso-di-n-propylamine	<0.0934	<0.0959	<0.0957	<0.0991	<0.0978	<0.460	<0.0894	<0.0894	<0.056	<0.055	<0.054	NS	NS
N-Nitrosodimethylamine	<0.115	<0.118	<0.118	<0.122	<0.120	<0.565	<0.110	<0.110	NA	NA	NA	NS	NS
N-Nitrosodiphenylamine	<0.126	<0.130	<0.130	<0.134	<0.132	<0.623	<0.121	<0.121	<0.034	<0.034	<0.033	0.33	100
Naphthalene	<0.0688	<0.0707	<0.0705	<0.0730	<0.0720	<0.339	<0.0658	<0.0658	NA	NA	NA	NS	NS
Pentachlorophenol	<0.211	<0.217	<0.216	<0.224	<0.221	<1.04	<0.202	<0.202	<0.34	<0.33	<0.32	0.8	6.7
Phenanthrene	**0.806**	<0.150	**0.352**	<0.155	<0.153	<0.719	<0.140	<0.140	<0.029	<0.028	<0.028	100	100
Phenol	<0.121	<0.124	<0.124	<0.128	<0.126	<0.595	<0.116	<0.116	<0.034	<0.034	<0.033	0.33	100
Pyrene	**0.998**	<0.117	**0.476**	<0.121	<0.119	<0.562	<0.109	<0.109	<0.026	<0.026	<0.025	100	100
Pyridine	<0.196	<0.202	<0.201	<0.208	<0.205	<0.967	<0.188	<0.188	NA	NA	NA	NS	NS
Total SVOCs	**6.326**	ND	**1.7**	ND	**0.386**	ND	ND	**ND**	**ND**	**ND**	**ND**	NS	NS

J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated

ND=analyte not detected at or above the level indicated

NS=this indicates that no regulatory limit has been established for this analyte

NA...this indicates the analyte was not a target for this sample

Table 5 (Cont.)

Soil Samples Analytical Results for Pesticides & PCBs

11-28 31st Drive, Queens, NY

Sample ID	SP-1	SP-1	SP-2	SP-2	SP-2	SP-3	SP-3	SP-4	SP-4	SP-5	SP-5	NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives mg/kg dry	Restricted Use Soil Cleanup Objectives (6 NYC RR Pt.375-6.8b) - Restricted Residential mg/kg dry
Sampling Depth (ft)	0'-2'	8'-9'	0'-2'	8'-9'	8'-9'	0'-2'	8-9'	2'-4'	6'-8'	0'-2'	6'-8'		
Sampling Date	4/24/2013	4/24/2013	4/24/2013	4/24/2013	4/24/2013	4/24/2013	4/24/2013	10/15/2013	10/15/2013	10/15/2013	10/15/2013		
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Units	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry		
4,4'-DDD	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<<0.00177	0.0024	<0.0024	<0.0023	0.0033	13
4,4'-DDE	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.00076	<0.00075	<0.00073	0.0033	8.9
4,4'-DDT	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.0012	<0.0012	<0.0012	0.0033	7.9
Aldrin	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.0014	<0.0013	<0.0013	0.005	0.097
alpha-BHC	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.0030	<0.0030	<0.0029	0.02	0.48
alpha-Chlordane	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.00075	<0.00074	<0.00072	0.094	4.2
beta-BHC	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.00098	<0.00098	<0.00095	NS	NS
delta-BHC	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.0022	<0.0022	<0.0022	0.04	100
Dieldrin	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.00077	<0.00076	<0.00074	0.005	0.2
Endosulfan I	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.00090	<0.00089	<0.00087	2.4	24
Endosulfan II	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.0029	<0.0028	<0.0028	2.4	24
Endosulfan sulfate	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.0037	<0.0036	<0.0035	2.4	24
Endrin	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.0015	<0.0014	<0.0014	0.014	11
Endrin aldehyde	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.0022	<0.0022	<0.0021	NS	NS
Endrin ketone	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.0025	<0.0025	<0.0025	NS	NS
gamma-BHC (Lindane)	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.0015	<0.0015	<0.0015	NS	NS
gamma-Chlordane	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.0014	<0.0014	<0.0014	NS	NS
Heptachlor	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.00095	<0.00094	<0.00092	NS	NS
Heptachlor epoxide	<0.00185	<0.00190	<0.00189	<0.00196	<0.00193	<0.00182	<0.00177	<0.00177	<0.0038	<0.0038	<0.0037	0.1	1.3
Methoxychlor	<0.00923	<0.00948	<0.00946	<0.00979	<0.00966	<0.00910	<0.00883	<0.00883	<0.0011	<0.0011	<0.0011	NS	NS
Toxaphene	<0.0934	<0.0959	<0.0957	<0.0991	<0.0978	<0.0921	<0.0894	<0.0894	<0.023	<0.023	<0.022	NS	NS
Aroclor 1016	<0.0190	<0.0195	<0.0195	<0.0202	<0.0199	<0.0187	<0.0182	<0.0182	<0.073	<0.072	<0.070	NS	NS
Aroclor 1221	<0.0190	<0.0195	<0.0195	<0.0202	<0.0199	<0.0187	<0.0182	<0.0182	<0.059	<0.059	<0.057	NS	NS
Aroclor 1232	<0.0190	<0.0195	<0.0195	<0.0202	<0.0199	<0.0187	<0.0182	<0.0182	<0.085	<0.084	<0.082	NS	NS
Aroclor 1242	<0.0190	<0.0195	<0.0195	<0.0202	<0.0199	<0.0187	<0.0182	<0.0182	<0.076	<0.075	<0.073	NS	NS
Aroclor 1248	<0.0190	<0.0195	<0.0195	<0.0202	<0.0199	<0.0187	<0.0182	<0.0182	<0.071	<0.070	<0.068	NS	NS
Aroclor 1254	<0.0190	<0.0195	<0.0195	<0.0202	<0.0199	<0.0187	<0.0182	<0.0182	<0.030	<0.030	<0.029	NS	NS
Aroclor 1260	<0.0190	<0.0195	<0.0195	<0.0202	<0.0199	<0.0187	<0.0182	<0.0182	<0.070	<0.070	<0.068	NS	NS
Total PCBs	<0.0190	<0.0195	<0.0195	<0.0202	<0.0199	<0.0187	<0.0182	<0.084	<0.085	<0.082	<0.082	0.1	1

NS=this indicates that no regulatory limit has been established for this analyte

Table 5 (Cont.)

Soil Samples Analytical Results for Metals

11-28 31st Drive, Queens, NY

Sample ID	SP-1	SP-1	SP-2	SP-2	SP-2	SP-3	SP-3	SP-4	SP-4	SP-5	SP-5	NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives mg/kg dry	Restricted Use Soil Cleanup Objectives (6 NYC RR Pt.375-6.8b) - Restricted Residential mg/kg dry
Sampling Depth (ft)	0'-2'	8'-9'	0'-2'	8'-9'	8'-9'	0'-2'	8-9'	2'-4'	6'-8'	0'-2'	6'-8'		
Sampling Date	4/24/2013	4/24/2013	4/24/2013	4/24/2013	4/24/2013	4/24/2013	4/24/2013	10/15/2013	10/15/2013	10/15/2013	10/15/2013		
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Units	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry		
Aluminum	**7630**	**11000**	**9370**	**11500**	**9660**	**9050**	**8960**	**10400**	**11400**	**8760**	**11600**	NS	NS
Antimony	**0.586**	<0.253	**2.64**	<0.261	<0.258	<0.243	<0.235	**19.5**	**10.6**	**8.43**	**10.7**	NS	NS
Arsenic	**7.14**	**4.94**	**4.04**	**6.7**	**6.35**	**4.21**	**3.93**	**4.38**	**3.85**	**4.02**	**3.62**	13	16
Barium	**63.9**	**36.5**	**57.6**	**25.2**	**21.8**	**86**	**36.3**	**88.1**	**24.4**	**18.3**	**48.6**	350	400
Beryllium	<0.112	<0.115	<0.115	<0.119	<0.117	<0.110	<0.107	**0.52**	**0.34**	**0.39**	**0.47**	7.2	72
Cadmium	<0.112	<0.115	<0.115	<0.119	<0.117	<0.110	<0.107	**2.37**	**2.12**	**1.75**	**2.22**	2.5	4.3
Calcium	**26900**	**1040**	**49300**	**955**	**1930**	**16400**	**617**	**2220**	**728**	**696**	**852**	NS	NS
Cobalt	**5.55**	**11.6**	**5.89**	**8.75**	**6.63**	**8.29**	**7.08**	**7.63**	**7.96**	**6.32**	**8.65**	NS	NS
Copper	**49.6**	**17.3**	**25.9**	**16**	**12.9**	**54.6**	**13.4**	**58.7**	**12.9**	**11.5**	**12.2**	50	270
Iron	**13400**	**18900**	**13900**	**23700**	**20200**	**17200**	**16600**	**18600**	**22300**	**18700**	**21500**	NS	NS
Lead	**191**	**19.3**	**42.3**	**7.52**	**6.63**	**96.8**	**5.18**	**157**	**8.2**	**7.01**	**10**	63	400
Magnesium	**8280**	**3230**	**11800**	**3010**	**2560**	**3250**	**3130**	**3110**	**3470**	**3100**	**3190**	NS	NS
Manganese	**237**	**876**	**235**	**261**	**189**	**458**	**413**	**390**	**277**	**194**	**430**	1,600	2,000
Nickel	**10.3**	**10.6**	**26.3**	**11**	**8.02**	**9.85**	**12.3**	**17.2**	**16.3**	**12.9**	**17.6**	30	310
Potassium	**1820**	**1180**	**964**	**1210**	**1190**	**1970**	**1470**	**947**	**879**	**772**	**1070**	NS	NS
Selenium	**2.65**	**2.77**	**0.953**	**3.23**	**2.97**	**2.22**	**2.65**	**6.7**	**7.69**	**7.73**	**9.87**	3.9	180
Silver	**0.708**	<0.115	<0.115	<0.119	<0.117	<0.110	<0.107	<1	<0.792	0.844	<0.878	2	180
Sodium	**321**	**160**	**226**	**127**	**118**	**282**	**142**	**60.7**	**41.5**	**48.4**	**109**	NS	NS
Thallium	<0.358	<0.368	<0.367	<0.380	<0.375	<0.353	<0.343	<2	<1.58	0.29	<1.76	NS	NS
Vanadium	**17.1**	**19.4**	**21.4**	**23.5**	**26.6**	**45.2**	**21.7**	**23**	**25.4**	**23.1**	**27.3**	NS	NS
Zinc	**111**	**56**	**60**	**44.8**	**33.3**	**64.7**	**34.0**	**142**	**47.1**	**38.8**	**53.4**	109	10,000
Mercury	<0.0369	<0.0379	<0.0378	<0.0392	<0.0386	<0.0364	<0.0353	**0.2**	**0.02**	<0.02	**0.02**	0.18	0.81
Chromium, Trivalent	**12.9**	**13.7**	**37.2**	**17.1**	**16.5**	**14.1**	**15.7**	**38.5**	**18.4**	**13.8**	**17.2**	30	180
Chromium, Hexavalent	<0.392	<0.402	**1.47**	<0.416	<0.410	<0.386	<0.375	<0.297	<0.297	<0.286	<0.286	1	110

NS=this indicates that no regulatory limit has been established for this analyte

J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated

Grey shaded values represent concentration exceeding Unrestricted Use SCOs

Table 6
Groundwater Samples Analytical Results for VOCs
11-28 31st Drive, Queens, NY

Sample ID	MW-1	MW-2	MW-3	MW-3 (Duplicate)	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	Field Blank	Trip Blank	Field Blank	Trip Blank	Field Blank	Trip Blank	NYSDEC TOGS Standards and Guidance Values - GA
Sampling Date	4/25/2013	4/25/2013	4/25/2013	4/25/2013	1/13/2015	1/13/2015	1/13/2015	1/13/2015	1/13/2015	1/13/2015	1/13/2015	1/13/2015	1/13/2015	1/13/2015	4/24/2013	4/25/2013	4/25/2013	4/25/2013	
Matrix	Groundwater	Groundwater	Groundwater	Groundwater	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	DI water	DI water	DI Water	DI Water	
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
Volatile Organics, 8260 List																			
1,1,1,2-Tetrachloroethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	1.40	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
1,1,1-Trichloroethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
1,1,2,2-Tetrachloroethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
1,1,2-Trichloroethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	0.76	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	1
1,1-Dichloroethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
1,1-Dichloroethylene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	0.46 J	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
1,1-Dichloropropylene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
1,2,3-Trichlorobenzene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
1,2,3-Trichloropropane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	0.04
1,2,4,5-Tetramethylbenzene	NT	NT	NT	NT	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	NT	NT	NT	NT	5
1,2,4-Trichlorobenzene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
1,2,4-Trimethylbenzene	<2.5	<2.5	<2.5	<2.5	0.21 J	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
1,2-Dibromo-3-chloropropane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	0.04
1,2-Dibromoethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
1,2-Dichlorobenzene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	3
1,2-Dichloroethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	0.6
1,2-Dichloropropane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	1
1,3,5-Trimethylbenzene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
1,3-Dichlorobenzene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	3
1,3-Dichloropropane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
1,4-Dichlorobenzene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	3
2,2-Dichloropropane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
2-Butanone	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	50
2-Chlorotoluene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
2-Hexanone	NT	NT	NT	NT	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	NT	NT	NT	NT	50
4-Chlorotoluene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
4-Methyl-2-pentanone	NT	NT	NT	NT	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	NT	NT	NT	NT	NS
Acetone	4.0 J,B	<2.5	3.6 J,B	3.9 J,B	<1 U	<1 U	<1 U	1.40 J	<1 U	<1 U	1.30 J	<1 U	<1 U	<1 U	12 J,B	16 B	5.4 J,B	16 B	50
Benzene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	1
Bromobenzene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
Bromochloromethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
Bromodichloromethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	50
Bromoform	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	50
Bromomethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
Carbon disulfide	NT	NT	NT	NT	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	NT	NT	NT	NT	NS
Carbon tetrachloride	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
Chlorobenzene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
Chloroethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
Chloroform	<2.5	<2.5	<2.5	4.7 J	<0.2 U	0.35 J	0.54	0.37 J	<0.2 U	<0.2 U	1	<0.2 U	<0.2 U	<0.2 U	<2.5 J	<2.5	<2.5	<2.5	7
Chloromethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
cis-1,2-Dichloroethylene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	1.10	20	<0.2 U	40 D	<0.2 U	1.10	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
cis-1,3-Dichloropropylene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	0.4
Dibromochloromethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	50
Dibromomethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	NS
Dichlorodifluoromethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
Ethyl Benzene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
Hexachlorobutadiene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	0.5
Isopropylbenzene	<0.63	<0.63	<0.63	<0.63	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<0.63	<0.63	<0.63	5
Methyl tert-butyl ether (MTBE)	<2.5	<2.5	<2.5	<2.5	0.28 J	<0.2 U	<0.2 U	3.10	0.39 J	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	10
Methylene chloride	3.0 J,B	3.3 J,B	2.8 J,B	4.2 J,B	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<2.5 J,B	12 B	5.4 J,B	12 B	5
Naphthalene	<2.5	<2.5	<2.5	<2.5	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<2.5	<2.5	<2.5	<2.5	10
n-Butylbenzene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
n-Propylbenzene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
o-Xylene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	0.28 J	0.29 J	<2.5	<2.5	<2.5	<2.5	5
p- & m- Xylenes	<2.5	<2.5	<2.5	<2.5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5.0	<2.5	<2.5	<2.5	5
p-Diethylbenzene	NT	NT	NT	NT	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	NT	NT	NT	NT	NS
p-Ethyltoluene	NT	NT	NT	NT	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	NT	NT	NT	NT	NS
p-Isopropyltoluene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
sec-Butylbenzene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
Styrene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
tert-Butylbenzene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<2.5	<2.5	<2.5	<2.5	5
Tetrachloroethylene	<2.5	<2.5	38	83	<0.2 U	3.03*	20.83*	3,799.83* D	5.43*	85.83* D	3.53	1.83	0.53	0.36 J	<2.5	<2.5	<2.5	<2.5	5
Toluene	<2.5	<2.5	<2.5	<2.5	0.28 J	<0.2 U	<0.2 U	0.12** J	<0.2 U	0.06** J	0.20 U	0.20 U	0.20 U	0.22 J	<2.5	<2.5	<2.5	<2.5	5
trans-1,2-Dichloroethylene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	0.28 J	0.20 U	0.20 U	0.20 U	0.20 U	<2.5	<2.5	<2.5	<2.5	5
trans-1,3-Dichloropropylene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	<2.5	<2.5	<2.5	<2.5	0.4
Trichloroethylene	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	0.52	17	0.81	8.90	0.20 U	1.20	0.20 U	0.20 U	<2.5	<2.5	<2.5	<2.5	5
Trichlorofluoromethane	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	<2.5	<2.5	<2.5	<2.5	5
Vinyl acetate	<2.5	<2.5	<2.5	<2.5	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	<2.5	<2.5	<2.5	<2.5	NS
Vinyl Chloride	<2.5	<2.5	<2.5	<2.5	<0.2 U	<0.2 U	<0.2 U	0.81	<0.2 U	0.42 J	0.20 U	0.20 U	0.20 U	0.20 U	<2.5	<2.5	<2.5	<2.5	2
Total VOCs	7	3.3	44.4	95.8	0.77	0.35	22.89	3,845.25	1.2	135.49	7.03	5.13	2.01	1.87	12	28	10.8	28	NS

B=analyte found in the analysis batch blank
J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated
NS=this indicates that no regulatory limit has been established for this analyte
Grey shaded values represent concentration exceeding GQS
NS=this indicates that no regulatory limit has been established for this analyte
NT=this indicates the analyte was not a target for this sample
*= result corrected by substructing the difference between field blank and trip blank
** = result corrected by substructing Trip blank

Table 6 (Cont.)
Groundwater Samples Analytical Results for SVOCs
11-28 31st Drive, Queens, NY

SampleID	MW-1	MW-2	MW-3	MW-3 (Duplicate)	Field Blank	Field Blank	NYSDEC TOGS Standards and Guidance Values - GA
Sampling Date	4/25/2013	4/25/2013	4/25/2013	4/25/2013	4/24/2013	4/25/2013	
Matrix	Groundwater	Groundwater	Groundwater	Groundwater	DI Water	DI Water	
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
Semi-Volatiles, 8270 Target List							
1,2,4-Trichlorobenzene	<2.47	<2.53	<2.53	<2.53	<2.53	<2.53	5
1,2-Dichlorobenzene	<2.49	<2.55	<2.55	<2.55	<2.55	<2.55	3
1,3-Dichlorobenzene	<2.61	<2.68	<2.68	<2.68	<2.68	<2.68	3
1,4-Dichlorobenzene	<2.21	<2.27	<2.27	<2.27	<2.27	<2.27	3
2,4,5-Trichlorophenol	<1.91	<1.96	<1.96	<1.96	<1.96	<1.96	1
2,4,6-Trichlorophenol	<1.75	<1.79	<1.79	<1.79	<1.79	<1.79	1
2,4-Dichlorophenol	<1.89	<1.94	<1.94	<1.94	<1.94	<1.94	5
2,4-Dimethylphenol	<1.60	<1.64	<1.64	<1.64	<1.64	<1.64	50
2,4-Dinitrophenol	<2.25	<2.31	<2.31	<2.31	<2.31	<2.31	10
2,4-Dinitrotoluene	<1.61	<1.65	<1.65	<1.65	<1.65	<1.65	5
2,6-Dinitrotoluene	<1.61	<1.65	<1.65	<1.65	<1.65	<1.65	5
2-Chloronaphthalene	<2.20	<2.26	<2.26	<2.26	<2.26	<2.26	10
2-Chlorophenol	<1.79	<1.84	<1.84	<1.84	<1.84	<1.84	1
2-Methylnaphthalene	<2.76	<2.83	<2.83	<2.83	<2.83	<2.83	NS
2-Methylphenol	<1.16	<1.19	<1.19	<1.19	<1.19	<1.19	1
2-Nitroaniline	<1.68	<1.72	<1.72	<1.72	<1.72	<1.72	5
2-Nitrophenol	<2.36	<2.42	<2.42	<2.42	<2.42	<2.42	1
3,3'-Dichlorobenzidine	<1.27	<1.30	<1.30	<1.30	<1.30	<1.30	5
3- & 4-Methylphenols	<1.12	<1.15	<1.15	<1.15	<1.15	<1.15	NS
3-Nitroaniline	<1.68	<1.72	<1.72	<1.72	<1.72	<1.72	5
4,6-Dinitro-2-methylphenol	<1.62	<1.66	<1.66	<1.66	<1.66	<1.66	NS
4-Bromophenyl phenyl ether	<1.33	<1.36	<1.36	<1.36	<1.36	<1.36	NS
4-Chloro-3-methylphenol	<1.89	<1.94	<1.94	<1.94	<1.94	<1.94	1
4-Chloroaniline	<2.98	<3.06	<3.06	<3.06	<3.06	<3.06	5
4-Chlorophenyl phenyl ether	<2.45	<2.51	<2.51	<2.51	<2.51	<2.51	NS
4-Nitroaniline	<2.68	<2.75	<2.75	<2.75	<2.75	<2.75	5
4-Nitrophenol	<1.66	<1.70	<1.70	<1.70	<1.70	<1.70	1
Acenaphthene	<1.77	<1.82	<1.82	<1.82	<1.82	<1.82	20
Acenaphthylene	<1.74	<1.78	<1.78	<1.78	<1.78	<1.78	NS
Aniline	<1.50	<1.54	<1.54	<1.54	<1.54	<1.54	5
Anthracene	<1.19	<1.22	<1.22	<1.22	<1.22	<1.22	50
Benzo(a)anthracene	<1.31	<1.34	<1.34	<1.34	<1.34	<1.34	0.002
Benzo(a)pyrene	<1.30	<1.33	<1.33	<1.33	<1.33	<1.33	0.002
Benzo(b)fluoranthene	<1.41	<1.45	<1.45	<1.45	<1.45	<1.45	0.002
Benzo(g,h,i)perylene	<1.71	<1.75	<1.75	<1.75	<1.75	<1.75	NS
Benzo(k)fluoranthene	<1.83	<1.88	<1.88	<1.88	<1.88	<1.88	0.002
Benzyl alcohol	<1.45	<1.49	<1.49	<1.49	<1.49	<1.49	NS
Benzyl butyl phthalate	<0.852	<0.874	<0.874	<0.874	<0.874	<0.874	50
Bis(2-chloroethoxy)methane	<1.77	<1.82	<1.82	<1.82	<1.82	<1.82	5
Bis(2-chloroethyl)ether	<1.50	<1.54	<1.54	<1.54	<1.54	<1.54	1
Bis(2-chloroisopropyl)ether	<2.99	<3.07	<3.07	<3.07	<3.07	<3.07	5
Bis(2-ethylhexyl)phthalate	<4.78	<4.90	<470	<4.90	<4.90	<4.90	5
Chrysene	<1.47	<1.51	<1.51	<1.51	<1.51	<1.51	0.002
Di-n-butyl phthalate	**11.2**	<2.10	<2.10	<2.10	<2.10	<2.10	50
Di-n-octyl phthalate	<1.12	<1.15	<1.15	<1.15	<1.15	<1.15	50
Dibenzo(a,h)anthracene	<1.56	<1.60	<1.60	<1.60	<1.60	<1.60	NS
Dibenzofuran	<2.41	<2.47	<2.47	<2.47	<2.47	<2.47	NS
Diethyl phthalate	<2.56	<2.63	<2.63	<2.63	<2.63	<2.63	50
Dimethyl phthalate	<1.91	<1.96	<1.96	<1.96	<1.96	<1.96	50
Fluoranthene	<1.24	<1.27	<1.27	<1.27	<1.27	<1.27	50
Fluorene	<1.83	<1.88	<1.88	<1.88	<1.88	<1.88	50
Hexachlorobenzene	<1.27	<1.30	<1.30	<1.30	<1.30	<1.30	0.04
Hexachlorobutadiene	<2.79	<2.86	<2.86	<2.86	<2.86	<2.86	0.5
Hexachlorocyclopentadiene	<2.53	<2.59	<2.59	<2.59	<2.59	<2.59	5
Hexachloroethane	<3.04	<3.12	<3.12	<3.12	<3.12	<3.12	5
Indeno(1,2,3-cd)pyrene	<1.70	<1.74	<1.74	<1.74	<1.74	<1.74	0.002
Isophorone	<2.68	<2.75	<2.75	<2.75	<2.75	<2.75	50
N-nitroso-di-n-propylamine	<2.56	<2.63	<2.63	<2.63	<2.63	<2.63	NS
N-Nitrosodimethylamine	<0.389	<0.399	<0.399	<0.399	<0.399	<0.399	NS
N-Nitrosodiphenylamine	<5.00	<5.13	<5.13	<5.13	<5.13	<5.13	50
Naphthalene	<1.99	<2.04	<2.04	<2.04	<2.04	<2.04	10
Nitrobenzene	<1.69	<1.73	<1.73	<1.73	<1.73	<1.73	0.4
Pentachlorophenol	<1.45	<1.49	<1.49	<1.49	<1.49	<1.49	1
Phenanthrene	<1.37	<1.41	<1.41	<1.41	<1.41	<1.41	50
Phenol	<1.10	<1.13	<1.13	<1.13	<1.13	<1.13	1
Pyrene	<1.73	<1.77	<1.77	<1.77	<1.77	<1.77	50
Pyridine	<3.91	<4.01	<4.01	<4.01	<4.01	<4.01	50
Total VOCs	**11.2**	ND	ND	ND	ND	ND	NS

ND=this indicates the analyte was not a detected

NS=this indicates that no regulatory limit has been established for this analyte

Table 6 (Cont.)

Groundwater Samples Analytical Results for PCBs & Pesticides

11-28 31st Drive, Queens, NY

SampleID	MW-1	MW-2	MW-3	MW-3 (Duplicate)	Field Blank	Field Blank	NYSDEC TOGS Standards and Guidance Values - GA
Sampling Date	4/25/2013	4/25/2013	4/25/2013	4/25/2013	4/24/2013	4/25/2013	
Matrix	Groundwater	Groundwater	Groundwater	Groundwater	DI Water	DI Water	
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
Pesticides							
4,4'-DDD	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
4,4'-DDE	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
4,4'-DDT	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
Aldrin	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
alpha-BHC	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
beta-BHC	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
Chlordane, total	<0.00410	<0.00410	<0.00410	<0.00410	NT	<0.00410	NS
delta-BHC	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
delta-BHC	NT	NT	NT	NT	<0.00100	NT	NS
Dieldrin	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
Endosulfan I	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
Endosulfan II	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
Endosulfan sulfate	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
Endrin	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
Endrin aldehyde	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
Endrin ketone	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
gamma-BHC (Lindane)	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
gamma-Chlordane	NT	NT	NT	NT	<0.00100	NT	NS
Heptachlor	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
Heptachlor epoxide	<0.00103	<0.00100	<0.00100	<0.00103	<0.00100	<0.00100	NS
Methoxychlor	<0.00513	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NS
Toxaphene	<0.0513	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	NS
Polychlorinated Biphenyls (PCB)							
Aroclor 1016	<0.0513	<0.0500	<0.0500	<0.0513	<0.0500	<0.0500	NS
Aroclor 1221	<0.0513	<0.0500	<0.0500	<0.0513	<0.0500	<0.0500	NS
Aroclor 1232	<0.0513	<0.0500	<0.0500	<0.0513	<0.0500	<0.0500	NS
Aroclor 1242	<0.0513	<0.0500	<0.0500	<0.0513	<0.0500	<0.0500	NS
Aroclor 1248	<0.0513	<0.0500	<0.0500	<0.0513	<0.0500	<0.0500	NS
Aroclor 1254	<0.0513	<0.0500	<0.0500	<0.0513	<0.0500	<0.0500	NS
Aroclor 1260	<0.0513	<0.0500	<0.0500	<0.0513	<0.0500	<0.0500	NS
Total PCBs	<0.0513	<0.0500	<0.0500	<0.0513	<0.0500	<0.0500	NS

NS=this indicates that no regulatory limit has been established for this analyte

NT=this indicates the analyte was not a target for this sample

Table 6 (Cont.)
Groundwater Metals Samples Analytical Results
11-28 31st Drive, Queens, NY

Sample ID	MW-1	MW-2	MW-3	MW-3 (Duplicate)	Field Blank	Field Blank	NYSDEC TOGS Standards and Guidance Values - GA
Sampling Date	4/25/2013	4/25/2013	4/25/2013	4/25/2013	4/24/2013	4/25/2013	
Matrix	Groundwater	Groundwater	Groundwater	Groundwater	DI Water	DI Water	
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
Metals, Target Analyte, Total							
Aluminum	**280**	**1910**	**53**	**748**	<10	<10	NS
Antimony	<3	<3	<3	<3	<3	<3	3
Arsenic	<4	<4	<4	<4	<4	<4	25
Barium	**65**	**184**	**41**	**71**	<2	<2	1000
Beryllium	1	1	<1	<1	<1	<1	3
Cadmium	<2	<2	<2	<2	<2	<2	5
Calcium	**50900**	**120000**	**68700**	**70400**	<19	**6050**	NS
Chromium	**2** J	**8**	<2	<2	<2	<2	50
Cobalt	**6**	**2** J	<2	**2** J	<2	<2	NS
Copper	<2	**7**	<2	<2	<2	<2	200
Iron	**243**	**860**	**52**	**402**	<10	<10	300
Lead	<2	**3**	<2	<2	<2	<2	25
Magnesium	**10700**	**16500**	**14400**	**14800**	<10	**953**	35000
Manganese	**1980**	**1190**	**19**	**165**	<2	<2	300
Nickel	**7**	**5**	1	**1** J	**1** J	<1	100
Potassium	**4590**	**4940**	**2160**	**2230**	<26	**654**	NS
Selenium	<7	**7** J	<7	<7	<7	<7	10
Silver	<2	<2	<2	<2	<2	<2	50
Sodium	**35600**	**27000**	**58600**	**58000**	<61	**5720**	20000
Thallium	<3	<3	<3	<3	<3	<3	0.5
Vanadium	<2	**2** J	<2	**2** J	<2	<2	NS
Zinc	**2** J	**27**	**2** J	**21**	**2** J	**2** J	5000
Mercury	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.7
Chromium, Trivalent	<8.00	<8.00	<8.00	<8.00	<8.00	<8.00	50
Chromium, Hexavalent	<6.00	<6.00	<6.00	<6.00	<6.00	<6.00	50

J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated

NS=this indicates that no regulatory limit has been established for this analyte

Groundwater Metals Samples Analytical Results
11-28 31st Drive, Queens, NY

Sample ID	MW-1	MW-2	MW-3	MW-3 (Duplicate)	Field Blank	Field Blank	NYSDEC TOGS Standards and Guidance Values - GA
Sampling Date	4/25/2013	4/25/2013	4/25/2013	4/25/2013	4/24/2013	4/25/2013	
Matrix	Groundwater	Groundwater	Groundwater	Groundwater	DI Water	DI Water	
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
Metals, Target Analyte, Dissolved							
Aluminum	<10	<10	<10	<10	NT	<10	NS
Antimony	<3	<3	<3	<3	NT	<3	3
Arsenic	<4	<4	<4	<4	NT	<4	25
Barium	**50**	**35**	**40**	**42**	NT	<2	1000
Beryllium	<1	<1	<1	<1	NT	<1	3
Cadmium	<2	<2	<2	<2	NT	<2	5
Calcium	**52700**	**106000**	**68700**	**69400**	NT	**6210**	NS
Chromium	<2	<2	<2	<2	NT	<2	50
Cobalt	**5**	<2	<2	<2	NT	<2	NS
Copper	<2	<2	<2	<2	NT	<2	200
Iron	**29**	<10	<10	<10	NT	<10	300
Lead	<2	<2	<2	<2	NT	<2	25
Magnesium	**10800**	**15000**	**14300**	**14600**	NT	**958**	35000
Manganese	**1910**	**566**	**16**	**17**	NT	<2	300
Nickel	**6**	<1	<1	<1	NT	<1	100
Potassium	**4830**	**4200**	**2210**	**2170**	NT	**705**	NS
Selenium	<7	<7	<7	<7	NT	<7	10
Silver	<2	<2	<2	<2	NT	<2	50
Sodium	**36600**	**27200**	**58700**	**59300**	NT	**6120**	20000
Thallium	<3	<3	<3	<3	NT	<3	0.5
Vanadium	<2	<2	<2	<2	NT	<2	NS
Zinc	<2	<2	<2	<2	NT	<2	5000
Mercury	<0.03900	<0.03900	<0.03900	<0.03900	NT	<0.039	0.7

J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated

NS=this indicates that no regulatory limit has been established for this analyte

Table 7

Soil Vapor Samples Analytical Results

11-28 31st Drive, Queens, NY

Sample ID	SV-1		SV-2		SV-3		SV-4	
Sampling Date	4/25/2013		4/25/2013		4/25/2013		7/8/2013	
Matrix	Soil Vapor		Soil Vapor		Soil Vapor		Soil Vapor	
Units	ug/m³		ug/m³		ug/m³		ug/m³	
Volatile Organics, EPA TO15 Full List								
1,1,1-Trichloroethane	<11		<11		<12		<9.9	
1,1,2,2-Tetrachloroethane	<14		<13		<16		<12	
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	<15		<15		<17		<14	
1,1,2-Trichloroethane	<11		<11		<12		<9.9	
1,1-Dichloroethane	<8.0		<7.8		<9.1		<7.3	
1,1-Dichloroethylene	<7.8		<7.6		<9.0		<7.2	
1,2,4-Trichlorobenzene	<15		<14		<17		<13	
1,2,4-Trimethylbenzene	<9.7		**35**	D	**29**	D	**18**	**D**
1,2-Dibromoethane	<15		<15		<17		<14	
1,2-Dichlorobenzene	<12		<12		<14		<11	
1,2-Dichloroethane	<8.0		<7.8		<9.1		<7.3	
1,2-Dichloropropane	<9.1		<8.9		<10		<8.3	
1,2-Dichlorotetrafluoroethane	<14		<13		<16		<13	
1,3,5-Trimethylbenzene	<9.7		<9.5		<11		<8.9	
1,3-Butadiene	<8.5		<8.4		<9.8		<7.8	
1,3-Dichlorobenzene	<12		<12		<14		<11	
1,4-Dichlorobenzene	<12		<12		<14		<11	
1,4-Dioxane	<7.1		<6.9		<8.1		<6.5	
2-Butanone	**40**	D	**15**	D	<6.7		**17**	**D**
2-Hexanone	<8.1		<7.9		<9.2		<7.4	
4-Methyl-2-pentanone	<8.1		<7.9		<9.2		<7.4	
Acetone	**900**	D	**520**	D	**82**	D	**91**	**D**
Benzene	<6.3		<6.2		<7.2		**14**	**D**
Benzyl chloride	<10		<10		<12		<9.3	
Bromodichloromethane	<12		<12		<14		<11	
Bromoform	<20		<20		<23		<19	
Bromomethane	<7.7		<7.5		<8.8		<7.0	
Carbon disulfide	<6.1		**8.4**	D	**7.0**	D	**41**	**D**
Carbon tetrachloride	<6.2		<6.1		<7.1		<5.7	
Chlorobenzene	<9.1		<8.9		<10		<8.3	
Chloroethane	<5.2		<5.1		<6.0		<4.8	
Chloroform	<9.6		<9.4		**18**	D	<8.8	
Chloromethane	<4.1		<4.0		<4.7		<3.7	
cis-1,2-Dichloroethylene	<7.8		<7.6		<9.0		<7.2	
cis-1,3-Dichloropropylene	<8.9		<8.7		<10		<8.2	
Cyclohexane	<6.8		<6.6		**44**	D	<6.2	
Dibromochloromethane	<16		<15		<18		<14	
Dichlorodifluoromethane	<9.7		<9.5		<11		<8.9	
Ethyl acetate	**230**	D	<6.9		<8.1		<6.5	
Ethyl Benzene	**10**	D	**12**	D	**9.8**	D	**10**	**D**
Hexachlorobutadiene	<21		<21		<24		<19	
Isopropanol	**2200**	D,E	**210**	D	**79**	D	**20**	**D**
Methyl Methacrylate	<8.1		<7.9		<9.2		<7.4	
Methyl tert-butyl ether (MTBE)	<7.1		<6.9		<8.1		<6.5	
Methylene chloride	**17**	D	**29**	D	**9.4**	D	**23**	**D**
n-Heptane	**820**	D	**55**	D	**32**	D	**8.1**	**D**
n-Hexane	**9.0**	D	<6.8		<8.0		**30**	**D**
o-Xylene	**14**	D	**15**	D	**12**	D	**13**	**D**
p- & m- Xylenes	**43**	D	**50**	D	**41**	D	**45**	**D**
p-Ethyltoluene	<48		<47		<56		<44	
Propylene	<3.4		<3.3		<3.9		<3.1	
Styrene	<8.4		<8.2		<9.6		<7.7	
Tetrachloroethylene	**140**	D	**1600**	D	**1400**	D	**1600**	**D**
Tetrahydrofuran	**23**	D	**25**	D	**20**	D	<5.3	
Toluene	**48**	D	**33**	D	**22**	D	**46**	**D**
trans-1,2-Dichloroethylene	<7.8		<7.6		<9.0		<7.2	
trans-1,3-Dichloropropylene	<8.9		<8.7		<10		<8.2	
Trichloroethylene	<5.3		**9.3**	D	**15**	D	**130**	**D**
Trichlorofluoromethane (Freon 11)	<11		<11		<13		<10	
Vinyl acetate	<6.9		<6.8		<8.0		<6.4	
Vinyl Chloride	<5.0		<4.9		<5.8		<4.6	

Table 1
Applicable Track 2 Soil Cleanup Objectives

Sample Identification	Restricted Use Soil Cleanup Objectives (6 NYC RR Pt.375-6.8b) - Restricted Residential
Sample Depth	
Sample Date	
Sample Matrix	
Units	mg/kg
Volatile Organic Compounds (mg/kg)	
1,1,1,2-Tetrachloroethane	NS
1,1,1-Trichloroethane	100
1,1,2,2-Tetrachloroethane	NS
1,1,2,2-Tetrachloroethylene	NS
1,1,2-Trichloroethane	NS
1,1-Dichloroethane	26
1,1-Dichloroethene	100
1,1-Dichloropropene	NS
1,2,3,4-Tetrachlorobenzene	NS
1,2,3-Trichlorobenzene	NS
1,2,3-Trichloropropane	NS
1,2,4-Trichlorobenzene	NS
1,2,4-Trimethylbenzene	52
1,2-Dibromo-3-chloropropane	NS
1,2-Dibromoethane	NS
1,2-Dichlorobenzene	100
1,2-Dichloroethane	3.1
1,2-Dichloropropane	NS
1,3,5-Trimethylbenzene	52
1,3-Dichlorobenzene	49
1,3-Dichloropropane	NS
1,4-Dichlorobenzene	13
1,4-Dioxane	13
113 Freon	NS
2,2-Dichloropropane	NS
2,4-Dichloro aniline	NS
2,6-Dinitrotoluene	NS
2-Chlorotoluene	NS
3,4-Dichloroaniline	NS
4-Chlorotoluene	NS
4-Isopropyltoluene	NS
4-mythyl-2-pentanone	NS
Acetone	100
Benzene	4.8
Bromobenzene	NS
Bromochloromethane	NS
Bromodichloromethane	NS
Bromoform	NS
Bromomethane	NS
Carbon Disulfide	NS
Carbon tetrachloride	2.4
Chloroacetamide	NS
Chlorobenzene	100
Chloroethane	NS
Chloroform	49
Chloromethane	NS
cis-1,2-Dichloroethene	0.25*
cis-1,3-Dichloropropene	NS
Dibromochloromethane	NS
Dibromomethane	NS
Dichlorodifluoromethane	NS
Ethylacetate	NS
Ethylbenzene	41
Hexachlorobenzene	1.2
Hexachlorobutadiene	NS
Hexachlorocyclopentadiene	NS
Isopropylbenzene	NS
m + p-Xylene	100
o-Xylene	100
Xylene (Total)	100
Methanol	NS
Methyl ethyl ketone (2-Butanone)	100
Methylene chloride	100
Methyl-Tert-Butyl-Ether	100
Naphthalene	NS
n-Butylbenzene	NS
N-Nitrosodiphenylamine	NS
n-Propylbenzene	100
Pentachlorobenzene	NS
Pentachloronitrobenzene	NS
sec-Butylbenzene	100

Applicable Track 2 Soil Cleanup Objectives

Sample Identification	Restricted Use Soil Cleanup Objectives (6 NYC RR Pt.375-6.8b) - Restricted Residential
Sample Depth	
Sample Date	
Sample Matrix	
Units	mg/kg
Volatile Organic Compounds (mg/kg)	
Styrene	NS
tert-Butylbenzene	100
Tetrachloroethene	1.3
Toluene	100
trans-1,2-Dichloroethene	100
trans-1,3-Dichloropropene	NS
Trichloroethene (Trichloroethylene)	0.47*
Trichlorofluoromethane	NS
Vinyl chloride	0.9

mg/kg…milligrams per kilogram

NS…no standard

**…Protection of Groundwater Standards*

Table 1 (Cont.)

Applicable Track 2 Soil Cleanup Objectives

Sample Identification	Restricted Use Soil Cleanup Objectives (6 NYC RR Pt.375-6.8b) - Restricted Residential
Sample Depth	
Sample Date	
Sample Matrix	
Units	mg/kg
Semi-Volatile Organic Compounds (mg/kg)	
1,2,3,6,7,8-HCDF	NS
1,2,4-Trichlorobenzene	NS
1,2-Dichlorobenzene	NS
1,3-Dichlorobenzene	NS
1,4-Dichlorobenzene	NS
2,3,4,5-Tetrachlorophenol	NS
2,3,5,6-Tetrachloroaniline	NS
2,4,5-Trichloroaniline	NS
2,4,5-Trichlorophenol	NS
2,4,6-Trichlorophenol	NS
2,4-Dichlorophenol	NS
2,4-Dinitrophenol	NS
2,4-Dinitrotoluene	NS
2,6-Dinitrotoluene	NS
2-Chloronaphthalene	NS
2-Chlorophenol	NS
2-Methylnaphthalene	NS
2-Nitroaniline	NS
2-Nitrophenol	NS
3,3'-Dichlorobenzidine	NS
3,4-Dichlorophenol	NS
3-Chlorophenol	NS
3-Nitroaniline	NS
4-Bromophenyl Phenyl Ether	NS
4-Chloroaniline	NS
4-Chlorophenyl Phenyl Ether	NS
4-methyl-2-pentanone	NS
4-Nitroaniline	NS
4-Nitrophenol	NS
Acenaphthene	100
Acenaphthylene	100
Aniline	NS
Anthracene	100
Benzo (a) Anthracene	1
Benzo (a) Pyrene	1
Benzo (b) Fluoranthene	1
Benzo (g,h,I) Perylene	100
Benzo (k) Fluoranthene	3.9
Benzoic Acid	NS
Benzyl Butyl Phthalate	NS
bis (2-Chloroethoxy) Methane	NS
bis (2-Chloroethyl) Ether	NS
bis (2-Chloroisopropyl) Ether	NS
bis (2-Ethyl Hexyl) Phthalate	NS
Carbazole	NS
Chloroethane	NS
Chrysene	3.9
Dibenzo (a,h) Anthracene	0.33
Dibenzofuran	NS
Diethyl Phthalate	NS
Dimethyl Phthalate	NS
Di-n-Butyl Phthalate	NS
Di-n-hexyl-phthalate	NS
D-n-n-octyl Phthalate	NS
Fluoranthene	100
Fluorene	100
Hexachlorobenzene	NS
Hexachlorobudadiene	NS
Hexachlorocyclopentadiene	NS
Hexachloroethane	NS
Indeno (1,2,3-cd) Pyrene	0.5
Isophorone	NS
m-Cresol	100
Naphthalene	100
Nitrobenzene	NS
n-Nitrosodi-n-propylamine	NS
N-Nitrosodiphenylamine	NS
o-Cresol	100

Applicable Track 2 Soil Cleanup Objectives

Sample Identification	Restricted Use Soil Cleanup Objectives (6 NYC RR Pt.375-6.8b) - Restricted Residential
Sample Depth	
Sample Date	
Sample Matrix	
Units	mg/kg
Semi-Volatile Organic Compounds (mg/kg)	
p-Cresol	100
Pentachloroaniline	NS
Pentachlorophenol	6.7
Phenanthrene	100
Phenol	100
Pyrene	100

mg/kg…milligrams per kilogram

NS…no standard

**…Protection of Groundwater Standards*

Table 1 (Cont.)
Applicable Track 2 Soil Cleanup Objectives

Sample Identification	Restricted Use Soil Cleanup Objectives (6 NYC RR Pt.375-6.8b) - Restricted Residential
Sample Depth	
Sample Date	
Sample Matrix	
Units	mg/kg
Pesticides	
2,3,7,8-TCDD	NS
2,3,7,8-TCDF	NS
2,4,5-TP Acid (Silvex)	100
2,4-D(2,4-Dichloro-Phenoxyacetic acid)	NS
a BHC	0.48
Aldrin	0.097
b BHC	0.36
Biphenyl	NS
Chlordane (alpha)	4.2
Chlordecone (Kepone)	NS
d BHC g	100
Dibenzofuran	59
Dieldrin	0.2
Endosulfan I	24
Endosulfan II	24
Endosulfan Sulfate	24
Endrin	11
Endrin Aldehyde	NS
Furan	NS
Gama Chlordane	NS
Heptachlor	2.1
Heptachlor Epoxide	NS
Lindane	1.3
Methoxychlor	NS
p,p-DDD	13
p,p-DDE	8.9
p,p-DDT	7.9
Parathion	NS
Polychlorinated biphenyls	1
Toxaphene	NS
PCBs	
Aroclor 1016	NS
Aroclor 1221	NS
Aroclor 1232	NS
Aroclor 1242	NS
Aroclor 1248	NS
Aroclor 1254	NS
Aroclor 1260	NS
TAL Metals	
Aluminum	NS
Antimony	NS
Arsenic	16
Boron	NS
Barium	400
Beryllium	72
Cadmium	4.3
Calcium	NS
Chromium Hexavalent	110
Chromium Trivalent	180
Cobalt	NS
Copper	270
Cyanide	27
Iron	NS
Lithium	NS
Lead	400
Molybdenum	NS
Magnesium	NS
Manganese	2,000
Mercury	0.81
Nickel	310
Potassium	NS
Selenium	180
Silver	180
Sodium	NS
Technetium	NS
Thallium	NS
Tin	NS
Vanadium	NS
Uranium	NS
Zinc	10,000

mg/kg…milligrams per kilogram

NS…no standard

**…Protection of Groundwater Standards*

Appendix 1

RA Project Description Letter

TLi
architect, pllc

957 56th Street
Brooklyn, NY 11219
Cell - 347.838.0846
E-Mail - tli.architect@gmail.com

Mayor's Office of Operations
E-Designation Program
c/o Dan Cole, Bureau Chief
100 Gold Street, 2nd Floor
New York, NY 10038

February 15, 2013

RE: 11-28 31st Drive
Long Island City, NY 11106
Block 502 Lot 22

Dear Mr. Cole,

We are proposing to develop the above-referenced premises. The existing lot area is approximately 2416.40 sf. Currently, a 1-story machine shop exists on the property.

The proposed project will be a major alteration. The existing 1-story machine shop building will be gutted and converted into residential and a 5-story vertical enlargement will be proposed on top of it, totaling 6 stories plus stair/elevator bulkhead. The total zoning floor area of the proposed building will be 8244-sf. The building footprint will be 25'-0" wide by 62'-0" long. The 1st floor will be 1 apartment and mechanical/janitorial space. Each of the floors above will have 2 apartments. There will be a total of 11 apartments in the building. The final height of the building will be 88'-2" from the ground to the top of the elevator bulkhead. Final building will not have a cellar, just an elevator pit. Lastly, a 25'-0" wide by 34'-0" long grass rear yard will be maintained at the back of the lot.

62'-0" of the two existing independent walls on both sides will be maintained. The proposed works at ground level are as follows:

> Four grade beams will span the width of the building at specified intervals per the structural drawings. The front and rear grade beams will be 4'-0" wide and 2'-0" deep, and will be placed underneath a 6" slab on grade. The middle two grade beams will be 3'-0" wide and 2'-0" deep.

Seven steel columns will also be placed at specified locations within the two remaining independent walls. (Three columns on the east wall, and four on the west wall). The columns on the four corners of the proposed building will terminate on the 4'-0" wide grade beams. Three middle columns on the sidewalls will terminate on column footings of 8'-6" long and 4'-6" wide each. These column footings are also 2'-0" deep below the 6" slab on grade.

The proposed elevator pit (8'-8" long by 6'-8" wide) will terminate at 5'-8" below grade. Below that, a 11'-8" long by 9'-8" wide by 2'-0" deep concrete base will be installed.

The proposed superstructure will be of steel and concrete with metal decking construction.

Please feel free to contact me with any questions regarding the details of this project.

Thank you.

Sincerely,

Timothy Li, R.A.

REGISTERED ARCHITECT
TIMOTHY LI
035356
STATE OF NEW YORK

TLi
architect, pllc
957 56th Street
Brooklyn, NY 11219
Cell - 347.838.0846
E-Mail - tli.architect@gmail.com

Mayor's Office of Operations
E-Designation Program
c/o Dan Cole, Bureau Chief
100 Gold Street, 2nd Floor
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Thank you.

Sincerely,

Timothy Li, R.A.

REGISTERED ARCHITECT
TIMOTHY LI
035356
STATE OF NEW YORK

Appendix 2 Fact Sheet

Where to Find Information:
Project documents are available at the following location(s) to help the public stay informed.

New York Public Library – Queens Library- Astoria
14-01 Astoria Blvd,
Astoria, NY 11102
Call for hours: 718) 278-2220

NYSDEC, Region 2 Office
47-40 21st Street
Long Island City, NY 11101
Call in advance: (718) 482-4900

Who to Contact:
Comments and questions are always welcome and should be directed as follows:

Project Related Questions
Sondra Martinkat, Project Manager
NYSDEC, Region 2 Office
47-40 21st Street
Long Island City, NY 11101
(718) 482-7541
smmartin@gw.dec.state.ny.us

Public Health questions:
Krista Anders
NYSDOH
Empire State Plaza
Corning Tower Room 1787
Albany, NY 12237
(518) 402-7860
kma06@health.state.ny.us

For additional information on the New York's Brownfield Cleanup Program, visit:
www.dec.ny.gov/chemical/8450.html

FACT SHEET

Brownfield Cleanup Program

11-28 31st Drive Site
11-28 31st Drive
Queens, NY 11106

SITE No. C241159
NYSDEC REGION 2

April 2016

Remedy Proposed for Brownfield Site Contamination; Public Comment Period Announced

The public is invited to comment on a proposed remedy being reviewed by the New York State Department of Environmental Conservation (NYSDEC) to address contamination related to the 11-28 31st Drive site (the "Site") located at 11-28 31st Drive in Long Island City, Queens, NY. Please see the map for the site location. Documents related to the cleanup of this site can be found at the location(s) identified on the left-hand side of this page under "Where to Find Information."

Based on the findings of the investigation, NYSDEC in consultation with the New York State Department of Health (NYSDOH) has determined that the site poses a significant threat to public health or the environment. This decision is based on elevated levels of dissolved contaminants identified in the vicinity of a on-site source of release and the potential for human exposure to site-related contaminants via soil vapors.

How to Comment: NYSDEC is accepting written comments about the proposed plan for 45 days, from **May 17th** through **June 30th, 2015**. The proposed plan is available for public review at the location(s) identified on the left-hand side of this page under "Where to Find Information." Please submit comments to the NYSDEC project manager listed under Project Related Questions in the "Who to Contact" area on the left-hand side of this page.

Draft Remedial Action Work Plan: The cleanup plan is described in a detailed "Remedial Action Work Plan". The proposed Track 2 Restricted Residential Use remedy consists of:

- Removal of Underground Storage Tanks (USTs);
- Excavation and off-site disposal of contaminated soil to approximately 3 feet below surface grade across the entire Site to achieve the Track 2 Restricted Residential Use cleanup. A small portion of property will be excavated to the depths of 7 feet 8 inches below grade;
- Remediation of dissolved plume of chlorinated hydrocarbons beneath the northern portion of the Site via ISCO injections.
- Collection and analysis of end-point soil samples a to evaluate the effectiveness of the remedy;
- Import of clean material that meets the established Soil Cleanup Objectives for use as backfill;
- Installation and operation of an active sub-slab depressurization system beneath the building footprint;
- Installation of a vapor barrier system consisting of a 20-mil VaporBlock Plus (VBP20) beneath the building slab-on grade in order to mitigate any

Continued on back

BROWNFIELD CLEANUP PROGRAM

soil vapor intrusion of soil vapor from beneath the site and from off-site;

- Implementation of a Health and Safety Plan and Community Air Monitoring Plan during all ground intrusive activities;
- Implementation of a Site Management Plan (SMP) for long term maintenance of the remedial systems.
- Recording of an Environmental Easement to ensure proper use of the site and continued registration of this site with an E-Designation at the NYC Buildings Department;

The proposed remedy was developed by the current Site owner Mr. George Man (the "applicant(s)") after performing a detailed investigation of the site under New York's Brownfield Cleanup Program (BCP). A "Remedial Investigation Report", which describes the results of the site investigation was submitted concurrently with the Remedial Action Work Plan and is also available for review at the locations identified on Page 1.

Site Description: The Site is 0.055-acres and is bordered on north-northeast by 31st Drive, on the south-southwest by a vacant land and a 1-story manufacturing building, on the east-southeast by a 1-story cabinet manufacturing facility and on the west-northwest by a vacant 1-story warehouse. The Site was utilized until most recently as a manufacturing facility of wood cabinets and then became vacant during the last quarter of 2012. The Site was historically utilized as an auto repair shop between 1934 and 1936, a machine shop between 1945 and 1970 and a commercial facility between 1977 and 2006.

Additional site details, including environmental and health assessment summaries, are available on NYSDEC's Environmental Site Remediation Database (by entering the Site ID, C241159) at:

http://www.dec.ny.gov/cfmx/extapps/derexternal/index.cfm?pageid=3

Summary of the Investigation: The primary contaminants of concern at the Site are heavy metals, which are present in shallow in soil Site-wide. Chlorinated solvents including PCE and its degradation products, which are likely to be originating on-site, have been identified in the groundwater in on-site groundwater monitoring wells located upgradient.

Next Steps: NYSDEC will consider public comments, revise the cleanup plan as necessary, and issue a final Decision Document. NYSDOH must concur with the proposed remedy. After approval, the proposed remedy becomes the selected remedy. The draft RAWP is revised as needed to describe the selected remedy, and will be made available to the public. The applicant(s) may then design and perform the cleanup action to address the site contamination, with oversight by NYSDEC and NYSDOH.

NYSDEC will keep the public informed throughout the investigation and cleanup of the site.

Brownfield Cleanup Program: New York's Brownfield Cleanup Program (BCP) encourages the voluntary cleanup of contaminated properties known as "brownfields" so that they can be reused and redeveloped. These uses may include recreation, housing, business or other uses. A brownfield is any real property that is difficult to reuse or redevelop because of the presence or potential presence of contamination.

For more information about the BCP, visit:
http://www.dec.ny.gov/chemical/8450.html

We encourage you to share this fact sheet with neighbors and tenants, and/or post this fact sheet in a prominent area of your building for others to see.

Receive Site Fact Sheets by Email

Have site information such as this fact sheet sent right to your email inbox. NYSDEC invites you to sign up with one or more contaminated sites county email listservs available at the following web page:

www.dec.ny.gov/chemical/61092.html

It's quick, it's free, and it will help keep you better informed. As a listserv member, you will periodically receive site-related information/ announcements for all contaminated sites in the county(ies) you select.

Note: Please disregard if you already have signed up and received this fact sheet electronically.

BROWNFIELD CLEANUP PROGRAM

Appendix 3 Fish and Wildlife Resources Impact Analysis

Appendix 2

Appendix 3C **Fish and Wildlife Resources Impact Analysis Decision Key**	If YES Go to:	If NO Go to:
1. Is the site or area of concern a discharge or spill event?	13 ✓	2
2. Is the site or area of concern a point source of contamination to the groundwater which will be prevented from discharging to surface water? Soil contamination is not widespread, or if widespread, is confined under buildings and paved areas.	13	3
3. Is the site and all adjacent property a developed area with buildings, paved surfaces and little or no vegetation?	4	9
4. Does the site contain habitat of an endangered, threatened or special concern species?	Section 3.10.1	5
5. Has the contamination gone off-site?	6	14
6. Is there any discharge or erosion of contamination to surface water or the potential for discharge or erosion of contamination?	7	14
7. Are the site contaminants PCBs, pesticides or other persistent, bioaccumulable substances?	Section 3.10.1	8
8. Does contamination exist at concentrations that could exceed ecological impact SCGs or be toxic to aquatic life if discharged to surface water?	Section 3.10.1	14
9. Does the site or any adjacent or downgradient property contain any of the following resources? i. Any endangered, threatened or special concern species or rare plants or their habitat ii. Any DEC designated significant habitats or rare NYS Ecological Communities iii. Tidal or freshwater wetlands iv. Stream, creek or river v. Pond, lake, lagoon vi. Drainage ditch or channel vii. Other surface water feature viii. Other marine or freshwater habitat ix. Forest x. Grassland or grassy field xi. Parkland or woodland xii. Shrubby area xiii. Urban wildlife habitat xiv. Other terrestrial habitat	11	10
10. Is the lack of resources due to the contamination?	3.10.1	14
11. Is the contamination a localized source which has not migrated and will not migrate from the source to impact any on-site or off-site resources?	14	12
12. Does the site have widespread surface soil contamination that is not confined under and around buildings or paved areas?	Section 3.10.1	12
13. Does the contamination at the site or area of concern have the potential to migrate to, erode into or otherwise impact any on-site or off-site habitat of endangered, threatened or special concern species or other fish and wildlife resource? (See #9 for list of potential resources. Contact DEC for information regarding endangered species.)	Section 3.10.1	14 ✓
14. No Fish and Wildlife Resources Impact Analysis needed.		

BROWNFIELD CLEANUP PROGRAM

Appendix 4 Quality Assurance Project Plan

QUALITY ASSURANCE PROJECT PLAN

11-28 31st Drive
Block 502; Lot 22
Queens, New York

NYSDEC BCP Number: C241159

Table of Content

Tables

Attachments

1.0 Introduction

This Quality Assurance Project Plan (QAPP) has been prepared for the post-excavation end point samples and post-remediation groundwater samples to be collected in accordance with the Remedial Action Work Plan (RAWP) developed for the remediation of the above referenced project. The intent of the QAPP is to ensure that (1) proper equipment handling and maintenance is followed, (2) cross-contamination between sampling locations does not occur, (3) standard number of quality control replicate environmental samples are obtained, (4) proper procedures for samples custody are performed and (5) data review, validation and verification requirements are complete.

All related portions of the fieldwork will be performed, at a minimum, in accordance with acceptable industry standards. These acceptable industry standards include, but are not limited to, the ASTM Standard Guide for Phase II Environmental Site Assessments (E 1903-97) and the New York State Department of Environmental Conservation (NYSDEC) Bureau of Spill Prevention & Response Sampling Guidelines and Protocols, March 1991 and NYSDEC DER-10, Technical Guidance for Site Investigation and Remediation, May 2010, 6 NYCRR Subpart 360.

2.0 Project Objective and Scope of Work

2.1 End Point Soil Sampling

End point samples will be collected around the closed and removed underground storage tank. Once the tank removal is complete, end point soil samples will then be obtained from directly from undisturbed soil from the bottom and sidewalls of the tank excavation. Excavation will be paused and the end point sample will be collected when the limits of sampling requirement are met, whether it is 30 feet of sidewall or a bottom sample representing 900 square feet. In all cases, post-remediation samples should be biased toward locations and depths of the highest expected contamination utilizing field indicators such as field instrument measurements or visual contamination identified during the soil screening.

This end point investigation will be performed in accordance to the New York State Department of Environmental Conservation (NYSDEC) requirements under the NYS Brownfield Cleanup Program (BCP) and in compliance with the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (May 2010) and other acceptable industry standards.

2.2 Groundwater Sampling

Groundwater samples will be obtained from four on-site and off-site monitoring wells utilizing a low flow pump fitted with dedicated polyethylene tubing. Initially, each monitoring well will be purged prior to sampling. Purging and sampling of the monitoring wells will be conducted according to USEPA's Low Stress/Flow Groundwater Sampling Protocol (SOP #GW0001, Rev. 1996) utilizing a portable Horiba U-22 water quality meter which utilizes an in-line flow cell for water quality indicator measurements (the USEPA low flow sampling protocol and monitoring well purge/sampling form is provided in **Attachment A**). Groundwater will be purged at a low flow rate of less than 500 milliliter per minute (mL/min) until water quality indicator parameters including pH, temperature, specific conductivity, oxidation reduction potential, dissolved oxygen and turbidity are stabilized. The sampling of each well will be performed once groundwater purging is completed.

3.0 Sampling Procedures, Decontamination Methods and Data Quality Usability Objectives

3.1 End Point Soil Sampling and Groundwater Sampling

Each groundwater sample and select end point soil sample and will be placed directly into pre-cleaned containers provided by the laboratory. Sample containers will be labeled and placed in a cooler filled with ice and maintained at 4 degrees Celsius. Each sample will be transmitted under proper chain of custody procedures to a NYSDOH ELAP-certified laboratory for analysis. **Table 1** and **Table 2** provide the sample containers, volumes, test methods, preservation techniques, reporting limits and holding times for soil and groundwater samples.

3.2 Decontamination Procedures

During the field sampling, Paul Matli, who is a Project Manager (PM) at Hydro Tech will be responsible for monitoring the decontamination procedure of every piece of sampling equipment prior to each use by field personnel. The following procedure will be implemented during the decontamination process:

- Wipe clean and wash with Alconox®
- Potable water rinse
- Methanol rinse
- Deionized water rinse
- Air dry

All decontamination procedures will be performed in an area segregated from any sampling areas. Any rinsate from the decontamination area will be contained and removed from the Site.

3.3- Quality Assurance and Quality Control (QA/QC)

The following Quality Assurance and Quality Control (QA/QC) samples will also be collected and analyzed.

- One trip blank per each shipment of soil or groundwater samples will be analyzed for TCL VOCs+ 10 TICs via EPA Method 8260 + 20 TICs.
- Field blank and duplicate samples will be collected as per ASP.
- A Matrix Spike and a Matrix Spike duplicate will be collected per each sampling matrix at a frequency of 1 per 20 samples per each sampling matrix and will be analyzed for full set of analytical parameters as the soil or groundwater samples.

A summary of anticipated QA/QC for soil samples is included in **Table 1**. A summary of anticipated QA/QC for groundwater samples is included in **Table 2**.

3.4- General QA/QC Considerations

The end point soil and groundwater samples will be managed and analyzed as per the following protocols:

- Hydro Tech PM (Paul Matli) shall perform field audits to verify compliance with the RAWP and identify corrective measures where problems are identified. A resume for Paul Matli is included in **Attachment B**.
- Samples will be labeled and logged in a monitor notebook and Chain of Custody upon collection including sampler name, sampling identification, date and time of sample collection and sampling depth, sampling methods and devices.
- In the field, samples will be the responsibility of, and will stay with, the Hydro Tech field geologist (Paul I. Matli). A resume for Paul I. Matli is included in **Attachment B**.
- Once samples have been collected they are returned to Hydro Tech office and logged in for temporary storage under a proper Chain of Custody. **Attachment C** provides a sample chain of custody form.
- Soil samples will be refrigerated to maintain a temperature at a maximum 4 degrees Celsius.
- Hydro Tech staff will be then responsible for transporting samples to State-certified (ELAP) laboratory for analysis under a proper Chain of Custody.
- Laboratory personnel will record the date and time of samples arrival at the lab and ensure that all holding times for each matrix and analysis will be met.
- After samples are analyzed, laboratory information is added to the label.
- The Sample Chain of Custody form will be used to record all transport and storage information.
- Samples analytical data report will undergo QA/QC performed by a laboratory QA officer who checks each data sheet for precision, missing or illegible information, errors in calculation and values outside of the expected range. A minimum of five percent of the total of a given type of sample shall be devoted to internal QC checks. These checks are designed to insure accuracy in the sampling procedure and the analytical methods and include blanks, duplicates, matrix spikes reference standards and performance evaluation samples. **Attachment D** provides a conventional lab QA/QC procedures associated with soil samples and analysis.
- The Laboratory data packages will conform to the Analytical Services Protocols (ASP) Category B Deliverables in accordance to NYSDEC DER-10 Appendix 2B.
- To ensure that data quality objectives are met, Hydro Tech QAO will assess data precision, accuracy, degree of representation, comparability and completeness of samples and data. This is primarily accomplished in the evaluation of data together with field notes and sampling logs. In order to ensure that cross-contamination between sampling locations did not occur, each piece of detection and reporting limits shall allow for comparison with soil quality standards.
- All deficiencies identified by Hydro Tech PM during the performance of field audits or evaluation of the data will be immediately reported to the field Geologist, and the NYSDEC. In addition to identifying deficiencies, the Hydro Tech PM is responsible for recommending corrective actions.

- The analytical data generated from this project will be provided in an electronic format in accordance with NYSDECs DER-10 Section 1.15. Specifically, the final reports shall be in an electronic format that complies with the NYSDEC's Electronic Document Standards (EDS).
- A Category B deliverable is required and a Data Usability Summary Report (DUSR) will be prepared. The DUSR will include all data and answer the following questions:
  3. Is the data package complete as defined under the requirements for the most current DEC ASP Category B or USEPA CLP data deliverables?
  4. Have all holding times been met?
  5. Do all the QC data; blanks, instrument tunings, calibration standards, calibration verifications, surrogate recoveries, spike recoveries, replicate analyses, laboratory controls and sample data fall within the protocol required limits and specifications?
  6. Have all of the data been generated using established and agreed upon analytical protocols?
  7. Does an evaluation of the raw data confirm the results provided in the data summary sheets and quality control verification forms?
  8. Have the correct data qualifiers been used and are they consistent with the most current DEC ASP?
  9. Have any quality control (QC) exceedances been specifically noted in the DUSR and have the corresponding QC summary sheets from the data package been attached to the DUSR?
- All validated data will be reviewed by Donald C. Anné, an independent QAO of the laboratory who is responsible of generating a data usability analysis. This analysis shall consist of (1) an assessment to determine if the data quality objectives were met; (2) evaluation of field duplicate results to indicate the samples are representative; (3) comparison of the results of trip blanks and methods blanks with full data sets to provide information concerning contaminants that may have been introduced during sampling, shipping or analyzing; (4) evaluation of matrix effects to assess the performance of the analytical method with respect to sample matrix, and determine whether the data have been biased high or low due to matrix effects. A Data Usability Summary Report (DUSR) will be prepared and provided in an electronic format in accordance to NYSDEC DER-10 Appendix 2B and in compliance with the NYSDEC's Electronic Document Standards (EDS). A resume for Donald C. Anné is included in **Attachment B.**
- Field investigation will be performed under the full oversight of Ariel Czemerinski, a NYS registered professional engineer. A resume for Ariel Czemerinski is included in **Attachment B**.

Table 1: Sampling & Analytical Method Requirements – Tank End Point Soil Samples

Soil Matrix (1)	Parameters	Minimum Sample Volume	Sample Container	Sample Preservation	Analytical Method	Lab Reporting Limit	Technical Holding Time
Sample ID							
EP-1 to EP-5	TCL VOCs+10 TICs	4 OZ+ 20 mg	2 oz. clear wide-mouth glass with Teflon lined septum + 40 ml methanol vial with Teflon lined cap + 40 ml DI water vial with Teflon lined cap + 40 ml unpreserved vial with Teflon lined cap	Cool to 4 °C(2)	EPA Method 8260+15/SW-846 Method 5035	Compound Specific (1-20 µg/Kg)	14 days
	TCL SVOCs+20 TICs	4 OZ	4 oz. clear wide-mouth glass with Teflon lined septum	Cool to 4 °C	EPA Method 8270+15	Compound Specific (165-830 g/Kg)	14 days extract; 40 days analyze
Matrix Spike /Matrix Spike Duplicate	TCL VOCs+10 TICs	4 OZ+ 20 mg	2 oz. clear wide-mouth glass with Teflon lined septum + 40 ml methanol vial with Teflon lined cap + 40 ml DI water vial with Teflon lined cap + 40 ml unpreserved vial with Teflon lined cap	Cool to 4 °C(2)	EPA Method 8260+15/SW-846 Method 5035	Compound Specific (1-20 µg/Kg)	14 days
	TCL SVOCs+20 TICs	4 OZ	4 oz. clear wide-mouth glass with Teflon lined septum	Cool to 4 °C	EPA Method 8270+15	Compound Specific (165-830 g/Kg)	14 days extract; 40 days analyze
Trip Blank	TCL VOCs +10 TICs	80 ml	40 ml VOC vial with Teflon lined cap	1:1 HCL to pH<2 Cool to 4 °C	EPA Method 8260+15	Compound Specific (0.5-20 µg/L)	14 days

(1)….Analytical Services Protocols (ASP) Deliverables Package Category B.

(2)…If samples are not delivered to the lab with 48 hours after collection, the 40 ml DI Water vials should be preserved in a frozen condition following sampling

Table 2: Sampling & Analytical Method Requirements – Groundwater Samples

Water Matrix (1)	Parameters	Minimum Sample Volume (2)	Sample Container	Sample Preservation	Analytical Method	Lab Reporting Limit	Technical Holding Time
Sample ID							
MW-1 to MW-6	PCE & TCE	120 ml	40 ml VOC vial with Teflon lined cap	1:1 HCL to pH<2 Cool 2-6 °C	EPA Method 8260**B**	Compound Specific (0.5-20 µg/L)	14 days
Field Blank	PCE & TCE	120 ml	40 ml VOC vial with Teflon lined cap	1:1 HCL to pH<2 Cool 2-6 °C	EPA Method 8260B	Compound Specific (0.5-20 µg/L)	14 days
Matrix Spike /Matrix Spike Duplicate	PCE & TCE	120 ml	40 ml VOC vial with Teflon lined cap	1:1 HCL to pH<2 Cool 2-6 °C	EPA Method 8260B	Compound Specific (0.5-20 µg/L)	14 days
Trip Blank	PCE & TCE	120 ml	40 ml VOC vial with Teflon lined cap	1:1 HCL to pH<2 Cool 2-6 °C	EPA Method 8260B	Compound Specific (0.5-20 µg/L)	14 days

(1)….Analytical Services Protocols (ASP) Deliverables Package Category

ATTACHMENT A
LOW FLOW SAMPLING PROTOCOL AND MONITORING WELL PURGE/SAMPLING FORM

United States
Environmental Protection
Agency

Office of
Research and
Development

Office of Solid Waste
and Emergency
Response

EPA/540/S-95/504
April 1996

Ground Water Issue

LOW-FLOW (MINIMAL DRAWDOWN) GROUND-WATER SAMPLING PROCEDURES

by Robert W. Puls[1] and Michael J. Barcelona[2]

Background

The Regional Superfund Ground Water Forum is a group of ground-water scientists, representing EPA's Regional Superfund Offices, organized to exchange information related to ground-water remediation at Superfund sites. One of the major concerns of the Forum is the sampling of ground water to support site assessment and remedial performance monitoring objectives. This paper is intended to provide background information on the development of low-flow sampling procedures and its application under a variety of hydrogeologic settings. It is hoped that the paper will support the production of standard operating procedures for use by EPA Regional personnel and other environmental professionals engaged in ground-water sampling.

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I. Introduction

The methods and objectives of ground-water sampling to assess water quality have evolved over time. Initially the emphasis was on the assessment of water quality of aquifers as sources of drinking water. Large water-bearing units were identified and sampled in keeping with that objective. These were highly productive aquifers that supplied drinking water via private wells or through public water supply systems. Gradually, with the increasing awareness of subsurface pollution of these water resources, the understanding of complex hydrogeochemical processes which govern the fate and transport of contaminants in the subsurface increased. This increase in understanding was also due to advances in a number of scientific disciplines and improvements in tools used for site characterization and ground-water sampling. Ground-water quality investigations where pollution was detected initially borrowed ideas, methods, and materials for site characterization from the water supply field and water analysis from public health practices. This included the materials and manner in which monitoring wells were installed and the way in which water was brought to the surface, treated, preserved and analyzed. The prevailing conceptual ideas included convenient generalizations of ground-water resources in terms of large and relatively homogeneous hydrologic *units*. With time it became apparent that conventional water supply generalizations of *homogeneity* did not adequately represent field data regarding pollution of these subsurface resources. The important role of *heterogeneity* became increasingly clear not only in geologic terms, but also in terms of complex physical,

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chemical and biological subsurface processes. With greater appreciation of the role of heterogeneity, it became evident that subsurface pollution was ubiquitous and encompassed the unsaturated zone to the deep subsurface and included unconsolidated sediments, fractured rock, and *aquitards* or low-yielding or impermeable formations. Small-scale processes and heterogeneities were shown to be important in identifying contaminant distributions and in controlling water and contaminant flow paths.

It is beyond the scope of this paper to summarize all the advances in the field of ground-water quality investigations and remediation, but two particular issues have bearing on ground-water sampling today: aquifer heterogeneity and colloidal transport. Aquifer heterogeneities affect contaminant flow paths and include variations in geology, geochemistry, hydrology and microbiology. As methods and the tools available for subsurface investigations have become increasingly sophisticated and understanding of the subsurface environment has advanced, there is an awareness that in most cases a primary concern for site investigations is characterization of contaminant flow paths rather than entire aquifers. In fact, in many cases, plume thickness can be less than well screen lengths (e.g., 3-6 m) typically installed at hazardous waste sites to detect and monitor plume movement over time. Small-scale differences have increasingly been shown to be important and there is a general trend toward smaller diameter wells and shorter screens.

The hydrogeochemical significance of colloidal-size particles in subsurface systems has been realized during the past several years (Gschwend and Reynolds, 1987; McCarthy and Zachara, 1989; Puls, 1990; Ryan and Gschwend, 1990). This realization resulted from both field and laboratory studies that showed faster contaminant migration over greater distances and at higher concentrations than flow and transport model predictions would suggest (Buddemeier and Hunt, 1988; Enfield and Bengtsson, 1988; Penrose et al., 1990). Such models typically account for interaction between the mobile aqueous and immobile solid phases, but do not allow for a mobile, reactive solid phase. It is recognition of this third *phase* as a possible means of contaminant transport that has brought increasing attention to the manner in which samples are collected and processed for analysis (Puls et al., 1990; McCarthy and Degueldre, 1993; Backhus et al., 1993; U. S. EPA, 1995). If such a phase is present in sufficient mass, possesses high sorption reactivity, large surface area, and remains stable in suspension, it can serve as an important mechanism to facilitate contaminant transport in many types of subsurface systems.

Colloids are particles that are sufficiently small so that the surface free energy of the particle dominates the bulk free energy. Typically, in ground water, this includes particles with diameters between 1 and 1000 nm. The most commonly observed mobile particles include: secondary clay minerals; hydrous iron, aluminum, and manganese oxides; dissolved and particulate organic materials, and viruses and bacteria. These reactive particles have been shown to be mobile under a variety of conditions in both field studies and laboratory column experiments, and as such need to be included in monitoring programs where identification of the *total* mobile contaminant loading (dissolved + naturally suspended particles) at a site is an objective. To that end, sampling methodologies must be used which do not artificially bias *naturally* suspended particle concentrations.

Currently the most common ground-water purging and sampling methodology is to purge a well using bailers or high speed pumps to remove 3 to 5 casing volumes followed by sample collection. This method can cause adverse impacts on sample quality through collection of samples with high levels of turbidity. This results in the inclusion of otherwise immobile artifactual particles which produce an overestimation of certain analytes of interest (e.g., metals or hydrophobic organic compounds). Numerous documented problems associated with filtration (Danielsson, 1982; Laxen and Chandler, 1982; Horowitz et al., 1992) make this an undesirable method of rectifying the turbidity problem, and include the removal of potentially mobile (contaminant-associated) particles during filtration, thus artificially biasing contaminant concentrations low. Sampling-induced turbidity problems can often be mitigated by using low-flow purging and sampling techniques.

Current subsurface conceptual models have undergone considerable refinement due to the recent development and increased use of field screening tools. So-called hydraulic *push* technologies (e.g., cone penetrometer, Geoprobe®, QED HydroPunch®) enable relatively fast screening site characterization which can then be used to design and install a monitoring well network. Indeed, alternatives to conventional monitoring wells are now being considered for some hydrogeologic settings. The ultimate design of any monitoring system should however be based upon adequate site characterization and be consistent with established monitoring objectives.

If the sampling program objectives include accurate assessment of the magnitude and extent of subsurface contamination over time and/or accurate assessment of subsequent remedial performance, then some information regarding plume delineation in three-dimensional space is necessary prior to monitoring well network design and installation. This can be accomplished with a variety of different tools and equipment ranging from hand-operated augers to screening tools mentioned above and large drilling rigs. Detailed information on ground-water flow velocity, direction, and horizontal and vertical variability are essential baseline data requirements. Detailed soil and geologic data are required prior to and during the installation of sampling points. This includes historical as well as detailed soil and geologic logs which accumulate during the site investigation. The use of borehole geophysical techniques is also recommended. With this information (together with other site characterization data) and a clear understanding of sampling objectives, then appropriate location, screen length, well diameter, slot size, etc. for the monitoring well network can be decided. This is especially critical for new in situ remedial approaches or natural attenuation assessments at hazardous waste sites.

In general, the overall goal of any ground-water sampling program is to collect water samples with no alteration in water chemistry; analytical data thus obtained may be used for a variety of specific monitoring programs depending on the regulatory requirements. The sampling methodology described in this paper assumes that the monitoring goal is to sample monitoring wells for the presence of contaminants and it is applicable whether mobile colloids are a concern or not and whether the analytes of concern are metals (and metalloids) or organic compounds.

II. Monitoring Objectives and Design Considerations

The following issues are important to consider prior to the design and implementation of any ground-water monitoring program, including those which anticipate using low-flow purging and sampling procedures.

A. Data Quality Objectives (DQOs)

Monitoring objectives include four main types: detection, assessment, corrective-action evaluation and resource evaluation, along with *hybrid* variations such as site-assessments for property transfers and water availability investigations. Monitoring objectives may change as contamination or water quality problems are discovered. However, there are a number of common components of monitoring programs which should be recognized as important regardless of initial objectives. These components include:

1) Development of a conceptual model that incorporates elements of the regional geology to the local geologic framework. The conceptual model development also includes initial site characterization efforts to identify hydrostratigraphic units and likely flow-paths using a minimum number of borings and well completions;

2) Cost-effective and well documented collection of high quality data utilizing simple, accurate, and reproducible techniques; and

3) Refinement of the conceptual model based on supplementary data collection and analysis.

These fundamental components serve many types of monitoring programs and provide a basis for future efforts that evolve in complexity and level of spatial detail as purposes and objectives expand. High quality, reproducible data collection is a common goal regardless of program objectives.

High quality data collection implies data of sufficient accuracy, precision, and completeness (i.e., ratio of valid analytical results to the minimum sample number called for by the program design) to meet the program objectives. Accuracy depends on the correct choice of monitoring tools and procedures to minimize sample and subsurface disturbance from collection to analysis. Precision depends on the repeatability of sampling and analytical protocols. It can be assured or improved by replication of sample analyses including blanks, field/lab standards and reference standards.

B. Sample Representativeness

An important goal of any monitoring program is collection of data that is truly representative of conditions at the site. The term *representativeness* applies to chemical and hydrogeologic data collected via wells, borings, piezometers, geophysical and soil gas measurements, lysimeters, and temporary sampling points. It involves a recognition of the statistical variability of individual subsurface physical properties, and contaminant or major ion concentration levels, while explaining extreme values. Subsurface temporal and spatial variability are facts. Good professional practice seeks to maximize representativeness by using proven accurate and reproducible techniques to define limits on the distribution of measurements collected at a site. However, measures of representativeness are dynamic and are controlled by evolving site characterization and monitoring objectives. An evolutionary site characterization model, as shown in Figure 1, provides a systematic approach to the goal of consistent data collection.

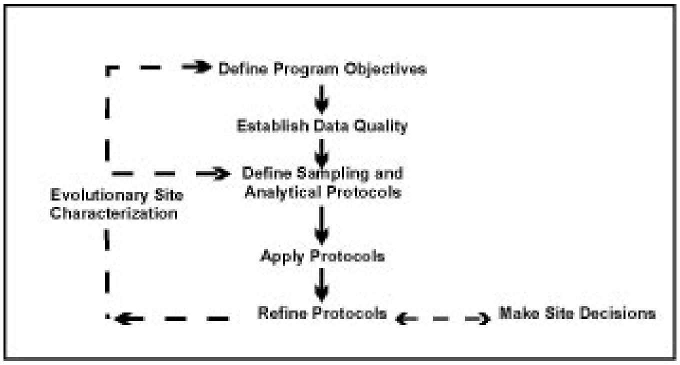

Figure 1. Evolutionary Site Characterization Model

The model emphasizes a recognition of the causes of the variability (e.g., use of inappropriate technology such as using bailers to purge wells; imprecise or operator-dependent methods) and the need to control avoidable errors.

1) Questions of Scale

A sampling plan designed to collect representative samples must take into account the potential scale of changes in site conditions through space and time as well as the chemical associations and behavior of the parameters that are targeted for investigation. In subsurface systems, physical (i.e., aquifer) and chemical properties over time or space are not statistically independent. In fact, samples taken in close proximity (i.e., within distances of a few meters) or within short time periods (i.e., more frequently than monthly) are highly auto-correlated. This means that designs employing high-sampling frequency (e.g., monthly) or dense spatial monitoring designs run the risk of redundant data collection and misleading inferences regarding trends in values that aren't statistically valid. In practice, contaminant detection and assessment monitoring programs rarely suffer these *over-sampling* concerns. In corrective-action evaluation programs, it is also possible that too little data may be collected over space or time. In these cases, false interpretation of the spatial extent of contamination or underestimation of temporal concentration variability may result.

2) Target Parameters

Parameter selection in monitoring program design is most often dictated by the regulatory status of the site. However, background water quality constituents, purging indicator parameters, and contaminants, all represent targets for data collection programs. The tools and procedures used in these programs should be equally rigorous and applicable to all categories of data, since all may be needed to determine or support regulatory action.

C. Sampling Point Design and Construction

Detailed site characterization is central to all decision-making purposes and the basis for this characterization resides in identification of the geologic framework and major hydro-stratigraphic units. Fundamental data for sample point location include: subsurface lithology, head-differences and background geochemical conditions. Each sampling point has a proper use or uses which should be documented at a level which is appropriate for the program's data quality objectives. Individual sampling points may not always be able to fulfill multiple monitoring objectives (e.g., detection, assessment, corrective action).

1) Compatibility with Monitoring Program and Data Quality Objectives

Specifics of sampling point location and design will be dictated by the complexity of subsurface lithology and variability in contaminant and/or geochemical conditions. It should be noted that, regardless of the ground-water sampling approach, few sampling points (e.g., wells, drive-points, screened augers) have zones of influence in excess of a few feet. Therefore, the spatial frequency of sampling points should be carefully selected and designed.

2) Flexibility of Sampling Point Design

In most cases *well-point* diameters in excess of 1 7/8 inches will permit the use of most types of submersible pumping devices for low-flow (minimal drawdown) sampling. It is suggested that *short* (e.g., less than 1.6 m) screens be incorporated into the monitoring design where possible so that comparable results from one device to another might be expected. *Short*, of course, is relative to the degree of vertical water quality variability expected at a site.

3) Equilibration of Sampling Point

Time should be allowed for equilibration of the well or sampling point with the formation after installation. Placement of well or sampling points in the subsurface produces some disturbance of ambient conditions. Drilling techniques (e.g., auger, rotary, etc.) are generally considered to cause more disturbance than *direct-push* technologies. In either case, there may be a period (i.e., days to months) during which water quality near the point may be distinctly different from that in the formation. Proper development of the sampling point and adjacent formation to remove fines created during emplacement will shorten this water quality *recovery* period.

III. Definition of Low-Flow Purging and Sampling

It is generally accepted that water in the well casing is non-representative of the formation water and needs to be purged prior to collection of ground-water samples. However, the water in the screened interval may indeed be representative of the formation, depending upon well construction and site hydrogeology. Wells are purged to some extent for the following reasons: the presence of the air interface at the top of the water column resulting in an oxygen concentration gradient with depth, loss of volatiles up the water column, leaching from or sorption to the casing or filter pack, chemical changes due to clay seals or backfill, and surface infiltration.

Low-flow purging, whether using portable or dedicated systems, should be done using pump-intake located in the middle or slightly above the middle of the screened interval. Placement of the pump too close to the bottom of the well will cause increased entrainment of solids which have collected in the well over time. These particles are present as a result of well development, prior purging and sampling events, and natural colloidal transport and deposition. Therefore, placement of the pump in the middle or toward the top of the screened interval is suggested. Placement of the pump at the top of the water column for sampling is only recommended in unconfined aquifers, screened across the water table, where this is the desired sampling point. Low-flow purging has the advantage of minimizing mixing between the overlying stagnant casing water and water within the screened interval.

A. Low-Flow Purging and Sampling

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface which can be affected by flow regulators or restrictions. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical taking into account established site sampling objectives. Typically, flow rates on the order of 0.1 - 0.5 L/min are used, however this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations have been successfully sampled in this manner at flow rates to 1 L/min. The effectiveness of using low-flow purging is intimately linked with proper screen location, screen length, and well construction and development techniques. The reestablishment of natural flow paths in both the vertical and horizontal directions is important for correct interpretation of the data. For high resolution sampling needs, screens less than 1 m should be used. Most of the need for purging has been found to be due to passing the sampling device through the overlying casing water which causes mixing of these stagnant waters and the dynamic waters within the screened interval. Additionally, there is disturbance to suspended sediment collected in the bottom of the casing and the displacement of water out into the formation immediately adjacent to the well screen. These disturbances and impacts can be avoided using dedicated sampling equipment, which precludes the need to insert the sampling device prior to purging and sampling.

Isolation of the screened interval water from the overlying stagnant casing water may be accomplished using low-flow minimal drawdown techniques. If the pump intake is located within the screened interval, most of the water pumped will be drawn in directly from the formation with little mixing of casing water or disturbance to the sampling zone. However, if the wells are not constructed and developed properly, zones other than those intended may be sampled. At some sites where geologic heterogeneities are sufficiently different within the screened interval, higher conductivity zones may be preferentially sampled. This is another reason to use shorter screened intervals, especially where high spatial resolution is a sampling objective.

B. Water Quality Indicator Parameters

It is recommended that water quality indicator parameters be used to determine purging needs prior to sample collection in each well. Stabilization of parameters such as pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature and turbidity should be used to determine when formation water is accessed during purging. In general, the order of stabilization is pH, temperature, and specific conductance, followed by oxidation-reduction potential, dissolved oxygen and turbidity. Temperature and pH, while commonly used as purging indicators, are actually quite insensitive in distinguishing between formation water and stagnant casing water; nevertheless, these are important parameters for data interpretation purposes and should also be measured. Performance criteria for determination of stabilization should be based on water-level drawdown, pumping rate and equipment specifications for measuring indicator parameters. Instruments are available which utilize in-line flow cells to continuously measure the above parameters.

It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter, particularly with respect to drawdown, flow rate and sampling device. Generally, the time or purge volume required for parameter stabilization is independent of well depth or well volumes. Dependent variables are well diameter, sampling device, hydrogeochemistry, pump flow rate, and whether the devices are used in a portable or dedicated manner. If the sampling device is already in place (i.e., dedicated sampling systems), then the time and purge volume needed for stabilization is much shorter. Other advantages of dedicated equipment include less purge water for waste disposal, much less decontamination of equipment, less time spent in preparation of sampling as well as time in the field, and more consistency in the sampling approach which probably will translate into less variability in sampling results. The use of dedicated equipment is strongly recommended at wells which will undergo routine sampling over time.

If parameter stabilization criteria are too stringent, then minor oscillations in indicator parameters may cause purging operations to become unnecessarily protracted. It should also be noted that turbidity is a very conservative parameter in terms of stabilization. Turbidity is always the last parameter to stabilize. Excessive purge times are invariably related to the establishment of too stringent turbidity stabilization criteria. It should be noted that natural turbidity levels in ground water may exceed 10 nephelometric turbidity units (NTU).

C. Advantages and Disadvantages of Low-Flow (Minimum Drawdown) Purging

In general, the advantages of low-flow purging include:

- samples which are representative of the *mobile* load of contaminants present (dissolved and colloid-associated);
- minimal disturbance of the sampling point thereby minimizing sampling artifacts;
- less operator variability, greater operator control;

- reduced stress on the formation (minimal drawdown);
- less mixing of stagnant casing water with formation water;
- reduced need for filtration and, therefore, less time required for sampling;
- smaller purging volume which decreases waste disposal costs and sampling time;
- better sample consistency; reduced artificial sample variability.

Some disadvantages of low-flow purging are:

- higher initial capital costs,
- greater set-up time in the field,
- need to transport additional equipment to and from the site,
- increased training needs,
- resistance to change on the part of sampling practitioners,
- concern that new data will indicate a *change in conditions* and trigger an *action*.

IV. Low-Flow (Minimal Drawdown) Sampling Protocols

The following ground-water sampling procedure has evolved over many years of experience in ground-water sampling for organic and inorganic compound determinations and as such summarizes the authors' (and others) experiences to date (Barcelona et al., 1984, 1994; Barcelona and Helfrich, 1986; Puls and Barcelona, 1989; Puls et. al. 1990, 1992; Puls and Powell, 1992; Puls and Paul, 1995). High-quality chemical data collection is essential in ground-water monitoring and site characterization. The primary limitations to the collection of *representative* ground-water samples include: mixing of the stagnant casing and *fresh* screen waters during insertion of the sampling device or ground-water level measurement device; disturbance and resuspension of settled solids at the bottom of the well when using high pumping rates or raising and lowering a pump or bailer; introduction of atmospheric gases or degassing from the water during sample handling and transfer, or inappropriate use of vacuum sampling device, etc.

A. Sampling Recommendations

Water samples should not be taken immediately following well development. Sufficient time should be allowed for the ground-water flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on site conditions and methods of installation but often exceeds one week.

Well purging is nearly always necessary to obtain samples of water flowing through the geologic formations in the screened interval. Rather than using a general but arbitrary guideline of purging three casing volumes prior to sampling, it is recommended that an in-line water quality measurement device (e.g., flow-through cell) be used to establish the stabilization time for several parameters (e.g. , pH, specific conductance, redox, dissolved oxygen, turbidity) on a well-specific basis. Data on pumping rate, drawdown, and volume required for parameter stabilization can be used as a guide for conducting subsequent sampling activities.

The following are recommendations to be considered before, during and after sampling:

- use low-flow rates (<0.5 L/min), during both purging and sampling to maintain minimal drawdown in the well;
- maximize tubing wall thickness, minimize tubing length;
- place the sampling device intake at the desired sampling point;
- minimize disturbances of the stagnant water column above the screened interval during water level measurement and sampling device insertion;
- make proper adjustments to stabilize the flow rate as soon as possible;
- monitor water quality indicators during purging;
- collect unfiltered samples to estimate contaminant loading and transport potential in the subsurface system.

B. Equipment Calibration

Prior to sampling, all sampling device and monitoring equipment should be calibrated according to manufacturer’s recommendations and the site Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP). Calibration of pH should be performed with at least two buffers which bracket the expected range. Dissolved oxygen calibration must be corrected for local barometric pressure readings and elevation.

C. Water Level Measurement and Monitoring

It is recommended that a device be used which will least disturb the water surface in the casing. Well depth should be obtained from the well logs. Measuring to the bottom of the well casing will only cause resuspension of settled solids from the formation and require longer purging times for turbidity equilibration. Measure well depth after sampling is completed. The water level measurement should be taken from a permanent reference point which is surveyed relative to ground elevation.

D. Pump Type

The use of low-flow (e.g., 0.1-0.5 L/min) pumps is suggested for purging and sampling all types of analytes. All pumps have some limitation and these should be investigated with respect to application at a particular site. Bailers are inappropriate devices for low-flow sampling.

1) General Considerations

There are no unusual requirements for ground-water sampling devices when using low-flow, minimal drawdown techniques. The major concern is that the device give consistent results and minimal disturbance of the sample across a range of *low* flow rates (i.e., < 0.5 L/min). Clearly, pumping rates that cause minimal to no drawdown in one well could easily cause *significant* drawdown in another well finished in a less transmissive formation. In this sense, the pump should not cause undue pressure or temperature changes or physical disturbance on the water sample over a reasonable sampling range. Consistency in operation is critical to meet accuracy and precision goals.

2) Advantages and Disadvantages of Sampling Devices

A variety of sampling devices are available for low-flow (minimal drawdown) purging and sampling and include peristaltic pumps, bladder pumps, electrical submersible pumps, and gas-driven pumps. Devices which lend themselves to both dedication and consistent operation at definable low-flow rates are preferred. It is desirable that the pump be easily adjustable and operate reliably at these lower flow rates. The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and some volatiles loss. Gas-driven pumps should be of a type that does not allow the gas to be in direct contact with the sampled fluid.

Clearly, bailers and other *grab* type samplers are ill-suited for low-flow sampling since they will cause repeated disturbance and mixing of *stagnant* water in the casing and the *dynamic* water in the screened interval. Similarly, the use of inertial lift foot-valve type samplers may cause too much disturbance at the point of sampling. Use of these devices also tends to introduce uncontrolled and unacceptable operator variability.

Summaries of advantages and disadvantages of various sampling devices are listed in Herzog et al. (1991), U. S. EPA (1992), Parker (1994) and Thurnblad (1994).

E. Pump Installation

Dedicated sampling devices (left in the well) capable of pumping and sampling are preferred over <u>any</u> other type of device. Any portable sampling device should be slowly and carefully lowered to the middle of the screened interval or slightly above the middle (e.g., 1-1.5 m below the top of a 3 m screen). This is to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize resuspension of solids which will have collected at the bottom of the well. These two disturbance effects have been shown to directly affect the time required for purging. There also appears to be a direct correlation between size of portable sampling devices relative to the well bore and resulting purge volumes and times. The key is to minimize disturbance of water and solids in the well casing.

F. Filtration

Decisions to filter samples should be dictated by sampling objectives rather than as a *fix* for poor sampling practices, and field-filtering of certain constituents should not be the default. Consideration should be given as to what the application of field-filtration is trying to accomplish. For assessment of truly dissolved (as opposed to operationally *dissolved* [i.e., samples filtered with 0.45 µm filters]) concentrations of major ions and trace metals, 0.1 µm filters are recommended although 0.45 µm filters are normally used for most regulatory programs. Alkalinity samples must also be filtered if significant particulate calcium carbonate is suspected, since this material is likely to impact alkalinity titration results (although filtration itself may alter the CO_2 composition of the sample and, therefore, affect the results).

Although filtration may be appropriate, filtration of a sample may cause a number of unintended changes to occur (e.g. oxidation, aeration) possibly leading to filtration-induced artifacts during sample analysis and uncertainty in the results. Some of these unintended changes may be unavoidable but the factors leading to them must be recognized. Deleterious effects can be minimized by consistent application of certain filtration guidelines. Guidelines should address selection of filter type, media, pore size, etc. in order to identify and minimize potential sources of uncertainty when filtering samples.

In-line filtration is recommended because it provides better consistency through less sample handling, and minimizes sample exposure to the atmosphere. In-line filters are available in both disposable (barrel filters) and non-disposable (in-line filter holder, flat membrane filters) formats and various filter pore sizes (0.1-5.0 µm). Disposable filter cartridges have the advantage of greater sediment handling capacity when compared to traditional membrane filters. Filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of 1 L of ground water following purging and prior to sampling. Once filtration has begun, a filter cake may develop as particles larger than the pore size accumulate on the filter membrane. The result is that the effective pore diameter of the membrane is reduced and particles smaller than the stated pore size are excluded from the filtrate. Possible corrective measures include prefiltering (with larger pore size filters), minimizing particle loads to begin with, and reducing sample volume.

G. Monitoring of Water Level and Water Quality Indicator Parameters

Check water level periodically to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.1 m) during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience. In-line water quality indicator parameters should be continuously monitored during purging. The water quality indicator parameters monitored can include pH, redox potential, conductivity, dissolved oxygen (DO) and turbidity. The last three parameters are often most sensitive. Pumping rate, drawdown, and the time or volume required to obtain stabilization of parameter readings can be used as a future guide to purge the well. Measurements should be taken every three to five minutes if the above suggested rates are used. Stabilization is achieved after all parameters have stabilized for three successive readings. In lieu of measuring all five parameters, a minimum subset would include pH, conductivity, and turbidity or DO. Three successive readings should be within ± 0.1 for pH, ± 3% for conductivity, ± 10 mv for redox potential, and ± 10% for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable values during purging. Dissolved oxygen and turbidity usually require the longest time for stabilization. The above stabilization guidelines are provided for rough estimates based on experience.

H. Sampling, Sample Containers, Preservation and Decontamination

Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The same device should be used for sampling as was used for purging. Sampling should occur in a progression from least to most contaminated well, if this is known. Generally, volatile (e.g., solvents and fuel constituents) and gas sensitive (e.g., Fe^{2+}, CH_4, H_2S/HS^-, alkalinity) parameters should be sampled first. The sequence in which samples for most inorganic parameters are collected is immaterial unless filtered (dissolved) samples are desired. Filtering should be done last and in-line filters should be used as discussed above. During both well purging and sampling, proper protective clothing and equipment must be used based upon the type and level of contaminants present.

The appropriate sample container will be prepared in advance of actual sample collection for the analytes of interest and include sample preservative where necessary. Water samples should be collected directly into this container from the pump tubing.

Immediately after a sample bottle has been filled, it must be preserved as specified in the site (QAPP). Sample preservation requirements are based on the analyses being performed (use site QAPP, FSP, RCRA guidance document [U. S. EPA, 1992] or EPA SW-846 [U. S. EPA, 1982]). It may be advisable to add preservatives to sample bottles in a controlled setting prior to entering the field in order to reduce the chances of improperly preserving sample bottles or introducing field contaminants into a sample bottle while adding the preservatives.

The preservatives should be transferred from the chemical bottle to the sample container using a disposable polyethylene pipet and the disposable pipet should be used only once and then discarded.

After a sample container has been filled with ground water, a Teflon™ (or tin)-lined cap is screwed on tightly to prevent the container from leaking. A sample label is filled out as specified in the FSP. The samples should be stored inverted at 4°C.

Specific decontamination protocols for sampling devices are dependent to some extent on the type of device used and the type of contaminants encountered. Refer to the site QAPP and FSP for specific requirements.

I. Blanks

The following blanks should be collected:

(1) field blank: one field blank should be collected from each source water (distilled/deionized water) used for sampling equipment decontamination or for assisting well development procedures.

(2) equipment blank: one equipment blank should be taken prior to the commencement of field work, from each set of sampling equipment to be used for that day. Refer to site QAPP or FSP for specific requirements.

(3) trip blank: a trip blank is required to accompany each volatile sample shipment. These blanks are prepared in the laboratory by filling a 40-mL volatile organic analysis (VOA) bottle with distilled/deionized water.

V. Low-Permeability Formations and Fractured Rock

The overall sampling program goals or sampling objectives will drive how the sampling points are located, installed, and choice of sampling device. Likewise, site-specific hydrogeologic factors will affect these decisions. Sites with very low permeability formations or fractures causing discrete flow channels may require a unique monitoring approach. Unlike water supply wells, wells installed for ground-water quality assessment and restoration programs are often installed in low water-yielding settings (e.g., clays, silts). Alternative types of sampling points and sampling methods are often needed in these types of environments, because low-permeability settings may require extremely low-flow purging (<0.1 L/min) and may be technology-limited. Where devices are not readily available to pump at such low flow rates, the primary consideration is to avoid dewatering of the well screen. This may require repeated recovery of the water during purging while leaving the pump in place within the well screen.

Use of low-flow techniques may be impractical in these settings, depending upon the water recharge rates. The sampler and the end-user of data collected from such wells need to understand the limitations of the data collected; i.e., a strong potential for underestimation of actual contaminant concentrations for volatile organics, potential false negatives for filtered metals and potential false positives for unfiltered metals. It is suggested that comparisons be made between samples recovered using low-flow purging techniques and samples recovered using passive sampling techniques (i.e., two sets of samples). Passive sample collection would essentially entail acquisition of the sample with no or very little purging using a dedicated sampling system installed within the screened interval or a passive sample collection device.

A. Low-Permeability Formations (<0.1 L/min recharge)

1. Low-Flow Purging and Sampling with Pumps

   a. "portable or non-dedicated mode" - Lower the pump (one capable of pumping at <0.1 L/min) to mid-screen or slightly above and set in place for minimum of 48 hours (to lessen purge volume requirements). After 48 hours, use procedures listed in Part IV above regarding monitoring water quality parameters for stabilization, etc., but do not dewater the screen. If excessive drawdown and slow recovery is a problem, then alternate approaches such as those listed below may be better.

   b. "dedicated mode" - Set the pump as above at least a week prior to sampling; that is, operate in a dedicated pump mode. With this approach significant reductions in purge volume should be realized. Water quality parameters should stabilize quite rapidly due to less disturbance of the sampling zone.

2. Passive Sample Collection

Passive sampling collection requires insertion of the device into the screened interval for a sufficient time period to allow flow and sample equilibration before extraction for analysis. Conceptually, the extraction of water from low yielding formations seems more akin to the collection of water from the unsaturated zone and passive sampling techniques may be more appropriate in terms of obtaining "representative" samples. Satisfying usual sample volume requirements is typically a problem with this approach and some latitude will be needed on the part of regulatory entities to achieve sampling objectives.

B. Fractured Rock

In fractured rock formations, a low-flow to zero purging approach using pumps in conjunction with packers to isolate the sampling zone in the borehole is suggested. Passive multi-layer sampling devices may also provide the most "representative" samples. It is imperative in these settings to identify flow paths or water-producing fractures prior to sampling using tools such as borehole flowmeters and/or other geophysical tools.

After identification of water-bearing fractures, install packer(s) and pump assembly for sample collection using low-flow sampling in "dedicated mode" or use a passive sampling device which can isolate the identified water-bearing fractures.

VI. Documentation

The usual practices for documenting the sampling event should be used for low-flow purging and sampling techniques. This should include, at a minimum: information on the conduct of purging operations (flow-rate, drawdown, water-quality parameter values, volumes extracted and times for measurements), field instrument calibration data, water sampling forms and chain of custody forms. See Figures 2 and 3 and "Ground Water Sampling Workshop -- A Workshop Summary" (U. S. EPA, 1995) for example forms and other documentation suggestions and information. This information coupled with laboratory analytical data and validation data are needed to judge the "useability" of the sampling data.

VII. Notice

The U.S. Environmental Protection Agency through its Office of Research and Development funded and managed the research described herein as part of its in-house research program and under Contract No. 68-C4-0031 to Dynamac Corporation. It has been subjected to the Agency's peer and administrative review and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

VIII. References

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Figure 2. **Ground Water Sampling Log**

Project ________________ **Site** ________________ **Well No.** ______________ **Date** ___________________________

Well Depth _____________ **Screen Length** ___________ **Well Diameter** __________ **Casing Type** _____________

Sampling Device ________________ **Tubing type** ______________________ **Water Level** ___________________

Measuring Point ____________________ **Other Infor** ____

____

Sampling Personnel ____

Time	pH	Temp	Cond.	Dis.O_2	Turb.	[ ]Conc			Notes

Type of Samples Collected

____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi\ r^3$

Figure 3. **Ground Water Sampling Log** (with automatic data logging for most water quality parameters)

Project ________________ **Site** ________________ **Well No.** ______________ **Date** __________________________

Well Depth _____________ **Screen Length** ___________ **Well Diameter** __________ **Casing Type** ____________

Sampling Device ________________ **Tubing type** ______________________ **Water Level** __________________

Measuring Point ____________________ **Other Infor** ____

____

Sampling Personnel ____

Time	Pump Rate	Turbidity	Alkalinity	[ ] Conc	Notes

Type of Samples Collected

____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $\mathrm{Vol}_{cyl} = \pi r^2 h$, $\mathrm{Vol}_{sphere} = 4/3\pi\ r^3$

Hydro Tech Environmental, Corp.

Monitoring Well Sampling Log Sheet

Job No.: _______________ **Well No.:** _______________ **Date:** __/__/__

Well Depth: _____________ **Screen Length:** ________________ **Well Diameter:** ___________ **Casing Type:** ____________

Sampling Device: _________________ **Tubing Type:** _______ **Initial DTP:** _______________ **Initial DTW:** _____________

Well Volume: _____________________ **Total Volume Purged:** ______________

Sampling Personnel:____

Low Flow Sampling required ? Yes : __________ No: _____________

Order of stabilization			a	b	c	e	f	d	
Deviation			±1		± 3%	± 10%	± 10%	± 10 mv	

Time	DTP (ft)	DTW (ft)	pH	Temp (ºF)	Cond. (S/Cm)	Dis.O2 (mg/L)	Turb.(NTU)	ORP (mV)	Notes

ATTACHMENT B
RESUMES OF KEY PERSONNEL INVOLVED WITH THIS PROJECT

Paul I. Matli (Ph.D.)

EXPERIENCES

Senior Project Manager
Hydro Tech Environmental Corp. - USA
Apr. 2005 - Nov. 2005 & July 2006 - Present
Completed Environmental Assessment Statements, Phase I Environmental Site Assessments, Phase II Investigations Work Plans, environmental monitoring programs of groundwater and indoor air quality, field sampling of soil, water, air, soil gas, mold and solid wastes, data evaluation through Quality Assurance and Quality Control programs and reports writing. Prepared and engineered Phase III Remedial Action Work Plans for regulated developments, superfund sites and hazardous waste facilities by implementing in-situ bio-chemical remedial technologies, ex-situ disposal of impacted media and on-site mitigation methods of soil vapor intrusion. Supervised and coordinated the closure and removal of petroleum storage tanks. Fulfilled the task of Health and Safety Officer and the duties of a Geologist at a New York State Brownfield Cleanup Program site and multiple New York City Brownfield Cleanup Program sites.

Vocational Lecturer of the Course "Ecology and Environment"
Saint Joseph University – Lebanon
Nov. 2003 - Feb. 2004
Introduced undergraduate students in the School of Agriculture Engineering and the Nursing School to advanced knowledge in the fields of ecology, environment, ecosystem management, earth science and multivariate statistical analytical methods.

Agriculture Engineer in the Italian Rural Development Project in the Upper Bekaa Valley, Baalbek-Hermel Region
Lebanese Agricultural Research Institute - Lebanon
May 2003 - Jan. 2004
Contributed to boosting agricultural production in rural communities in a semi-arid region by identifying deficient production and marketing elements in their farming system and promoting sustainbale agriculture by introducing drought tolerant crops and the construction and management of engineered water reservoirs.

Teaching Assistant
Tokyo University of Agriculture and Technology - Japan
Apr.1999-Sept. 2002
Played a key role in the completion of research thesis of graduate research students by instructing and assisting them in their experimental designs and the application of statistical analytical methods.

Environmental Manager of Ammiq Private Wetlands in the Bekaa Valley - Lebanon
Oct.1997 - Sept. 1998
Successfully managed the exploitation of natural resources of privately owned wetlands by local stakeholders and implemented the United Nations strategies to suppress hunting of endangered bird species and waterfawls in coordination with government and international non-government organizations.

EDUCATION

Ph.D. in Environmental Sciences (a)
Tokyo University of Agriculture and Technology- Japan
Apr. 1999 - Sept. 2002
Research Theme: Conducted field research of crop physiological responses to micro-climatic conditions and developed empirical and multivariate statistical models predicting the impact of future global warming on crop production.

M.Sc. in Environmental Sciences [(b)]
International Center for Advanced Mediterranean Agronomic Studies - Greece
Sept. 1995 - Sept. 1997
Research Theme: Performed field surveys and laboratory analytical studies of the physico-chemical properties of forest and plant species in promoting wildland fires and developed empirical statistical models predicting their inputs into forest fire behavior prediction systems.

D.S.P.G.S. in Management and Conservation of Mediterranean Ecosystems
International Center for Advanced Mediterranean Agronomic Studies - Greece
Nov. 1994 - Aug. 1995
Top second among 15% of students successfully passing a one-year postgraduate program of intensive multidisciplinary courses for the major of management and conservation of natural renewable resources with a GPA of 4.0.

Diploma of Agricultural Engineer [(c)]
University of Saint Joseph - Lebanon
Sept. 1989 - July 1994
Successfully passed a five-year engineering program in agronomy and ranked first in the 1994 class graduation with a GPA of 3.69.
Research Theme: Collected and established a socio-economic database of the impact of trout fish farms on the bio-chemical property and microbial quality of fresh watercourses.

PEER-REVIEWED PUBLICATIONS

Matli P.I., Aoki M., Ozawa Y., Hideshima Y., Nakayama H., and Maruya S. 2002. Characterization of canopy photosynthetic CO_2 flux and leaf stomatal conductance responses of potato crop to changing field meteorological conditions in Hokkaido (in English). Journal of Agricultural Meteorology, **58**(3)115-122.

Dimitrakopoulos A.P., and **Matli P.** 2001. Bulk density and physical properties of *Sarcopoterium spinosum* (L.) Spach as fuel characteristics (in English). Journal of Mediterranean Ecology, **2**:75-82.

Elzein G., **Matli P.**, and Darwish S. 1997. The Study of physico-chemical and biological parameters of fresh water in fisheries in the Bekaa Valley (in French). Lebanese Scientific Bulletin, **10**(1):3-20.

Matli P. 1998. Measures and strategies to prevent and manage forest fires in Lebanon (in Arabic). Al Nahar Newspaper; Nahar El Shabab, Sept. 22, pp.2-3.

Matli P. 1997. A preliminary planning of managerial strategies for the conservation and management of Ammiq private wetlands (in English). Technical report submitted to the owners committee of Ammiq Estates-Lebanon, 10p.

EXTRACURRICULAR TRAININGS AND SKILLS

40 Hours OSHA training Course in Health & Safety Methods in Handling Hazardous Materials, USA, Feb. 2010.

10 Hours OSHA Training Course in Construction Safety & Health, Feb. 2013.

Turbo Training in pursuing environmental remedial activities at hazardous sites in compliance with the New York City Mayor’s Office of Environmental Remediation, Feb. 2015.

[(a), (b), (c)] Accredited US Educational Equivalence, *Globe Language Services, Inc*.

DONALD C. ANNÉ
SENIOR CHEMIST

EDUCATION:	M.S., Chemical Oceanography, Florida Institute of Technology, 1981 B.A., Earth Sciences, Millersville University of Pennsylvania, 1975
SPECIAL TRAINING:	Certified 40-Hour OSHA Health and Safety Certified 8-Hour OSHA Supervisory Course Ground Water Geochemistry (NWWA) Ground Water Pollution and Hydrology (Princeton Associates) Quality Assurance Programs for Environmental Monitoring Data (Stat-A-Matrix)
PROFESSIONAL AFFILIATIONS:	American Chemical Society (AFS), 1979-Present

EXPERIENCE SUMMARY:

Mr. Anné has more than 27 years of environmental chemistry experience specializing in data validation, environmental sampling, analytical methodologies, petroleum fingerprinting, laboratory audits, field sampling audits, and preparing Quality Assurance Project Plans and Quality Assurance Manuals. Mr. Anné's experience includes analytical laboratory work with gas chromatography, atomic absorption, infrared spectrometry and wet chemistry methods.

PROJECT EXPERIENCE:

Quality Assurance/Quality Control of Chemical Data

Mr. Anné has more than 20 years experience as a data validator and quality assurance officer. Mr. Anné has validated data for most EPA Regions and under several independent state programs, including the NYSDEC. He has performed laboratory and field audits as well as written Quality Assurance Project Plans. Mr. Anné has written, reviewed, and initiated laboratory Quality Assurance Manuals for laboratories to maintain their regulatory compliance. Typical project experience includes:

- Senior Chemist responsible for data validation. Reviewed chemical data for several projects under the New Jersey ISRA regulations. The clients included industry and utilities.

- Supervising Environmental Scientist responsible for data validation. Reviewed chemical laboratory data for adherence to QA/QC protocols for several key projects, including National Priorities List sites and RCRA Corrective Actions located in EPA Regions I, II, III, IV, V, and IX. Validated analytical data, outlined problems and actions to be taken, and qualified all affected data. Consulted with project managers on data usability, and recommended corrective actions to support project goals. Responded to comments made by regulators regarding data quality.

- Supervising Environmental Scientist recognized by the New York State Department of Environmental Conservation (NYSDEC) to perform third party data validation. Attended NYSDEC workshop on data validation as part of the requirements set forth by NYSDEC. Performed data validation in support of NYSDEC STARS and ASP programs as well as data in support of the NYSDEC Part 360 Regulations for landfills. Validated data for an Albany area municipal landfill.

- Supervising Environmental Scientist responsible for developing and preparing Quality Assurance Project Plans (QAPPs) for several state and federal Superfund sites and federal RCRA corrective action sites. Negotiated with regulators for the acceptance of the QAPPs. The sites were located throughout the eastern United States.

- Environmental Chemist responsible for developing a laboratory QA/QC program which fulfilled requirements of the EPA and agencies from the States of Texas and Louisiana. Implemented and managed the program throughout DOE's SPR Environmental laboratories. Received verbal commendations from EPA and the Texas Water commission on the QA/QC Program.

Environmental Chemistry

Mr. Anné is experienced in sampling soil, water, air, and wastes in accordance with federal and state guidelines. He has performed field sampling audits and prepared sampling plans for numerous projects in accordance with applicable programmatic requirements. Mr. Anné is familiar with the geochemical aspects of fate and transport of contaminants. Mr. Anné's typical project experience includes:

- Data manager for the Pennwalt Corporation's RCRA Corrective Action RFI Phase I program. The project included quantifying and characterizing soil contamination and hydrogeologic flow systems of 12 SWMUs at a flourochemicals plant in Thorofare, New Jersey. Validated and prepared QA/QC reports for data generated during the project. Qualified all data in preparation of the final report. Work was performed under the direction of NJDEP.

- Project Chemist in charge of field sampling activities, including coordinating and scheduling all subcontracted laboratory work for more than 25 sites in Connecticut. Trained field teams in sampling techniques for soil, groundwater, and surface water; chain of custody requirements; sampling QA/QC protocols; and analytical requirements. Work was performed under the scrutiny of ConnDEP.

- Field Team Leader for a major hazardous waste drum excavation project. Supervised all field activities including site safety; excavation; removal, sampling, and over packing of drums; staging and sampling of contaminated soil; and preparation of samples. Coordinated excavation and laboratory subcontractors. Work was performed under the scrutiny of ConnDEP.

- Created an environmental monitoring program for the Bryan Mound site of DOE's Strategic Petroleum Reserve for testing ground water and surface water. Developed sampling protocols, frequency of sampling, and lists of target analytes. This program was designed to provide baseline data for pre-spill conditions in the event of a release. The site was under scrutiny by EPA Region V and the Texas Water commission.

- Project Chemist responsible for developing analytical QA/QC program that included sampling and chemical analyses of surface water, groundwater, soil, and sediment matrices as part of a Remedial Investigation/Feasibility Study (RI/FS). The RI/FS involved more than 25 sites throughout the State of Connecticut. Work was under the guidance of ConnDEP.

Analytical Chemistry

Mr. Anné has experience working in both fixed-base and mobile laboratories. His experience includes the use of gas chromatography, atomic absorption spectrometers, infrared spectrometers, and numerous wet chemistry and preparation equipment methods. He has served in the laboratory as an analyst, laboratory advisor, and QA officer. He has interfaced with regulators in the area of analytical chemistry and has experience in petroleum fingerprinting techniques and methods. Typical projects include:

- Performed bench scale experiments for St. Lawrence Zinc in order to obtain the optimum level of Phlotec necessary to treat discharged water to resolve an N.O.V. for the SPDES outfall. The optimum level of Phlotec would precipitate enough dissolved zinc for the water to meet the discharge requirement. Also performed routine analyses of samples after implementing the treatment, to insure that the proper concentration was being used.

- Environmental Chemist in charge of project to design updates for the DOE's laboratories at its SPR facilities. Evaluated IR and FT-IR instrumentation and personal computers to link with existing and future instrumentation. Wrote procedures for the acceptance of an alternative oil & grease method for NPDES permit monitoring by EPA Region V. Coordinated all site activities necessary for implementing upgrades.

- Environmental Chemist in charge of replacing obsolete total organic carbon (TOC) analyzers for the SPR laboratories. Evaluated state-of-the-art TOC analyzers and recommended replacement TOC analyzer. Negotiated with supplier and wrote technical specification for the bid process required by DOE. Supervised installation and set-up of all new TOC analyzers.

- Analytical Chemist for Berkley Products Company responsible for product development. Analyzed competitor's products and formulated new coatings with equal or better quality. Responsible for solvent operations which included managing the waste solvent recovery operations, solvent formulation, and manufacturing QA/QC. Worked with sales and manufacturing staff to address and resolve client complaints. Received two cash bonuses for suggestions on the manufacture of products which saved the company money.

- Analytical Chemist for the mobile laboratory responsible for sample preparation in support of several projects for a range of clients located in three EPA regions and in conjunction with several state agencies. Extracted, concentrated, and prepared water and soil samples for analyses by GC/FIND, GC/ECD, GC/PID, and GC/MS. Samples were prepared for PCB, pesticide, polynuclear aromatic hydrocarbon, and petroleum hydrocarbon analyses.

EMPLOYMENT: 2005- present, Alpha Geoscience
1998-2005, Alpha Environmental Consultants, Inc.
1990-1998, McLaren/Hart
1986-1990, Fred C. Hart Associates
1985-1986, Boeing Petroleum Services
1982-1985, Petroleum Operations and Support Services
1981-1982, Dravo Utility Constructors
1979-1981, Florida Institute of Technology
1975-1979, Berkley Products Company

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SUMMARY:

New York State Professional Engineer. Results-oriented Chemical and Environmental Engineer, with 21 years of experience in the chemical and environmental areas. Areas of expertise include inspections and sign off on Large Scale Vapor Barrier Installations at Various NYC schools, Design and inspections of Sub Slab Depressurization Systems, wastewater treatment systems, process control and automation, process optimization, productivity improvement, quality systems, environmental compliance, Phase I Environmental Site Assessments, Phase II Environmental Investigations, Phase III: Remedial Activities, process and plant safety, and management of a production facility. Special Inspector with New York City Department of Buildings. Registered PE in NY.

WORK EXPERIENCE:

2012-present C Squared Environmental Corp. Jericho, NY (Incorporated in 2012).

President

- Provide environmental and geotechnical services.
- Obtain soil and water samples.
- Conduct environmental monitoring activities.

1997-present AMC Engineering, PLLC. Jericho, NY (Organized in 2000).

Principal. Clients range from small car wash and Laundromat operators to large chemical process companies.

- Engineering Consulting Services.
- Design and Inspection of SubSlab Depressurization Systems
- Design of Subsurface Drainage Systems.
- SPDES and SWPPP Inspections
- Environmental Compliance.
- Phase I ESA, Phase II ESI. Remedial Investigations, Remediation of contaminated sites.
- Wastewater Treatment systems.
- Design of cleaning compounds for the Transportation industry.
- Zoning regulations. Expediting Services. NYFD, NYC Buildings, NYSDEC, Suffolk County
- Permitting: NYSDoB, NYCDEP, NYFD, NYSDEC
- NYCDOB Special Inspector: for heating system, chimneys and fire stops, and mechanical systems
- Safety and environmental training.
- Soil and Water characterization and sampling
- Inspections and sign off on Large Scale Vapor Barrier Installations at Various NYC schools

1994-2001 Axel Plastics Research Laboratories, Woodside, NY

Plant Manager

- Responsible for all day-to-day operations.
- Designed and installed a powders blending facility, including materials handling, dust collection systems, mixers, and other processing equipment.

- Implemented a safety program, based on OSHA standards.
- Implemented a Company-wide Quality Management system (ISO 9000).
- Successfully addressed all environmental-related issues with local authorities.
- Wrote all operating procedures and instructions. Designed and implemented an Intranet system with all information pertaining to day-to-day operations, for Company wide use.
- Planned production for the two plants and more than 140 lines of products.
- Managed all shipping/receiving operations. Managed all equipment and process maintenance.

1992-1994 Millennium Chemicals (SCM, Colors & Silica), Baltimore, MD.
Process Engineer and Project Manager.

- Process engineering, design, manufacturing and environmental control for the Silica Gel plant.
- Responsible for ISO 9000 certification. Wrote all procedures and instructions for the plant and maintenance.
- Conducted capital asset planning.
- Responsible for Health, Safety and Environmental compliance.

1990-1992 CROMPTON (WITCO) CORPORATION, POLYMER ADDITIVES, Taft, LA.
Process Development Engineer.

- Routine responsibilities were to develop new processes and optimize existing ones.
- Successfully designed and installed a distributed control system to remotely control an organic peroxides facility (Marshall, TX).
- Designed, erected and operated a Pilot Plant. It successfully brought to the market a pesticide, patented by Dupont and commercialized by Witco (Seenox).
- Conducted process simulation to identify process and product optimization.
- Designed process equipment (reactors, heat exchangers, pumps)

1987-1988 VINISA S.A.I.C. - PVC COMPOUNDING, Buenos Aires, Argentina.
Production and Project Manager.
Coordinated production in VINISA's 3 compounding plants. Routine responsibilities included: Technical assistance to PVC compounders, Production organization, planning and control, production management.

EDUCATION:

1988-1990 COLUMBIA UNIVERSITY, New York, NY
M.S. Chemical Engineering, Feb. 1990.
Awarded Fellowship as a Teaching Assistant. Thesis: Optimal Periodic Control.

1981-1987 UNIVERSITY OF BUENOS AIRES, Buenos Aires, Argentina.
Chemical Engineer (six year program).
Teaching Assistant Inorganic Chemistry.

Continuing Education Courses attended: (partial list)

- Building Inspections Course
- Environmental Regulation
- Design of Subsurface Drainage Systems
- Process Hazard Analysis
- Hazardous Materials Regulations

- Supervisors Training
- OSHA regulations
- ISO 9000
- Lead auditor training
- Wastewater Treatment System

ADDITIONAL INFORMATION

Speaker at Water Conferences: Long Island Water, wastewater and aquifers. Director, Metro New York Section, AIChE

ATTACHMENT C
SAMPLE CHAIN OF CUSTODY FORM

YORK
ANALYTICAL LABORATORIES, INC.
120 RESEARCH DR. STRATFORD, CT 06615
(203) 325-1371 FAX (203) 357-0166

Field Chain-of-Custody Record

Page____ of ____

NOTE: York's Std. Terms & Conditions are listed on the back side of this document. This document serves as your written authorization to York to proceed with the analyses requested and your signature binds you to York's Std. Terms & Conditions unless superseded by written contract.

York Project No._______________

Client Information

Company: ____________
Address: ____________
____
Phone No. ____________
Contact Person: ____________
E-Mail Address: ____________

Report To:

Company: ____________
Address: ____________
____
Phone No. ____________
Attention: ____________
E-Mail Address: ____________

Invoice To:

Company: ____________
Address: ____________
____
Phone No. ____________
Attention: ____________
E-Mail Address: ____________

Client Project ID

Purchase Order No.

Turn-Around Time

24 hr ________
48 hr ________
72 hr ________
5 Day ________
Standard______

Report Type/Deliverbles

Summary Results Only______QA/QC Summary______
RCP Package______ASP B Pkg ________
ASP A Pkg______Excel format________
EDD ________OTHER________________

Print Clearly and Legibly. All Information must be complete. Samples will NOT be logged in and the turn-around time clock will not begin until any questions by York are resolved.

____
Samples Collected/Authorized By (Signature)

____
Name (printed)

Matrix Codes
S - soil
Other - specify(oil, etc.)
WW - wastewater
GW - groundwater
DW - drinking water
Air-A - ambient air
Air-SV - soil vapor

Volatiles		**Semi-Vols.**	**Pest/PCB/Herb**	**Metals**	**Misc. Org.**	**Full Lists**	**Miscellaneous Parameters**		
8260 full	TICs	8270 or 625	8082PCB	RCRA8	TPH GRO	Pri.Poll.	Corrosivity	Nitrate	Color
624	Site Spec.	STARS	8081Pest	PP13	TPH DRO	TCL Organics	Reactivity	Nitrite	Phenols
STARS	SPLP or TCLP	BN Only	8151Herb	TAL	CT ETPH	TAL Met/CN$^-$	Ignitability	TKN	Cyanide-T
BTEX	Benzene	Acids Only	CT RCP	CT15	NY 310-13	Full TCLP	Flash Point	Tot. Nitrogen	Cyanide-A
MTBE	Nassau Co.	PAH	App. IX	Total	TPH 418.1	Full App. IX	Sieve Anal.	Ammonia-N	BOD5
TCL list	Suffolk Co.	TAGM	Site Spec.	Dissolved	Air TO14A	Part 360-Routine	Heterotrophs	Chloride	CBOD5
TAGM	Ketones	CT RCP	SPLP or TCLP	SPLP or TCLP	Air TO15	Part 360-Baseline	TOX	Phosphate	BOD28
CT RCP	Oxygenates	TCL list	TCLP Pest	**Indiv. Metals**	Air STARS	Part 360-Expanded No Dioxins/Furans	BTU/lb.	Tot. Phos.	COD
Arom.	TCLP list	TICs	TCLP Herb	Hg, Pb, As, Cd	Air VPH	Part 360-Expanded Full List	Aquatic Tox.	Oil&Grease	TSS
Halog.	524.2	App. IX	Chlordane	Cr, Ni, Be, Fe,	Air TICs	NYCDEP Sewer	TOC	F.O.G.	Total Solids
App.IX	502.2	SPLP or TCLP	608 Pest	Se, Tl, Sb, Cu,	Methane	NYSDEC Sewer	Asbestos	pH	TDS
8021B list	5035	TCLP BNA	608 PCB	Na, Mn, Ag, etc.	Helium	TAGM	Silica	MBAS	TPH - IR

Special Instructions
Field Filtered ☐
Lab to Filter ☐

Sample Identification	**Date Sampled**	**Sample Matrix**	**Choose Analyses Needed from the Menu Above and Enter Below**							Container Description(s)
Comments		**Preservation** **Check those Applicable**	**4ºC____ Frozen____** **HCl MeOH**	**4ºC____**	**4ºC____**	**HNO$_3$____** **4ºC**	**4ºC____** **H$_2$SO$_4$____**	**4ºC____** **Other**	**4ºC____ H$_2$SO$_4$____ NaOH____** **ZnAc Ascorbic Other____**	**Temperature on Receipt** _____ºC

____________________ ____________
Samples Relinquished By Date/Time

____________________ ____________
Samples Received By Date/Time

____________________ ____________
Samples Relinquished By Date/Time

____________________ ____________
Samples Received in **LAB** by Date/Time

ATTACHMENT D
CONVENTIONAL LABORATORY QA/QC

YORK
ANALYTICAL LABORATORIES INC

120 Research Drive
Stratford, CT 06615
203-325-1371

Quality Manual

Laboratory Director: **Ben Gulizia**

Quality Manager: **Teresa V. Weikel** Teresa V. Weikel

Date of Issue: **April 12, 2013**

Revision: **2.4**

NELAP ACCREDITED
TNI
LABORATORY

Controlled Copy #: ______

Quality Manual

This Quality Manual meets the requirements of ISO 17025, ISO 9001 and NELAC. This Quality Manual is confidential and assigned as outlined below.

Issued to: ______________________________

Revision History

Revision 2.0	04/30/2010	First issue rewritten quality manual
Revision 2.1	11/13/2011	Updated Org Chart and Master List of Documents
Revision 2.2	06/29/2012	Updated Org Chart and Master List of Documents
Revision 2.3	12/26/2012	Added Data Integrity Plan, Reformatted document
Revision 2.4	04/12/2013	Added Aquatic Toxicity information

Controlled Copy in Canary Yellow only

Table of Contents

1. Introduction

Purpose

This Quality Manual contains all the requirements that our laboratory uses to demonstrate our quality management system, technical competence, and valid results.

Analytical data are used for many purposes, including: compliance with regulatory requirements; determination for the presence, concentration, and movement of hazardous materials in the environment; potential effects upon or protection required for persons; and the actions necessary for disposal of treatment of hazardous materials.

Analytical data may be used to support a broader-based project involved with: site characterization and/or remediation; on-site treatment; treatment and/or disposal or health and safety protection of York personnel and the public. Data may also be produced for outside commercial testing and submitted directly to clients for their decision making. In all cases, data must be of known quality.

It is the purpose of the York Quality Assurance Program, as expressed in this Quality Systems Manual, to provide all data which are of known quality. To achieve this, a system is described which controls:

- Preservation of samples
- Receipt and handling of samples
- Processing and analyses of samples
- Analytical instrumentation
- Data verification
- Data reporting

Section 4 specifies how we demonstrate sound management and maintain client satisfaction.

Section 5 specifies how we demonstrate technical competence in our laboratory.

In addition, this Quality Manual outlines how York complies with:

- ISO 17025
- ISO 9001
- NELAC

All personnel are to take an active role in establishing, implementing, and maintaining our quality management program. We do not separate quality from our daily business. Quality cannot be something that we do just to pass audits. Quality is integrated into every facet of the decision-making process in the management of our laboratory and the science that we practice.

Distribution List

The Quality Assurance Officer (QAO) maintains the distribution list for this Quality Manual.

2. Scope

This Quality Manual facilitates:

- Recognition of technical competence for standardized methods, non-routine methods, and laboratory-developed methods we perform
- Inspection and product certification capabilities and/or services we provide
- Total quality for our administrative and technical systems
- Audits by clients, regulatory authorities and accreditation bodies
- Meeting the requirements of NELAC, ISO 17025, and ISO 9001
- Client satisfaction

3. Normative References

Reference List

ISO/IEC 17000, Conformity assessment – Vocabulary and general principles

VIM, International vocabulary of basic and general terms in metrology, issued by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML.

ISO 9001:2008 – Quality Management Systems – Requirements.

ISO 17025:2005 – General Requirements for the Competence of Testing and Calibration Laboratories.
NELAC 2003-Quality Systems

4. Management Requirements

4.1 Organization

This section discusses general positions and quality-related responsibilities which provide for the implementation of the Quality Assurance Program and completion of quality control activities. Also discussed is the role of the York Quality Assurance Officer.

4.1.1 Legal Identification / Registration

York Analytical Laboratories, Inc.
120 Research Drive
Stratford, Connecticut 06615
203-325-1371
Fax 203-357-0166
E-mail: ClientServices@yorklab.com

State of Connecticut Department of Health (CTDOH) License no. PH-0723
New York State Department of Health (NYSDOH) ELAP/NELAP License no. 10854
State of New Jersey Dept. of Environmental Protection (NJDEP) License no. CT-005
State of Pennsylvania Registration No. 68-04440
EPA ID NO. CT-005

4.1.2 Laboratory Requirements

The departments of York Analytical Laboratories, Inc. have been organized to satisfy the needs of the Client and regulatory authorities and to meet the NELAC and international standards ISO 17025 and ISO 9001. York Analytical Laboratories, Inc. is comprised of the following Departments or Groups:

Laboratory Director's Office
Quality Assurance Group
Client Services/Sales Groups
Sample Control Group

Classical Chemistry Group
Organic Preparations Group
Atomic Spectroscopy Group
Gas Chromatography Group
Gas Chromatography/Mass Spectrometry Groups (Volatiles and Semi-Volatiles)
Aquatic Toxicity Group
Report production/Data Mangement Group

4.1.3 Scope of Management System

The management system covers activities in the laboratory's permanent facility at 120 Research Drive, Stratford, CT 06615. The fields of activities include:

Analysis of environmental samples (water, wastewater, soil, sludge, and air) for Federal and State regulated contaminants.

The laboratory's scope of tests is listed in the our specific licenses and encompasses volatile organics, semi-volatile organics, pesticides, herbicides, PCBs, metals, Aquatic Toxicity and various general chemistry parameters.

4.1.4 Potential Conflicts of Interest

York has no potential conflicts of interest since it is independently owned and operated and provides only environmental laboratory analysis services. The ownership of York does not have any other interest that would be considered a potential conflict of interest.

4.1.5 Organization

A) Management and Technical Personnel

Policy:
The laboratory managerial and technical personnel, irrespective of other responsibilities, have the necessary authority and resources needed to meet the mandates assigned to their areas.

Details:
Responsibilities are detailed in 4.1.5 (F).

Departures from the organizational and management policies in this manual can only be approved by the Laboratory Director.

Departures from quality management system procedures can only be approved by the Quality Assurance Officer or the Laboratory Director.

Departures from test methods or technical standard operating procedures (SOPs) can only be approved by the Laboratory Director.

See also section 5.2.

B) Undue Pressure

Policy:
Management and personnel are to be free from any undue internal and external commercial, financial and other pressures that may adversely affect the quality of their work. The integrity of test results is the responsibility of all personnel. Management ensures that employees are never instructed or forced to alter or falsify data.

Details:
The following list provides some guidelines on how employees avoid conflict of interest situations. Employees shall not:

- falsify records, prepare fraudulent reports, or make false claims
- seek or use privileged or confidential company information, or data from any Client, for any purpose beyond the scope of employment
- conduct non-laboratory business on laboratory time, or use company facilities or instrumentation to conduct outside interests in business, unless prior approval has been obtained
- solicit business on their own behalf (rather than the laboratory) from a Client
- be employed by, or affiliated with, organizations whose products or services compete with laboratory products or services
- have employment that negatively affects or interferes with their performance of laboratory duties
- compete with the laboratory in the purchase, sale, or leasing of property or goods
- allow association, family, or friends to influence business decisions to their benefit - decisions must be made on a strictly business basis, always in the best interest of the laboratory
- make any decision that provides gains or benefits to the employee and/or others
- have personal financial dealings with an individual or company that does business with the laboratory which might influence decisions made on the laboratory's behalf

Firm adherence to this code of values forms the foundation of our credibility. Personnel involved in dishonest activities are subject to a range of disciplinary action including dismissal.

C) Client Confidentiality

Policy:
It is the policy of our laboratory to protect the confidential information and proprietary rights of our Client including the electronic storage and transmission of results.

Details and Procedures:
All employees sign an Employee Confidentiality Agreement. The signed agreement is retained in each employee's Human Resources file.

Test results are only released to the Client. Release to someone other than the Client requires the express permission of the Client, except when the situation contravenes State or Federal Legislation and the results must be provided to the appropriate agency. The release of test results to anyone other than the Client requires the permission of the Client and management. Laboratory reports are reviewed for accuracy and completeness prior to release.

D) Operational Integrity

Policy:
The laboratory will avoid involvement in any activities that would diminish confidence in its competence, impartiality, judgment, or operational integrity.

Details and Procedures:
To ensure confidence in laboratory operations a formal quality assurance program is implemented. Technical competence is ensured through check sample programs. Impartiality is assessed through audits and approvals. Judgment is ensured through the hiring of qualified personnel and by continuously refining, upgrading, and improving his or her skills. Operational integrity is reviewed by management on a regular basis at management review meetings to ensure continued suitability and effectiveness of laboratory policies and procedures. Any problems are acted on immediately through corrective action procedures.

E) Organizational Structure

Policy:
The organization and management structure of the laboratory and the relationships between management, technical operations, support services, and the quality management system is defined through the aid of an organizational chart.

Details:
Senior management keeps the most current organizational chart on file. An organizational chart is available with this manual as a reference record-ATTACHMENT A and is considered the official record on the date it is marked in the lower right corner.

F) Responsibility and Authority

Laboratory Director

- develops primary goals, operating plans, policies, and short and long range objectives for the laboratory; implements these following Board of Directors' approval
- directs and coordinates activities to achieve profit and return on capital
- establishes organizational structure and delegates authority to subordinates
- leads the laboratory towards objectives, meets with and advises other executives, and reviews results of business operations
- determines action plans to meet the needs of stakeholders
- represents organization to major Clients, government agencies, shareholders, and the public
- is knowledgeable of the scope of all processes under supervision
- provides the necessary resources (personnel, instrumentation, supplies) for the quality assurance program, in order to ensure confidence in the laboratory's results
- ensures instrumentation is maintained and calibrated, reporting all deficiencies (e.g., instrumentation malfunctions) in the appropriate manner
- ensures personnel are trained for the duties they perform - includes substitutes when regular personnel are absent
- maintains current job descriptions
- maintains records and manages all aspects of testing activities

Quality Assurance Officer (QAO)

- ensures that the Quality Management System is established, implemented and maintained in accordance with the ISO 9001, ISO 17025 and NELAC standards
- manages the internal audit program
- coordinates laboratory accreditation activities
- handles the maintenance and distribution of the Quality Manual and associated documents

- maintains a master list of current versions of quality documentation
- trains personnel on Quality Management System activities
- monitors the Quality Management System
- reports on the performance of the Quality Management System to senior management for review and as a basis for improvement of the Quality Management System
- supervises the laboratory's double-blind proficiency testing program

Group Leaders

- responds to York Client Servies Group inquiries and provides professional advice
- hires personnel
- orientates new personnel
- determines technical training needs of personnel
- conducts employee performance reviews
- schedules vacation and coverage
- ensures that all health and safety regulations are followed
- ensures that all Human Rights Legislation are complied with
- prioritizes workload
- facilitates operational concerns in their area
- ensures accurate and consistent testing procedures through the validation of all current procedures and by developing, validating and implementing new procedures
- coordinates purchasing requests
- ensures that the operational needs are within budget and advising management of any discrepancies

Analysts and Technicians

- maintains records of all quality activities as documented in SOPs and test methods
- handles samples and performing analyses according to SOPs and test methods
- provide input and assists in preparation of SOPs and test methods
- maintain and calibrate instrumentation and instrumentation
- reports deficiencies or malfunctions to the Group Leader
- identifies and records nonconformities on *Corrective Action Reports*
- identifies and recording potential nonconformities on *Preventive Action Requests*
- corrects nonconformities and potential nonconformities
- improves laboratory and/or quality activities on a continuous basis

Client Services Managers

- provides vision and direction for analysis activities
- Responds to Clients' and provides professional advice
- develops and reviews proposals/Quotations
- Reviews Quality Assurance Project Plans for Clients
- monitors the progress of Work-in-Process

- reviews reports for selected Clients
- oversees, standard pricing, customized quotations, and invoicing for tests performed
- controls the flow of communication between the Client and the laboratory

Administrative/Data Management Personnel

- performs work functions and keeps records as per approved SOPs and/or laboratory policies
- generate final reports, invoices and data packages for transmittal to Clients
- assist in preparation of SOPs
- identifies and records nonconformities on *Corrective Action Reports*
- identifies and records potential nonconformities on *Preventive Action Requests*
- corrects nonconformities and potential nonconformities
- improves laboratory and/or quality activities on a continuous basis

G) Laboratory Supervision

Policy:
Adequate supervision is provided in each area of the laboratory for all testing and calibration personnel, including trainees, by persons familiar with the methods and procedures.

Details:
Adequate supervision is ensured through designated supervisors as well as through documentation such as this Quality Manual, test methods and SOPs. A thorough orientation and training program is adhered to for all new employees. Ongoing training for regular personnel is required.

H) Technical Management

Policy:
A Group Leader is assigned to each major technical department of the laboratory. They have overall responsibility for the technical operations and the provision of resources needed to ensure the required quality and production of laboratory operations.

Details:
While the Group Leader may at times delegate duties to other personnel, the Group Leader is accountable for any nonconforming activities.

I) Quality Assurance Officer

Policy:
The Quality Assurance Officer is appointed by the highest level of management. The Quality Assurance Officer, who, irrespective of other duties and responsibilities, has defined responsibility and authority for ensuring that the management system related to quality is implemented and followed. The Quality Assurance Officer has direct access to the highest level of management where decisions are taken on laboratory policy or resources.

Details:
This statement notifies all laboratory personnel that Teresa Weikel is the Quality Assurance Officer as authorized by the Laboratory Director. Any change in this position requires the reissue of this section to all holders of controlled copies of the Quality Manual. The following signature also serves as approval for this Quality Manual and affirms senior management's commitment to the policies and procedures set forth in this manual.

J) Managerial Substitutions

Policy:
Deputies for key personnel are appointed to fulfill the key personnel's duties in their absence.

Details:
In the absence of the Quality Assurance Officer, the Laboratory Director will assume his/her responsibilities.

In the absence of the Group Leader, the Laboratory Director or other Group Leader will assume his/her responsibilities.

Management is responsible for ensuring that current and/or increased workload requirements are met. This includes making adjustments as a result of employee absence. Only fully trained employees are utilized to fulfill the duties of personnel who are absent. If sufficient human resources are not available, management will identify the best possible solution to meet operational requirements.

K) Awareness

Policy:

Management ensures that its personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the objectives of the management system.

Details:
Supervisors review the details of each employee’s job description with the appropriate employee and how the overall Quality Policy Statement (Section 4.2.2) relates to their activities to achieve the objectives of the management system.

4.1.6 Communication Processes

Policy and Details:
Top management ensures that appropriate communication processes are established within the laboratory and that communication takes place regarding the effectiveness of the management system.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual
Revision 2.1	11/14/2011	Changed QA Officer name to Teresa Weikel

4.2 Management System

4.2.1 Policies and Procedures

Policy:
The Quality Management System is established, implemented, and maintained by management. It is applicable to all the fields of testing and activities in which the laboratory is involved and undertakes. All policies, systems, programs, procedures and instructions are documented to the extent necessary to enable the laboratory to assure the quality of results generated. These documents are communicated to, understood by, available to, and implemented by the appropriate personnel.

Details:
The purpose of our Quality Management System is to ensure that all services and products satisfy the Client's requirements and have been designed, manufactured, and delivered under controlled conditions.

The effectiveness of the Quality Management System is assessed in several ways:

- by a program of planned internal audits, covering all aspects of the operation of the quality management system
- by regular management reviews of the suitability and effectiveness of the quality management system
- by analysis of potential and actual problems as shown by Client complaints and supplier and subcontractor assessments
- by other methods approved from time to time by the Laboratory Director

This Quality Manual and associated documents (including procedures) and records serves as the quality plan for the laboratory. Other documents and records include:

- standard operating procedures
- quality control plans in test methods
- organizational charts
- proposals and Quality Assurance Project Plans (QAPP)
- project management schemes

4.2.2 Quality Policy Statement

Policy:
The policies and objectives for laboratory operations are documented in this Quality Manual. The overall objectives are set out in the Quality Policy Statement and reviewed during management review. The Quality Policy Statement is issued under the authority of the Laboratory Director on the effective date.

Quality Policy Statement:
To ensure accurate and timely environmental laboratory analysis services and to continuously meet or exceed the stated or implied expectations of our Clients through day-to-day interactions.

Effective Date: April 30, 2010

a) *Management commitment to good professional practice and quality of services provided to the Client*: analyses and calibrations are always carried out in accordance with stated standardized methods and Clients' requirements. Requests to perform tests that may jeopardize an objective result or have a low validity are rejected.

b) *Standards of service include*:

- Client Satisfaction
- Quality
- Timeliness

Excellence in the workplace is promoted by providing all employees with the knowledge, training, and tools necessary to allow for the completion of accurate and timely work.

c) *Purpose of management system related to quality*: to manage our business by meeting the needs of our Clients.

d) *Personnel*: familiarize themselves with quality documentation and implement the policies and procedures in their work.

e) *Management is committed to complying with NELAC, ISO 17025 and ISO 9001 international standards and to continually improve the effectiveness of the management system*: the objective of this Quality Manual is to document the compliant policies and associated procedures that are integrated into our daily activities. Continual improvements are established, implemented, and integrated into the management system.

Additional objectives include:

- to establish the level of the laboratory's performance

- to make test method changes to improve performance
- to participate in proficiency testing or quality evaluation programs with peer laboratories
- to ensure that all personnel are trained to a level of familiarity with the quality management system appropriate to the individual's degree of responsibility
- to improve and validate laboratory methodologies by participation in method validation collaborative tests
- to establish and report on quality savings

4.2.3 Commitment to the Management System

Policy:
Top management is committed to the development and implementation of the management system and continually improving its effectiveness.

Details:
The results of the management system are regularly reviewed during management review (see Section 4.15) and continual improvements are made as outlined in Section 4.10 – Improvements.

4.2.4 Communication of Requirements

Policy:
Top management communicates to the organization the importance of meeting Client requirements as well as statutory and regulatory requirements.

Details:
In general, the underlying message in all oral and written management communications involves meeting the aforementioned requirements. Meeting Client requirements ensures that ongoing business relationships secure the contracts that keep everyone employed. Meeting statutory and regulatory requirements ensures that laboratory operations will not be disrupted and the organization can continue to meet Client needs.

4.2.5 Quality Manual

Policy:
This Quality Manual outlines the structure of the documentation used in the quality management system. This Quality Manual makes reference to supporting procedures including technical procedures and is maintained up to date.

Details:
This quality management system is structured in three tiers of documentation. The tiers are as follows:

1. Quality Manual
2. Standard Operating Procedures and Test Methods
3. Records

For most Clients, this Quality Manual and the associated documents form a general Quality Plan. If necessary, specific Quality Assurance Project Plans (QAPP) will be prepared on a 'per-Client' basis. These QAPPs will modify the general requirements stated in the Manual and associated documents.

All of the above documents are controlled documents in yellow only.

The following records and directive documents are referenced in the Quality Manual, but maintained separately:

- organizational chart (section 4.1.5.E)
- copies of the Quality Policy Statement posted in the laboratory (section 4.2.2)
- identification of resources and management review (section 4.15.1)
- job descriptions (section 5.2.4)
- statistical techniques (section 5.9)
- test reports (section 4.13.2 and 5.10)
- identification of the laboratory's approved signatures (section 5.10.2)
- laboratory's scope of tests (section 4.1.3)
- instrumentation inventory and records (sections 5.5.4 and 5.5.5)
- calibration status indicators (section 5.5.8)
- reference standards inventory (section 5.6.3)
- verification records (section 5.9)
- quality control plan / criteria for workmanship (section 5.4.1)
- corrective action records (section 4.11)
- preventive action records (section 4.12)
- client complaint records (section 4.8.1)
- audit schedule and records (section 4.14.3)
- procurement and subcontracting records (sections 4.6 and 4.5.4)
- training records (section 5.2.5)
- master list of documentation (section 4.3.2)
- confidentiality agreements (section 4.1.5 C)
- contract review (section 4.4.2)
- validation of test methods (section 5.4.5)
- facility floor plan (section 5.3.1)

4.2.6 Technical Management and the Quality Assurance Officer

The roles and responsibilities for technical management (Group Leaders) and the Quality Assurance Officer are outlined in section 4.1.5 (F) of this manual.

Technical management (Group Leaders) ensures that section 5 of this manual is implemented and maintained. The Quality Assurance Officer ensures that section 4 of this manual is implemented and maintained.

4.2.7 Maintenance

Policy and Details:
Top management ensures that the integrity of the management system is maintained when changes to the management system are planned and implemented.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual

4.3 Document Control

4.3.1 Policies and Procedures

Policy:
The SOP# ADMINDOC043010 is used to control all quality management system documents. These may include documents of external origin, such as regulations, standards, other normative documents, test and/or calibration methods, as well as drawings, specifications, instructions, and manuals.

Details:
Document means any information or instructions including policy statements, procedures, specifications, calibration tables, charts, text books, posters, notices, memoranda, software, drawings, and plans. These may be in various media, whether hard copy or electronic and they may be digital, analog, photographic or written.

The documents to be controlled include:
- Quality Manual
- Standard Operating Procedures
- Forms
- Standards

The control of data related to testing and calibration is covered in section 5.4.7. The control of records is covered in section 4.13.

4.3.2 Document Approval and Issue

4.3.2.1 Review / Approval / Master List

Policy and Details:
All documents issued to personnel in the laboratory as part of the quality management system are reviewed and approved for use by authorized personnel prior to issue (i.e., reviewed by personnel knowledgeable in the documented activity and then approved by management). A master list identifying the current revision status and distribution of documents in the quality management system is readily available in order to preclude the use of invalid and/or obsolete documents (see SOP# ADMINDOC043010). A revision history of documents is also maintained. Documents are formally reviewed on a biennial basis to ensure their continuing suitability. APPENDIX B contains a current Master List of Documents.

4.3.2.2 Availability and Obsolete Documents

Policy and Details:
The master list includes all current controlled documents. The master list document is organized with the following information:

- Description
- SOP Number
- Date of Issue (effective date of each procedure)
- Revision Number
- Date of Revision (effective date of each current revision)

Controlled documents are approved before issue.

The SOP# ADMINDOC043010 for document control ensures that:
- authorized editions of appropriate documents are available at all locations where operations essential to the effective functioning of the laboratory are performed
- documents are periodically reviewed and where necessary revised to ensure continuing suitability and compliance with applicable requirements
- invalid or obsolete documents are promptly removed from all points of issue or use to assure against unintended use
- obsolete documents retained for either legal or knowledge preservation purposes are suitably marked (i.e., stamped "OBSOLETE" and dated)

4.3.2.3 Identification

Policy and Details:
All quality management system documentation is identified by:

- date of issue and/or revision number
- page numbering
- total number of pages (e.g., page 5 of 5)
- issuing authority (i.e., approval signature)

4.3.3 Document Changes

4.3.3.1 Review / Approval

Policy:
Changes to documents are reviewed and approved by the same function (i.e., personnel or position) that performed the original review unless specifically designated otherwise.

Details:
Developments in policies and procedures require documents to be changed from time to time. Changes to documents receive the same level of review and approval as the originals.

The Quality Manual is reviewed annually by the Quality Assurance Officer. Records are kept of this review.

Test methods and SOPs are reviewed on a biennial basis. Procedures for this are outlined in SOP# ADMINDOC043010.

Obsolete documents are withdrawn, but are retained for archive purposes and clearly labeled as obsolete.

4.3.3.2 Identification of Changes

Policy:
The nature of document changes is identified in the document.

Details:
As outlined in SOP# ADMINDOC043010.

In general, the nature of changes is described in the document. Revision history is recorded at the end of the document.

4.3.3.3 Amendments by Hand

Policy and Details:

Hand-written amendments are clearly marked, initialed, and dated by the Laboratory Director and/or the QA/QC Officer on all controlled yellow copies.

4.3.3.4 Computerized Documents

Policy and Details:
The SOP# ADMINDOC043010 details how changes in documents maintained in computerized systems are made and controlled.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual
Revision 2.1	06/29/2012	Modified Master List information, and hand amendments

4.4 Review of Requests and Contracts

4.4.1 Policies and Procedures

Policy:
The SOP AMINCONTRACT043010 is used to review requests or contracts. This procedure ensures that:

a) the Client requirements including the methods to be used are adequately defined, documented and understood (see section 5.4.2)
b) the laboratory has the licensing, capability and resources to meet the requirements
c) the appropriate testing method is selected and capable of meeting the Client's requirements or data quality objectives (see section 5.4.2)

Any differences between the request and the contract are resolved before any work commences. Each contract must be acceptable by both the laboratory and the Client.

Details:
The request and contract review is conducted in a practical and efficient manner, and the effect of financial, legal, and time schedule aspects are taken into account.

The review of capability establishes that the laboratory possesses the necessary physical, personnel, and information resources, and that the laboratory's personnel have the skills and expertise necessary for the performance of the tests in question. The review may also encompass results of earlier participation in inter-laboratory comparisons or proficiency testing and/or the running of trial test using samples or items of known value in order to determine uncertainties of measurement, limits of detection, and confidence limits.

The contract review ensures that each Client's requirements are adequately defined and documented before the service or product is ordered or dispatched. This should ensure that any order, once accepted, can be completed without delay, and that the Client's requirements including delivery date, technical specification, and cost can be met.

If the contract review highlights any ambiguities or uncertainties then the Client will be contacted and the problem resolved before the order is accepted.

The SOP AMINCONTRACT043010 also describes the activities that take place should there be a subsequent amendment to a Client's order.
Typical types of contracts include:

- approved service quotations
- confidentiality agreements
- non-disclosure agreements
- sample submission requests
- memorandum of agreement
- memorandum of understanding
- research proposals and contracts
- verbal orders (oral agreements)
- activity plans

4.4.2 Records of Review

Policy:
Records of request and contract review, including significant changes, are maintained. Records of pertinent discussions with a Client relating to the Client's requirements or the work during the period of execution of the contract are also maintained.

Details:
For review of routine and other simple tasks, the date and the identification (e.g., initials) of the person in the laboratory responsible for carrying out the contracted work are considered adequate. For repetitive routine tasks, the review need be made only at the initial enquiry stage or on grant of the contract for on-going routine work performed under a general agreement with the Client, provided that the Client's requirements remain unchanged. For new, complex or advanced testing tasks, a more comprehensive record is maintained.

4.4.3 Review of Subcontracted Work

Policy:
Request and contract review also includes work that is subcontracted by the laboratory.

Details:
Subcontractor laboratories are reviewed as described in section 4.5.

4.4.4 Notification of Client

Policy and Details:
Clients are informed of deviations from the contract. This is typically communicated to the Client prior to the performing the deviation.

4.4.5 Contract Amendment

Policy and Details:
If a contract needs to be amended after the work has commenced, the same contract review process is repeated and any amendments are communicated to all affected personnel.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.5 Subcontracting of Analyses and Calibrations

4.5.1 Subcontractor Competence

Policy:

Work that must be subcontracted due to:

- unforeseen circumstances
- workload
- large contracts
- contracts requiring some extra technical expertise
- Tests not performed in-house

is subcontracted to a technically competent laboratory.

Details:

The subcontracted laboratory demonstrates technical competence by possession or receipt of one or more of the following:

- recognized technical accreditation- NYSDOH NELAC or other NELAC accreditation body
- registration under the ISO 9001 standard
- satisfactory performance of appropriate quality control check samples, certified reference material, in-house reference material or replicate analysis
- Review of the subcontractor’s quality management system by our QA Officer

It is the responsibility of the Quality Assurance Officer to assess and approve the competence level of subcontractor laboratories.

4.5.2 Client Approval

Policy:
Clients are advised of work (or any portion thereof) that is being subcontracted to another laboratory and their approval is obtained (preferably in writing). Upon log-in at the lab, a Subcontract Notification Form is generated by Sample Control and e-mailed immediately to the Client.

Details:
Clients are advised of subcontracted work through fee schedules or any type of contract listed in section 4.4.1.

4.5.3 Assurance of Subcontractor Competence

Policy:
The laboratory is responsible to the Client for the subcontractor's work. Technical competence of subcontractor laboratories is demonstrated through various records.

> **Note** – there may be circumstances where the Client specifies which subcontractor is to be used. In such cases we may not be able to demonstrate the competence of the subcontractor and therefore are not responsible for the results.

Details:
Records of subcontractor competence may include, but are not limited to, the following:
- accreditation certificates or documentation
- registration certificates
- check sample results
- audit results
- approval by the Quality Assurance Officer

4.5.4 Subcontractor Register

Policy:
A register of all subcontractors performing tests is maintained.

Details:
The approved register of subcontractors and all relevant records are maintained by the Quality Assurance Officer.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.6 Purchasing Services and Supplies

4.6.1 Policies and Procedures

Policy:
The SOP ADMINPURCHASESING043010 is used to select and purchase services and supplies. The SOP ADMINPURCHASESING043010 is used for procurement, reception, and storage of supplies.

Details:
Consumable materials are stored according to the appropriate test method, SOP, or work instruction.

4.6.2 Specifications

Policy:
Only services and supplies of the required quality are used. These quality requirements are detailed in laboratory SOPs under the "*Materials Required*" section and will identify the appropriate minimum specifications when necessary.

Details:
Packing slips are checked against package content labels and matched with the Purchase Order if accepted. Once accepted, the packing slip is dated and initialed as evidence of compliance. Certificates of analysis (COA) are maintained on file after the COA is checked to ensure the received item meets minimum specifications.

Chemicals are purchased with manufacturer's certificates where possible. Uncertified chemicals are purchased from ISO 9000 registered companies. Whatever the source, the laboratory verifies the quality of the standards by comparing the new batch of standards to the old. Due regard is paid to the manufacturer's recommendations on storage and shelf life.

Reagents are generally purchased from manufacturers who have a quality management system based on ISO 9000. The grade of any reagent used (including water) is stated in the method together with guidance on any particular precautions to be observed in its preparation or use.

Where no independent assurance of the quality of procured goods or services is available or the supplier's evidence is insufficient the laboratory ensures that purchased goods and services comply with specified requirements. Where possible and practical the laboratory ensures that goods are inspected, calibrated, or are otherwise in compliance with any standard specification relevant to the calibrations or tests concerned.

4.6.3 Purchasing Documents

Policy:
Purchasing requests are recorded on the Purchase Order form and contain data describing the product ordered. The Purchase Order is reviewed and approved for technical content prior to release.

Details:
The description may include type, class, grade, precise identification, specifications, drawings, inspection instructions, other technical data including approval of test results, quality required and quality management system standard under which they were produced.

The completion of the Purchase Order is the responsibility of the originator.

4.6.4 Approved Suppliers

Policy:
Suppliers of critical services are evaluated and approved before use. An approved supplier list is maintained.

Details:
Audits or tender evaluation is conducted to qualify suppliers of critical services prior to use. The criteria for evaluation may include, but is not limited to the following:

- references
- accreditation
- formal recognition

The records are maintained by purchasing personnel. SOPs detail the acceptable vendors for all materials.

Revision History

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4.7 Service to the Client

4.7.1 Service

Policy:
Client requests are clarified for the Clients or their representatives. Furthermore the Client or their representative will be afforded the right to monitor the performance of the laboratory in relation to the work performed, provided that the laboratory ensures confidentiality to other Clients.

Details and Procedures:
Service to the Client includes:

- Affording the Client or the Client's representative reasonable access to relevant areas of the laboratory for the witnessing of work performed for the Client; it is understood that such access should not conflict with rules of confidentiality of work for other Clients or with safety.

- Preparing, packaging, and dispatching of test data needed by the Client for verification purposes.

- Maintaining of open contacts. The Client values advice and guidance in technical matters, and opinions and interpretations based on results. Contact with the Client, especially in large assignments, should be maintained throughout the work by Client Services personnel. The laboratory should inform the Client of any delays or major deviations or issues encountered during the performance of the tests.

4.7.2 Feedback

Policy and Details:
The laboratory seeks feedback from the Client. Positive and negative feedback can be obtained passively through ongoing communications with the Client (e.g., review of test reports with Clients) or actively through Client satisfaction surveys. The feedback is used to improve the quality management system, testing activities, and Client service.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.8 Complaints

4.8.1 Policies and Procedures

Policy:
The SOP ADMINCOMPLAINTS 04302010 is used for resolving complaints received from Clients or other parties. Records are maintained of all complaints and follow-up.

Details:
Records of complaints include the following information:

- details of the complaint
- investigation
- corrective action
- follow-up verification

See also section 4.11.

All personnel are responsible for recording and responding to complaints.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.9 Control of Nonconforming Analyses

4.9.1 Procedures to Control Nonconforming Work

Policy:
The SOP ADMINNONCONFORM 04302010 is used to control any aspect of testing, or the results of this work, when they do not conform with the test methods, SOPs or the agreed to requirements of the Client.

Details:
The procedure ensures that:

- Responsibilities and authorities for the management of nonconforming work are designated and actions (including halting of work and withholding of test reports as necessary) are defined and taken into consideration when nonconforming work is identified
- an evaluation of the significance of the nonconforming work is made
- correction is taken immediately, together with any decision about the acceptability of the nonconforming work
- where necessary, the Client is notified and the work is recalled
- the responsibility for authorizing the resumption of work is defined

Identification of nonconforming work or problems with the quality management system or with testing activities can occur at various locations within the quality management system and technical operations such as:

- Client complaints
- quality control
- instrument calibration
- checking of consumable materials
- staff observations or supervision
- test report review
- management reviews
- internal or external audits

4.9.2 Root Cause Analysis

Policy:
Where evaluation indicates that nonconforming work could recur or that there is doubt about the compliance of the laboratory's operations with its own policies and procedures, the corrective action procedures given in 4.11 are followed to identify the root cause(s) of the problem and to eliminate cause(s).

Details:
The SOP ADMINCORRACTION043010 outlines the recording of the root cause analysis for investigating nonconforming work.

Situations warranting corrective action investigation include:
- failure to comply with test method including all applicable procedures necessary to ensure the integrity and representative nature of the sample
- presentation of uncertain knowledge as to compliance with test methods including all applicable procedures necessary to ensure the integrity and representative nature of the sample
- failure or suspected failure in method performance as demonstrated by results provided by quality control samples
- lack of relevant evidence provided by quality audit, proficiency testing, or Client feedback
- lack of relevant evidence provided by data validation
- neglect to check the inherent property of the sample that compromises the testing

Revision History

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4.10 Improvements

4.10.1 Policies and Procedures

Policy:
The laboratory continually improves the effectiveness of its management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective actions, and management review.

Details:
The laboratory has implemented a continual improvement philosophy within the management system. Every employee in the laboratory is encouraged to suggest new ideas for improving services, processes, systems, productivity, and the working environment.

Opportunities for improvement of operations and processes are identified by managers on a continual basis from ongoing feedback on operations and through management reviews. Opportunities for improvement of services are identified by anyone within the organization including Sales, Marketing and Client Services.

Inputs for improvement opportunities are obtained from the following sources:
- Client satisfaction surveys and any other Client feedback
- market research and analysis
- employees, suppliers, and other interested parties
- internal and external audits of the management system
- records of service nonconformities
- data from process and service characteristics and their trends

Opportunities for improvement may also be identified on a special project basis. The following are listed only as examples:
- improving usefulness of bench space
- reducing excessive inspection/analysis
- reducing excessive handling and storage
- reducing test/calibration failures

Opportunities for improvement from daily feedback on operational performance (i.e., internal audits, Client feedback, test/calibration failures) are evaluated by the Laboratory Director or Quality Assurance Officer. Typically, they are implemented through the corrective and preventive action system.

Opportunities for improvement from analysis of longer-term data and trends are evaluated and implemented through the management review process. They are prioritized with respect to their relevance for achieving quality objectives. When opportunities for improvement are no longer supported by the current policy and objectives, management will establish new quality objectives, and possibly change the policy. The process for this evaluation is described in Section 4.15. Longer-term improvement projects are initiated through the management review process, as well as the corrective and preventive action system.

Service improvement opportunities are evaluated by management. They are implemented through the supervisor of the laboratory who ensures that the improvements are validated as outlined in Section 5.4 of this manual and appropriate level of quality control is performed on an ongoing basis.

Revision History

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4.11 Corrective Action

4.11.1 General

Policy:
The SOP ADMINCORRACTION043010 is utilized for implementing corrective action when nonconforming work or departures from policies and procedures in the quality management system or technical operations have been identified. The procedure requires that appropriate authority be designated for the implementation of corrective actions. The procedure includes cause analysis, selection and implementation of corrective action, and monitoring of actions.

Details:
Problems with the quality management system or technical operations of the laboratory may be identified through a variety of activities, such as control of nonconforming work, internal or external audits, management reviews, feed-back from Clients, or staff observations.

Corrective action investigations are documented and required changes to operational procedures are implemented. The corrective action request (CAR), investigation and resolution are recorded on a CAR form.

4.11.2 Cause Analysis

Policy:
Corrective action always begins with an investigation to determine root cause(s) of the problem (see SOP ADMINCORRACTION043010).

Details:
Potential causes of the problem could include Client requirements, the samples, sample specifications, methods and procedures, personnel skills and training, consumable materials, or instrumentation and its calibration.

4.11.3 Selection and Implementation of Corrective Actions

Policy and Details:
After determining the cause(s) of the problem, potential corrective actions are identified. The most likely action(s) (this includes practical and/or reasonable) are selected and implemented to eliminate the problem and to prevent recurrence. It should be noted that any corrective actions taken to eliminate the cause(s) of nonconformities or other

departures are to a degree appropriate to address the magnitude of the problem and commensurate with the risks encountered (Note – in plain language, this means determine whether the benefit outweighs the cost). Controls are applied to prevent recurrence. The laboratory documents and implements the required changes resulting from corrective action investigations.

4.11.4 Monitoring of Corrective Action

Policy:
After implementing the corrective action(s), the laboratory monitors the results to ensure that the actions taken have been effective in overcoming the problems originally identified.

Details:
Monitoring is assigned to an appropriate individual such as the originator of the CAR or the originator's manager. Changes resulting from corrective action are documented.

4.11.5 Additional Audits

Policy:
Where the identification of nonconformities or departures casts doubts on compliance of policies, procedures, regulations, international quality standards, the appropriate areas of activity are promptly audited in accordance with section 4.14.

Details:
Special audits follow the implementation of corrective actions to confirm their effectiveness. A special audit is only necessary when a serious issue or risk to the business is identified. Special audits are carried out by trained and qualified personnel who are [whenever resources permit] independent of the activity to be audited. See section 4.14 for more details.

Revision History

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4.12 Preventive Action

4.12.1 Preventive Action Identification

Policy:
Opportunities for needed improvement and potential sources of nonconformities, either technical or with the quality management system shall be identified. If action is required, action plans are developed, implemented and monitored, to reduce the likelihood of occurrence of such nonconformities and to take advantage of the improvement opportunities.

Details:

Records of preventive action include the following information:

- details of potential nonconformities
- investigation
- preventive action
- follow-up verification

These records are maintained in the Preventive Action Request (PAR) form/binder.

4.12.2 Preventive Action Plans

Policy:
The preventive action procedure includes the initiation of such actions and application of controls to ensure that they are effective.

Details:
Preventive action may result from the review of operational procedures and analysis of data. Analysis of data includes trend analysis, analysis of proficiency testing results, and risk analysis.

The SOP ADMINPREVACTION043010 is utilized to implement opportunities for needed improvement and prevent potential sources of nonconformities.

Revision History

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4.13 Control of Records

The York Quality Assurance Program has been developed to provide analytical results of known quality. To demonstrate that quality has been achieved, York maintains a record management system that includes documents pertinent to the analytical performance of the laboratory. Laboratory records are maintained in two broad categories.

- Documents which are specific to a project or a group of samples within an ongoing project, such as chain-of-custody, and raw analytical data.
- Documents which demonstrate overall laboratory operation, such as instrument log books and control charts. These records will directly affect the data for a specific project, but in general their applicability is not limited to one project.

This procedure addresses identification, collection, indexing, access, file, store, maintain, protect, backup, and disposal of quality and technical records. To outline procedures for the protection and backup of data/records held on computers.

4.13.1 General

This procedure applies to all quality and technical records. Quality records include audit reports, management review, corrective action requests, and preventive action requests. Technical records include observations, calculations, derived data, calibration records, personnel records, and test reports.

4.13.1.1 Procedures

Policy:
The SOP ADMINRECORDS043010 is used to identify, collect, index, access, file, store, maintain, protect, backup, and dispose quality and technical records. Quality records include reports from internal audits and management reviews as well as corrective and preventive action records.

Details:
Records are available to demonstrate conformance to requirements and effective operation of the Quality Management System. Quality records from suppliers are also controlled.

All records, (electronic and hard copy) including test reports, are safely stored and held secure in locked areas, and in confidence to the Client. Records are maintained in the designated archival area for **five (5)** years.

4.13.1.2 PROJECT RECORDS

Separate files are maintained for each project. Filing of records for a specific project shall be by the unique project identification number assigned by the laboratory for that project. Within a project file, categories of information are filed separately. Upon completion of all projects (SDGs), the file contents are scanned to an unalterable image file (.pdf) and archived removable hard disk media. Such media are held for a period of 5 years. Paper copy is maintained for three months after data submission. Following is a brief discussion of each item that is maintained for each project file.

A - Correspondence

All correspondence pertinent to the analytical program shall be maintained. This includes letters to and from clients and internal memorandums. Correspondence should be filed chronologically.

B - Chain-of-Custody

Chain-of-custody records shall be maintained by the laboratory. The chain-of-custody forms should be filed for samples as received and should be placed in the project file immediately after they are signed by Sample Control personnel.

C - Request for Analysis

Analysis requests provided by the field personnel are maintained in this file. Also, any changes or additions to the analytical program should be documented in this file.

D - Calibration Records

In general, calibration records are maintained with laboratory operation records. However, if an analytical program requires a calibration which is performed solely for a project, the records shall be maintained in this file. If calibration is performed as an integral part of the analytical process, the calibration records should be maintained with the analytical data.

E - Analytical Data

Analytical data files should be complete for a group of samples. The file should contain raw analytical data, processing of the data and/or data reduction, and any data validation. It should be possible to use data files to completely demonstrate that the data have been adequately obtained, processed, and reviewed.

G - Quality Control Samples

If quality control samples, such as field blanks, are processed for a specific project, the data shall be maintained with the project file. The results of quality control samples processed on a general basis are included in the laboratory operations files. Statistical evaluation of quality control sample data for a project shall also be maintained in this file.

If quality control samples are processed as an integral part of a group of samples such that the data cannot be readily separated, the quality control sample data can be stored with the analytical data.

H - Data Reports

Complete copies of all reports issued by the laboratory are accessible on the Network and are not stored with the project files.

I - Project-Specific Requirements

If a project requires analytical procedures other than what is adopted in the York Quality Assurance Program, the requirements shall be included in this file. Specific requirements may be due to government regulations, specific contracts, or project need. Changes from stated practice can be, for example, frequency of QC sample analysis, test method, statistical data evaluation, and reporting format.

If it is necessary to adopt a new analytical procedure, a procedure different than conventionally used, or alter an existing procedure, the method used for the project must be documented. If the analytical procedure is developed by York as part of the analytical program, the procedure shall be documented and included. If an existing procedure is altered, the Analyst or Group Leader shall prepare a memorandum to the project file stating what the changes were and the justification for change.

J - Nonconformance

Nonconformances and subsequent corrective actions which are specific to a project are included in this file. The record should be in the form of a memorandum (or copy of other records discussed in this manual) with the nonconformance stated, how it was corrected, and the approval for the correction. A separate file for each incidence is not required, the file should be maintained chronologically.

K - QA Plan

If a specific Quality Assurance Project Plan, and revisions, are prepared for a project, they shall be stored in this file.

L - Miscellaneous

The miscellaneous file includes all records not applicable to the previous categories.

4.13.1.3 GENERAL LABORATORY OPERATIONS RECORDS

General laboratory records document overall laboratory performance and operations. These records are filed separately from project records and will be maintained so they can be referenced to project records if necessary. Examples of general records pertinent to project records are instrument log books and computer software verifications.

There are two types of general laboratory records:

- Documents which demonstrate laboratory performance
- Reference documents for laboratory operations

Records which demonstrate laboratory performance shall be filed in categories in a manner similar to project files. Reference documents are not indexed and their usage is not controlled.

Many of the laboratory operations records are in daily use, such as the Master Log Book, instrument calibration logs, and control charts. It is not intended that the records be stored daily while they are in use. However, when individual log books, etc. are filled, they shall be placed in the files.

Following is a brief discussion of the General Lab Operations records:

A - Sample Log Books

The Sample Log Books chronologically record all samples entering the laboratory, independent of project designation.

B - Instrument Calibration Logs

All calibration performed independent of a specific project shall be recorded by instrument. A separate file should be maintained for each instrument subject to calibration. These files are scanned and archived ot the network by instrument and date.

C - Instrument Maintenance Logs

Separate maintenance files should be kept for each instrument incorporated in the preventive maintenance program. The file shall include records of maintenance performed in-house or by outside groups.

D - Performance Evaluation Records

Laboratory participation in Performance Evaluation Programs shall be documented in this category. If performance standards are analyzed as part of the overall quality control sample program, the results should be included in Category G.

E - Certification Program (NY, CT, NJ , PA) Records

If the laboratory participates in certification programs, such as the NVLAP, ELAP, etc. program, the results shall be maintained in this category. Records should include all correspondence, analytical data, agency results, etc.

F - Control Charts

Control charts are generated and maintained on the Element LIMS.

G- Purchased Material Certificates

All information which verifies that purchased materials meet the requirements of the laboratory should be maintained. Certification may be supplied by a vendor or from in-house verification analysis. Separate files should be kept for chemicals, gases, water, glassware, etc.

4.13.1.4 RECORD CONTROL

The individual responsible for the records management system is part of the Data Management Group. This person shall:

- Initiate new project files including project index
- Add new records to existing files, initiate new files within a category, and update the index
- Assist laboratory personnel in withdrawing and returning records.

To maintain control of hard copy records within the laboratory, a Records Accession LOG is maintained. The LOG indicates:

- Project from which file is borrowed
- Date and person borrowing record

- Date returned to the record system

The dating format for records is MM/DD/YYYY.

4.13.2.1 Record Integrity

Policy:
All records are to be legible and shall be retained in such a way that they are readily retrievable in facilities that provide a suitable environment to prevent damage or deterioration and to prevent loss.

Details:
The retention time for records is set at **five** years.

Records may be in the form of any type of media, such as hard copy or electronic media.

4.13.2.2 Record Security

Policy:
All records are held secure and in confidence.

Details:
Access to records is secured through limited access areas and computer access via user defined privileges.

4.13.2.3 Record Backup

Policy:
The SOP ADMINRECORDS043010 is followed to protect and backup data/records held on computers at all times and to prevent unauthorized access to or amendment of data/records on computers.

Details:
Data is password protected.

Backups ensure integrity and availability of data / information in the event of a system / power failure.

4.13.3 Technical Records

4.13.3.1 Record Information

Policy:
Original observations, calculations, derived data and sufficient information to establish an audit trail, calibration records, personnel records and a copy of each test report issued are retained for five years.

The records for each test shall contain sufficient information to facilitate, if possible, identification of factors affecting the test uncertainty and to enable the test or calibration to be repeated under conditions as close as possible to the original. The records include the identity of personnel responsible for sampling, performing of each test and/or calibration and checking of results.

Details:
Technical records are accumulations of data (see 5.4.7) and information that result from carrying out tests and/or calibrations and which indicate whether specified quality or process parameters are achieved. They may include forms, contracts, work sheets, work books, note books, instrument printouts, magnetic media, check sheets, work notes, control graphs, test reports, calibration certificates, Client's notes, papers and feedback, and test reports to Clients.

The records for each test contain sufficient information to permit its repetition. Records include:

- date of sampling
- sample receipt
- sample handling, storage, and disposal
- identification of personnel
- analyst proficiency
- instrumentation identification and performance
- calibration records
- media performance, where appropriate
- test batch # or lot #, where appropriate
- results
- reports (mailed, e-mailed, faxed)
- review

Note – the above records may be stored in separate locations. They are cross-referenced for easy retrieval.

4.13.3.2 Recording

Policy:
Observations, data, and calculations are clearly and permanently recorded and identifiable to the specific job at the time they are made.

Details:

Handwritten records must be legible and made with indelible ink immediately after an observation, after data is collected and/or after calculations are made.

4.13.3.3 Corrections to Records

Policy:
Changes to test data are made so as not to obscure or delete the previous data entry.

Details:
Mistakes are crossed out and the correct value entered alongside. Mistakes are not erased, made illegible, or deleted. All alterations to records are signed or initialed by the person making the correction. In the case of computer-collected data, similar measures are taken to avoid loss or change of original data.

Revision History

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4.14 Internal Audits

4.14.1 Internal Audit Program

Policy:
The internal audit program involves periodic audits conducted according to a predetermined schedule for each year. This program is defined on an annual basis and conducted as outlined in this section with further details found in SOP ADMININTAUDIT043010. All elements of this Quality Manual will be audited each year and all relevant laboratory records are available to personnel conducting the audit. These audits are performed to verify operations continue to comply with the requirements of this Quality Manual and are effective.

Details:
The Quality Manual, test procedures, and laboratory results are verified for compliance. It is the responsibility of the Quality Assurance Officer to plan and organize audits as required by the schedule and requested by management. Audits are carried out by trained and qualified personnel who are independent of the activity to be audited. Personnel are not to audit their own activities except when it can be demonstrated that an effective audit will be carried out (see also 4.11.5). Audits are performed through the aid of a checklist prepared in advance to minimize the possibility of overlooking any details during the audit.

Generally, the types of audits include:
- quality management system
- processes and procedures
- services and reports

4.14.2 Corrective Action

Policy:
When audit findings cast doubt on the effectiveness of the operations or on the correctness or validity of test or calibration results, timely corrective action is taken and Clients are notified if investigations show that laboratory results may have been affected.

Details:
Nonconformities that can be resolved easily are to be corrected immediately, ideally during the audit. Records are made on the audit checklist. Nonconformities that require a more involved resolution are recorded on a CAR and resolved as described in section 4.11.

Corrective actions and Client modifications must be kept on record for each audit deviation that casts doubt as described in this section.

4.14.3 Records and Management

Policy:
Records are made of the activity being audited, the audit findings, and corrective actions that arise. Management ensures that corrective actions are discharged within an appropriate and agreed timeline.

Details:
A report is prepared by the auditors and distributed to those audited and/or the area manager/supervisor within an appropriate and agreed timeline. The audit report may include the following sections, as appropriate:

- audit objective and scope
- area or section audited
- personnel involved – auditors and auditees
- date of audit
- reference documents
- observations including nonconformities and commendations
- opening and closing meetings
- recommendations
- audit report distribution

The appropriate manager is responsible for ensuring that corrective actions are sufficiently recorded. Follow-up is performed by the auditor and recorded when corrective action is complete and deemed effective. The audit records are kept in the laboratory.

4.14.4 Follow-up Audits

Policy:
Follow-up audits are performed to verify and record the implementation and effectiveness of the corrective action taken.

Details:
The follow-up audit is performed at a mutually acceptable time between the area implementing corrective action and the auditor. This time is determined when the CAR is issued.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.15 Management Reviews

4.15.1 Review of Quality Management System and Testing

Policy:
Top management periodically (at least annually) and in accordance with a predetermined schedule and SOP ADMINMGMTREV043010, conduct a review of the laboratory's quality management system and testing activities to ensure their continuing suitability and effectiveness and to introduce any necessary changes or improvements.

Details:
The review takes account of:

- suitability of policies and procedures
- reports from managerial and supervisory personnel
- the outcome of recent internal audits
- corrective and preventive actions
- assessments by external bodies
- results of inter-laboratory comparisons or proficiency tests
- changes in the volume and type of work undertaken
- feedback from Clients, including complaints and Client satisfaction surveys
- recommendations for improvement
- other relevant factors, such as quality control activities, resources and personnel training

A minimum period for conducting a management review is once a year. Results of the review feed into the laboratory planning system and include goals, objectives and action plans for the coming year.

A management review can be supplemented by consideration of related subjects at regular management meetings.

4.15.2 Findings, Actions, and Records

Policy and Details:
Findings from management reviews and the actions that arise are recorded in the minutes of the meeting. Management will ensure that the actions are discharged within an appropriate and agreed upon timeline.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.16 Data Integrity Plan

4.16.1 Purpose

The purpose of the Data Integrity Plan is four-fold:

(a) to describe the laboratory's data integrity system,
(b) to emphasize the paramount importance of ethics in the performance of all analytical work,
(c) to obtain the commitment of laboratory staff to the principle that all analyses shall be performed in a controlled and documented manner, and
(d) to ensure that laboratory staff consistently meet the specific ethical requirements defined in this data integrity plan.

4.16.2 Scope

This procedure applies to all analyses and activities performed within the laboratory's scope of accreditation.

4.16.3 Responsibilities

Senior managers support and provide initial data integrity training and on-going annual training to laboratory managers and staff. Senior managers ensure that only staff who sign the ethics agreement are allowed to work in the laboratory.

The QAO shall maintain records of ethics/data integrity training and data integrity monitoring.

4.16.4 Procedure

Ethics Training

Ethics training is a required part of new employee orientation and is provided on an annual basis for all laboratory managers and staff by senior laboratory management. Initial training during orientation includes the overall organizational mission and its relationship to the absolute need for honesty and full disclosure in all analytical reporting and record-keeping. Resources where applicable ethics policy and law can be found are made available and copies are distributed. Examples are described that illustrate unethical behavior and ethical behavior related to laboratory data manipulation.

Laboratory standard operating procedures are reviewed with respect to proper procedure, data qualifiers, and adequacy of record keeping. Management will disclose that reports and the data generated to support them are subject to routine in-depth review.

The organizations response to infractions of the data integrity plan will be discussed and the trainee shall understand that infractions will be investigated in a detailed way. The consequences to an employee found to be in violation of the data integrity plan may result in immediate termination, debarment, and/or civil/criminal prosecution. Confidentiality is assured during this process.

Employee attendance or participation is documented.

Ethics Agreement

Following initial ethics training and on-going annual training for laboratory managers and staff, trainees shall sign a written ethics agreement. Senior managers who provide the training shall also sign the agreement. The agreement states that the signers will not engage in any unethical practices with respect to data integrity nor will they tolerate improper behavior in others if it is observed or suspected. By signing, senior managers acknowledge their duties in upholding the spirit and intent of the data integrity system and in effectively implementing the specific requirements of the plan.

Monitoring

Data integrity monitoring is accomplished by periodic data package and manual integration reviews by the QAO and/or Laboratory Director, annual internal audits, and monthly QC sample tracking. Therefore the QAO, shall have an in-depth understanding of typical inappropriate analytical behavior and be trained in the data integrity system. Refer to the laboratory’s SOP for data review.

Blind known reference samples may be submitted for analysis as real samples by the QAO, (blind to the analyst) as part of any project or event Data and results of the reference sample are reviewed by the QAO to verify that all data integrity requirements are met.

Documentation

All data integrity incidents must be documented, including investigative findings and disciplinary actions. Corrective actions are recorded. Confidentiality is critical and maintained by use of locked filing cabinets and password protected electronic files. If client disclosure is determined to be necessary by senior laboratory management, then such disclosures and outcomes are recorded.

All data integrity documents, plans, SOPs, personal records and records of investigations shall be maintained for a period of five years. Documents are subject to the document control system and records are subject to the records management system as described in the laboratory's quality manual and related SOPs.

4.16.5 References

Internal
York Data Integrity and Ethics Training SOP (ADMIN Ethics 040102)
York Internal Quality Audit SOP (ADMIN Audit 043010)
York Manual Integration Review SOP (ADMIN ManIntReview 043010)

External
NELAC Quality Systems, Chapter 5, Sections *5.4.2.3, 5.4.2.6, and 5.4.15*, June 5, 2003 and Module 2, *Sections 4.2.8.4, 4.2.8.1, 5.2.7, and 4.16*, August 24, 2009.

Revision History

Revision No.	Date	Responsible Person	Description of Change
1	12/26/12		Initial Release

4.16.6 Annual Review (The review is to be documented if the Quality Manual has not been revised in the past 12 months)

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Signature Title Date

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5.0 Technical Requirements

5.1 General

5.1.1 Correctness and Reliability

Policy and Details:
Correctness and reliability of the tests and/or calibrations performed have many contributing factors including:

- human factors (see section 5.2)
- accommodation and environmental conditions (see section 5.3)
- test and calibration methods and method validation (see section 5.4)
- instrumentation (see section 5.5)
- measurement traceability (see section 5.6)
- sampling (see section 5.7)
- handling of test and calibration items (see section 5.8)

5.1.2 Measurement Uncertainty

Policy:
When developing test and calibration methods and procedures, total measurement uncertainty must be accounted for in the training and qualification of personnel, and in the selection and calibration of instrumentation.

Details:
The extent to which the factors contribute to total measurement uncertainty differs between (types of) tests and between (types of) calibrations.

See section 5.4.6 for more details.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.2 Personnel

York recognizes that all laboratory personnel affect data quality. This manual has been prepared so that staff members will be cognizant of the procedures adopted by York for the production of analytical data, and so they will be aware of their responsibilities.

Staff are properly trained and qualified for their positions and specific procedures.

5.2.1 Competence and Qualification

Policy:
Management ensures the competency of all personnel charged with analysis and those evaluating results and signing test reports. Appropriate supervision is provided for employees undergoing training. Personnel performing specific tasks are qualified on the basis of appropriate education, training, experience and/or demonstrated skills, as required.

In addition, personnel responsible for the opinions and interpretations included in test reports also have:

- relevant knowledge of the technology used for the analysis, materials
- knowledge of the general requirements expressed in the legislation and standards
- an understanding of the significance of deviations found with regard to the normal use of the data

Details:
Management defines the minimum levels of qualification and experience necessary for all posts within the laboratory. In some technical areas it may be required that the personnel performing certain tasks be certified. The laboratory is responsible for fulfilling specified certification requirements of personnel. The requirements for personnel certification might be regulatory, might be included in the standards for the specific technical field, or required by the client.

Continued competence is monitored and where this is not achieved, the need to retrain personnel is considered. Where a method or technique is not in regular use, verification of personnel performance prior to testing may be necessary.

5.2.2 Training Policies and Procedures

Policy:
Management will formulate the goals with respect to the education and the skills of the laboratory personnel. The training program is relevant to the present and anticipated tasks

of the laboratory. SOP# QSP 5-2-1 is utilized to identify training needs and providing the necessary training for personnel. The effectiveness of the training actions taken is evaluated.

Details:
The skills and knowledge are defined in the job description for each job function as described in section 5.2.4. Management compares the job description to the skills and knowledge of the new incumbent to determine the training needs.

Training in the laboratory must include all methods or parts of methods and techniques that personnel are asked to perform. Minimally, the analyst must demonstrate competency (Initial Demonstration of Capability) through observation by management and verification using replicate and/or check samples. For technicians who perform only parts of the method, confirmation of competency may be verified by observation only. Re-verification of all personnel must be performed annually on all methods or techniques pertinent to their job description.

In some cases it may be appropriate to define competence related to a particular technique or instrument rather then methods. If so, it will be necessary to define for each method, the necessary technique-based competence required together with any additional requirements.

5.2.3 Employees

Policy:
Competent permanent or part-time employees are employed in the laboratory. No contract labor is used. The Managing Director ensures that all technical employees, and key support personnel are supervised and work in accordance to the policies and procedures of this Quality Manual.

Details:
Testing must be either performed or supervised by an experienced person qualified to degree level. Personnel have relevant practical work experience and training before being allowed to perform accredited work.

5.2.4 Job Descriptions

Policy:
Current job descriptions for managerial, technical and key support personnel involved in laboratory analyses are maintained centrally on the Network with appropriate access.

Details:
Minimum contents of job descriptions include:

- the duty of performing preparation/analysis
- the act of planning analyses and evaluation of results
- the responsibility of developing and validating new methods as / when requested
- expertise and experience
- qualifications and training programs
- managerial duties if applicable

Job descriptions are dated and signed to demonstrate that each incumbent has read it and is in agreement. They are maintained current on the Network.

5.2.5 Authorized Personnel

Policy:
Management authorizes specific personnel to perform particular types of analysis, to issue test reports, to give opinions and interpretations and to operate particular types of instrumentation. Records of the relevant competence, educational and professional qualifications, training, skills and experience of all technical personnel and contracted personnel are maintained. This information is readily available and includes the date on which authorization and/or competence was confirmed and the criteria on which the authorization is based and the confirming authority.

Details:
The purpose of these records is to provide evidence that personnel have been adequately trained and their competence to perform particular tests has been assessed. In some cases it may be pertinent to state any particular limitations to competence. The records are maintained in a registry of skills and include:

- academic and professional qualifications
- external and internal courses attended
- relevant on-the-job training and retraining as necessary (i.e., demonstration of capability)
- skills and experience (i.e., resume-maintained in employee administration file)
- relevant authorizations

Records are held centrally in the Employee Training Records Log.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.3 Accommodation and Environmental Conditions

5.3.1 Facility

Policy:
Laboratory facilities are appropriate to attain correct performance of all analyses. This may include, but not limited to, energy sources, lighting, heating, ventilation and any other environmental conditions.

Appropriate care is taken to ensure that the environment does not invalidate the results or adversely affect the required quality of any measurement. The technical requirements for accommodation and environmental conditions that can affect the results of tests and calibrations are documented.

Details:
This section deals with the test areas in the laboratory and premises for support such as sample receipt and storage. Central laboratory supplies and services, such as water purification systems, air supply, vacuum source, and sample storage, are appropriate to facilitate proper performance of analyses.

5.3.2 Monitoring

Policy:
Critical environmental conditions are monitored, controlled and recorded as required by the relevant specifications, methods, and procedures or where they may influence the quality of the results. Due attention is paid, for example, to the potential for cross contamination by methylene chloride, acetone and hexanes which are used in the Extractions processes, as appropriate to the technical activities concerned. Analyses are stopped when the environmental conditions jeopardize the results. O

Details:
Laboratories are ventilated to reduce the levels of contamination, lower humidity, and control temperature. Laboratories' test areas are air-conditioned. The relative humidity in test areas is 45-50 and the temperature is 20-25 °C. Volatiles analyses are conducted in a separate laboratory where the air conditioning system produces a positive pressure in the laboratory and the air intake (economizer) is disabled. In addition, samples for volatiles are stored in a separate Sample Control room in their own refrigerators to minimize potential for cross contamination.

Bench tops and floors are made of impervious, smooth easily cleaned materials. There is at least two linear meters workspace per analyst while working. Walls and ceilings are made of materials that are smooth and easily cleaned.

5.3.3 Separation of Incompatible Activities

Policy:
Effective separation between neighboring areas is made when the activities are incompatible. Measures are taken to prevent cross-contamination.

Details:
Reference materials and certified reference materials must be kept separated from samples (log-in and storage). Sample log-in and storage must are segregated, in separate areas from the testing laboratory, and include proper sanitation to exclude the possibility of cross-contamination. Segregation of activities is achieved through time and space allocations.

An example of space segregation would be for a trace volatiles analysis. Physical separation of the trace volatiles analysis from Extractions using solvents is achieved through the use of separate rooms.

An example of time segregation would be the coordination of activities at different times. It may be appropriate to perform work on “cleaner” samples first before starting “dirtier” type samples.

5.3.4 Controlled Access

Policy:
Access to and use of areas affecting quality of the analyses is defined and controlled.

Details:
Access to the laboratory is restricted to authorized personnel. The authorized personnel are made aware of the following items:

- the intended use of the area
- the restrictions imposed on working within such areas
- the reasons for imposing the restrictions

5.3.5 Good Housekeeping

Policy:
Measures are taken to ensure good housekeeping in the laboratory. Special procedures are prepared when necessary.

Details:
Controlled use of cleaning and pest control materials is exercised. The laboratory complies with the local health and safety requirements.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual

5.4 Tests and Calibration Methods and Method Validation

5.4.1 General

Policy:
Methods and procedures used for all analyses are appropriate as per:
- courier handling, transport, storage, and preparation of items to be tested
- an estimation of the measurement of uncertainty as well as statistical techniques for analysis of test data where appropriate

Instructions on the use and operation of all relevant instrumentation and on the handling and preparation of items for testing are available. All instructions, standards, manuals and reference data relevant to the work of the laboratory are maintained current and readily available to personnel. Deviation from SOP and test methods must be documented, technically justified, authorized, and accepted by the client.

Details:
There are SOPs for sample handling, transport, storage, preparation, QA/QC procedures, and standards for approving / rejecting results. These may be combined with or separate from the method. The content of a test method or SOP generally includes:
- scope
- description of test items
- holding times
- quantities to be tested
- materials and instrumentation required
- physical environmental conditions required (temperatures, pH requirements)
- description of procedures
- sample identification
- method of recording observations and results
- safety measures
- waste management/pollution prevention
- documentation
- method for data analysis and presentation
- sensitivity of method
- quality control plan

National or state standards or other recognized specifications that contain sufficient and concise information on how to perform the analyses are not necessarily supplemented or rewritten as an internal procedure when they are written in a way that can be used as published by laboratory staff. Consideration may need to be given to providing additional documentation for optional steps in the method.

5.4.2 Selection of Methods

Policy:
Preparation and analysis methods meet the needs of the client and are appropriate for the analysis undertaken. Preference is given to reference methods published as international, Federal, or State standards. The laboratory ensures that the latest edition of a standard is used unless it is not appropriate or possible to do so. When necessary, the standard is supplemented with additional details to ensure consistent application.

Details:
Methods that have been published either in international, Federal, or State standards, or by reputable technical organizations, or in relevant scientific texts or journals, or as specified by the manufacturer are selected when the client does not specify the method to be used. These methods may be adopted from the Environmental Protection Agency, ASTM, Standard Methods for the Examination of Water and Wastewater, Various State agencies, etc.

The ability of the laboratory to achieve satisfactory performance against documented performance characteristics is verified before samples are analyzed.

Laboratory-developed methods or methods adopted by the laboratory may also be used if they are appropriate for the intended use and if they are validated. The client is informed as to the method chosen. The laboratory confirms that it can properly operate standardized methods before introducing the samples for analysis.

The client is informed when the method proposed by the client is considered to be inappropriate or out of date.

5.4.3 Laboratory-Developed Methods

Policy:
Introduction of test methods developed internally is a planned activity and is assigned to qualified personnel equipped with adequate resources. Plans are updated as development proceeds and ensure effective communication among all personnel involved.

Details:
Methods developed in-house are validated and authorized before use. Where available, Certified Reference Materials (CRMs) are used to determine any systemic bias, or where possible results are compared with other techniques, preferably based on different principles of analysis. Determination of uncertainty must be part of this validation process and is essential for ongoing quality control.

5.4.4 Non-Standard Methods

Policy:
Utilization of non-standard methods is subject to agreement with the client and includes a clear specification of the client’s requirements and the purpose of the test. The developed method is validated appropriately before use.

Details:
Discussion and agreement for the use of non-standard methods is recorded as part of contract review procedures (see section 4.4).

All non-standard and new tests are validated for their intended purpose. Qualitative test methods must be validated to demonstrate estimated sensitivity and specificity, relative accuracy to official methods (if appropriate), positive and negative deviation, limit of detection, matrix effect, repeatability, and reproducibility.

Quantitative test methods are validated to demonstrate specificity, sensitivity, relative accuracy, positive and negative deviation, repeatability, reproducibility, and limit of determination.

For new methods where procedures are developing rapidly, especially for emergency situations, it may be necessary to circumvent normal validation procedures. Minimally, this must be a demonstrated recovery in replicate.

New test and/or calibration methods are documented prior to providing test and/or calibration results to clients and contain at least the following information:

- appropriate identification
- scope
- description of the type of item to be tested or calibrated
- parameters or quantities to be determined
- apparatus and instrumentation, including technical performance requirements
- reference standards and reference materials required
- environmental conditions required and any stabilization period needed
- description of the procedure, including:
  - affixing identification marks, handling, transporting, storing and preparing of items
  - ensuring checks are made before the work is started
  - checking that the instrumentation is working properly and, where required, calibrating and adjusting the instrumentation before each use
  - listing method of recording the observations and results
  - indicating any safety measures to be observed
- criteria and/or requirements for approval/rejection (quality control plan)

- data to be recorded and method of analysis and presentation
- uncertainty or procedure for estimating uncertainty

5.4.5 Validation of Methods

5.4.5.1 Performance Characteristics

Policy:
Validation of a method establishes, by systematic laboratory studies, that the performance characteristics of the method meet the specifications related to the intended use of the test results.

Details:
The performance characteristics of a validation plan includes, as applicable:

- selectivity and specificity
- range
- linearity
- sensitivity
- limit of detection
- limit of quantitation
- ruggedness
- accuracy
- precision
- reporting limit
- repeatability
- reproducibility
- recovery
- confirmation techniques
- criteria for the number of samples tested to validate method as per defined scope of method
- action levels where defined by regulation
- quality control incorporating statistics as applicable
- interpretation of population results as applicable

Performance characteristics that are selected take into account the intended use of the method, whether for screening, confirmatory analysis, or quantitation.

The design, verification of the method and documentation procedures for validation are planned and conducted by qualified personnel, equipped with adequate resources.

This section lists a few acceptable validation procedures. The choice of the procedure depends on the extent of the deviation from the published method.

Validation of methodology is a value judgment in which the performance parameters of the method are compared with the requirements for the test data. A prerequisite for a valid method is that data produced by the method must attain a state of statistical control. Such a state is obtained when the mean value of a large number of individual values tends to approach a limiting value called the limiting mean.

Methods may be validated by one or more alternative procedures. Some of these procedures are described below. Apparent differences can be analyzed statistically to confirm their significance. In all cases, the reasons for choosing one or more alternatives must be documented.

- analysis of standard reference materials (SRM) that are identical or almost identical to the test samples
- in the absence of suitable SRMs, analysis of reference materials that are similar in all respect to the test samples; the use and validity of this reference material must be documented
- using an alternative method to measure the same parameter provides a very high level of confidence if results are confirmed
- recovery studies by the addition of a known concentration of the parameter of interest to some of the replicates being measured

The parameters to be determined include:

- the scope of the method and any known interference
- detection limit
- the range of concentration where the method is valid
- precision and bias
- intra-laboratory variations
- inter-laboratory variations

Judgment is required to determine if some or all of the above is required. Requirements will depend largely on the extent of deviation from the original method.

Developments in methodology and techniques require methods to be changed from time to time. The difference in performance between revised and obsolete methods is established so that it is possible to compare old and new data.

Where a change in method involves only minor adjustments, such as sample size, or different reagents, the amended method is validated and the changes brought to the attention of the accreditation body at the next accreditation audit. Where the proposed change involves technology or methodology, the laboratory seeks the approval of the accreditation body.

Records are kept on all validation activities. The records include any of the performance characteristics chosen, reference procedures or guidance documents followed to validate the method or custom validation procedure, and a final confirmation (memo to file) that the method validation results are acceptable for continued use of the method. An example statement would be “This memo serves as record that the validation of the XYZ Test Method has been approved for use by [name and title of approver]”.

5.4.5.2 Fit for Use

Policy:
The laboratory validates non-standardized methods, laboratory-designed/developed methods, standardized methods used outside their intended range, and amplifications of standard methods to confirm that the methods are fit for the intended use. The validation is as extensive as is necessary to meet the needs in the given application or field of application (may include procedures for sampling, handling, and transportation). The laboratory records the results obtained, the procedure used for the validation, and a statement as to whether the method is fit for the intended use.

Details and Procedure:
Validation records are kept as in section 5.4.5.1. Included in these records is the validation procedure. The procedure used for the validation is likely to vary between different methods. Therefore, the procedures included in the laboratory records are not as detailed as a typical SOP, but are sufficient enough to re-create how the method was validated.

The techniques used for the determination of the performance of a method, are one of, or a combination of, the following:

- calibration using reference standards or reference materials
- comparison of results achieved with other methods
- inter-laboratory comparisons
- systematic assessment of the factors influencing the result
- assessment of the uncertainty of the results based on scientific understanding of the theoretical principles of the method and practical experience

When changes are made in the validated non-standard method, the influence of such changes carried out is documented and if appropriate a new validation is performed.

5.4.5.3 Client's Needs

Policy:
The range and accuracy of the values obtainable from validated methods (e.g., the uncertainty of the results, detection limit, selectivity of the method, linearity, limit of repeatability and/or reproducibility, robustness against external influences and/or cross-sensitivity against interference from the matrix of the sample/test object) as assessed for the intended use is relevant to the client's needs.

Details:
Validation includes the specification of the requirements, determination of the characteristics of the methods, the comparison of the requirements with the values of the characteristics of the method, and a statement on the validity.

As method development proceeds, regular review is required to verify that the needs of the client are still being fulfilled. Changing requirements requiring modifications to the development plan are approved and authorized.

Validation is always a balance between costs, risks, and technical possibilities.

5.4.6 Uncertainty of Measurement

5.4.6.1 Calibration

Policy:
Physical and chemical standards and instrumentation are calibrated or characterized internally and by subcontractors where appropriate.

Details and Procedures:
Repeatability and reproducibility data are components of measurement uncertainty and are determined as a first step towards producing estimates of this parameter. The uncertainty of measurement is available on the certificate of analysis or calibration certificate from a subcontractor.
Note – in-house calibrations include procedures for uncertainty of measurement estimates where this is common practice.

5.4.6.1.1 CALIBRATION PRACTICES

Instruments and instrumentation used at York are controlled by a formal calibration program. The program verifies that instrumentation is of the proper type, range, accuracy, and precision to provide data compatible with specified requirements. All instruments and instrumentation which measure a quantity, or whose performance is expected at a stated level, are subject to calibration. Calibration may be performed by York personnel using reference standards, or externally by calibration agencies or instrumentation manufacturers.

This section of the Quality Manual prescribes the practices used by York to implement a calibration program. Specifics are not provided herein because the requirements for the calibration of instruments and instrumentation are dependent upon the type and expected performance of individual instruments and instrumentation. Such details are provided in the specific SOPs. Implementation is the responsibility of the Group Leaders and Analysts. The Quality Assurance Officer shall review the implementation of the program as discussed in previously.

Two types of calibration are discussed in this section:

- Operational calibration which is routinely performed as part of instrument usage, such as the development of initial calibration curves for GC, GC/MS, etc. Operational calibration is generally performed for instrument systems.

- Periodic calibration which is performed at prescribed intervals for instrumentation, such as balances.

5.4.6.1.2 CALIBRATION SYSTEM

The following is a discussion of the elements comprising the calibration system.

5.4.6.1.3 Calibration Procedures

Written procedures are developed by York within the requirements of this manual for all instruments and instrumentation subject to calibration. Whenever possible, recognized procedures, such as those published by ASTM or the USEPA, or procedures provided by manufacturers are adopted. If established procedures are not available, a procedure shall be developed considering the type of instrumentation, stability characteristics of the instrumentation, required accuracy, and the effect of operational error on the quantities measured. As a minimum, the procedures shall include:

- Instrumentation to be calibrated

- Reference standards used for calibration

- Calibration technique and sequential actions
- Acceptable performance ranges
- Frequency of calibration
- Calibration documentation format

5.4.6.1.4 Instrumentation Identification

Instrumentation that is subject to calibration shall be uniquely identified so that calibration records can be designated with a specific instrument. Instrumentation identification can be by manufacturer's serial number, York inventory control number, or a unique number assigned by York.

5.4.6.1.5 Calibration Frequency

Instruments and instrumentation shall be calibrated at prescribed intervals and/or as part of the operational use of the instrumentation. Frequency shall be based on the type of instrumentation, inherent stability, manufacturer's recommendations, values provided in recognized standards, intended use, effect of error upon the measurement process, and prior experience.

5.4.6.1.6 Calibration Reference Standards

Two types of reference standards are used within the York laboratory for calibration:

- Physical standards, such as weights for calibrating balances and certified thermometers for calibrating working thermometers and ovens, which are generally used for periodic calibration.
- Chemical standards such as Standard Reference Materials (SRMs) provided by the National Bureau of Standards NIST or NIST-traceable standards which are primarily used for operational calibration.

Whenever possible, physical reference standards shall have known relationships to nationally recognized standards (e.g., NIST) or accepted values of natural physical constants. If national standards do not exist, the basis for the reference standards shall be documented.

Whenever possible, chemical references standards shall be directly traceable to NIST SRMs and/or EPA. If SRMs are not available, compounds of certified high purity will be used to prepare calibration standards.

5.4.6.1.7 Calibration Failure

Instrumentation that fails calibration or becomes inoperable during use shall be removed from service and segregated to prevent inadvertent use, or shall be tagged to indicate it is out of calibration. Such instrumentation shall be repaired and satisfactorily recalibrated before reuse

Scheduled calibration of instrumentation does not relieve the laboratory staff of the responsibility for using properly functioning instrumentation. If an instrumentation malfunction is suspected, the instrumentation shall be tagged and removed from service and recalibrated. If it fails recalibration, the above process shall apply.

5.4.6.1.8 Calibration Records

Records shall be prepared and maintained for each piece of instrumentation subject to calibration. Records demonstrating accuracy of reference standards shall also be maintained.

Records for periodically calibrated instrumentation shall include, as appropriate:

- Identification number of instrumentation and type of instrumentation.
- Calibration frequency and acceptable tolerances.
- Identification of calibration procedure used.
- Date calibration was performed.
- Identity of York personnel and/or external agencies performing the calibration.
- Reference standards used for calibration.
- Calibration date.
- Certificates or statements of calibration provided by manufacturers and external agencies, and traceability to national standards.
- Information regarding calibration acceptance or failure and any repair of failed instrumentation.

Records for periodically calibrated instrumentation shall be maintained in the Laboratory Operation Records. Records for each instrument/instrumentation and physical reference standard shall be kept in a separate folder. The title sheet for each file shall be a summary of calibrations performed. It is recommended that an index precede the instrumentation files which lists in matrix form all instrumentation and physical standards, calibration frequency, and dates for upcoming calibration. The use of a calibration due date matrix provides ready reference so that calibration can be maintained by the Group Leaders.

For instruments and instrumentation that are calibrated on an operational basis, calibration generally consists of determining instrumental response against compounds of known composition and concentration or the preparation of a standard response curve (either linear or average response factor) of the same compound at different concentrations. Records of these calibrations are be maintained in several ways:

- ➢ The calibration data for all GC, GC/MS, ICP/ICPMS, Ion Chromatography is kept in a uniquely numbered QUALITY BATCH (QB) file. These files include all initial calibrations and continuing calibrations, as well as method blanks, spikes, duplicates and control (LCS) data. The nomenclature for these files follows this example:
    - For a volatiles run on April 1, 2010 on Volatiles GC/MS # 1, the batch QA/QC data is placed in a QB file identified as QBV1040110A. The A represents the first batch of the day. If two batches are run, a B is affixed, etc.
    - This unique QB number appears on all sample headers to allow for cross referencing all QA data for a particular batch to each sample.
- ➢ A log book for each parameter documents all calibration and QA data for each wet chemistry, gravimetric or spectrophotometric analysis.

For operational calibration, the following is recommended:

As above, calibration data must be included in a batch file system. If samples from different projects are processed together, calibration data is included in a batch folder.

- The specific SOPs detail:

- Calibration instructions (curve preparation, linear ranges, etc.).

- Procedures for chemical standards preparations.

5.4.6.1.9 OPERATIONAL CALIBRATION

Operational calibration is generally performed as part of the analytical procedure. Included may be the analysis of a method blank and the preparation of continuing calibration verification standard or curve. Operational calibration is dependent upon the instrumentation within York, and as previously discussed, the laboratory uses a specific SOP for this purpose.

Following is a brief discussion of the analysis of method blanks and preparation of calibration curves. Guidelines for the major instrument systems within the York laboratory follow:

5.4.6.1.10 General Calibration Procedures

The initial phase of a laboratory testing program requires the selection and certification of the method best suited for an individual parameter. Certification, or verification, is the elimination, or minimizing, of determinate errors which may be due to Analyst's error, the use of less-than-optimum instrumentation, reagents, solvents, or gases. The quality of materials, even though they are AR grade or better, may vary from one source to another. The Analyst must determine, through the use of reagent and/or solvent blanks, if materials are free from interfering substances which could affect the analysis. Other steps in certifying the method include the determination of a method blank and the preparation of a standard calibration curve.

5.4.6.1.11 Method Blank

After determining the individual reagent or solvent blanks, the Analyst defines the method blank to determine if the cumulative blank interferes with the analysis. The method blank is defined by following the procedures step by step, including the addition of all of the reagents and solvents, in the quantity required by the method. If the cumulative blank interferes with the determination, steps must be taken to eliminate or reduce the interference to a level that will permit the combination of solvents and reagents to be used. If the blank interference cannot be eliminated, the magnitude of the interference must be considered when calculating the concentration of specific constituents in the samples analyzed.

A method blank must be determined whenever an analysis is made. The number of blanks is determined by the method of analysis and the number of samples analyzed at a given time, but is typically one per 20 samples or one per batch whichever is less.

5.4.6.1.12 Preparation of Standard Calibration Curve

Concurrent with the preparation of reagent and method blanks, a standard calibration curve is accomplished by using calibration standards. The process is summarized as:

- Preparation of a standard calibration curve is accomplished by using five calibration standards prepared by mixing the species to be analyzed into the "solvent" that is to be introduced into the instrument.

- The concentration of the calibration standards are chosen to cover the working range of the instrument.

- All sample measurements are made within this working range.

- The calibration curve is prepared by plotting instrument response versus concentration of the species analyzed. Acceptable linearity or RSDs are defined in the analysis specific SOPs.

- Concentrations of the sample prepared with the same procedure are read directly from the calibration curve or average response factor as detailed in the SOPs.

5.4.6.1.13 GC/MS CALIBRATION PROCEDURES

This section outlines the minimum operations necessary to satisfy analytical requirements associated with the determination of various target lists of organics compounds in air, water and soil/sediment samples. The following operations must be performed routinely (as specified in the SOPs) in the laboratory:

- Documentation of GC/MS mass calibration and abundance pattern.

- Documentation of GC/MS response factor stability.

- Internal standard response and retention time monitoring.

6.2.2.1 Tuning and GC/MS Mass Calibration

Prior to initiating data collection, it is necessary to establish that a given GC/MS meets the standard mass spectral abundance criteria. This is accomplished through the analysis of decafluorotriphenylphosphine (DFTPP) for base/neutral and acid

(BNA) compounds or p-bromofluorobenzene (BFB) for volatile compounds. The ion abundance criteria as listed in the methods or SOPs for each calibration compound should be met before samples, blanks, or standards can be analyzed.

DFTPP (decafluorotriphenylphosphine)

Each GC/MS system used for the analysis of semivolatile compounds must be tuned to meet the abundance criteria of the method for a 50 nanogram (ng) injection of DFTPP. DFTPP may be analyzed separately or as part of the calibration standard, and the criteria must be demonstrated each (12) hours of use. Documentation of the calibration must be provided in the form of a bar graph plot and as a mass listing.

BFB (p-bromofluorobenzene)

Each GC/MS system used for the analysis of volatile compounds must be tuned to meet the proper abundance criteria for a 50 ng injection of BFB. The criteria should be demonstrated each (12) hours of use. Documentation of the calibration should be provided in the form of a bar graph plot and as a mass listing.

Analysts obtain a system generated GC/MS Tuning and Mass Calibration each time an analytical system is tuned.

5.4.6.1.14 Calibration of the GC/MS System

Prior to the analysis of samples and after tuning criteria have been met, the GC/MS system must be initially calibrated at a minimum of five concentrations to determine the linearity of response utilizing standards. For GC/MS analysis, typical linear ranges are 0.05(SIM) to 200 ng for base neutrals, 5 to 400 ng for certain phenols, and 0.1 to 1,000 ng for volatiles.

Calibration standards are prepared to cover the linear range and are detailed in the SOPs.

Semivolatiles (B/N/A)

Initial calibration of semivolatile compounds is recommended at 5 to 140 ng for SCAN analysis with SIM covering the range 0.05 to 2 ng.

Pesticides & PCB

Pesticides by GC/ECD are calibrated at five levels from 0.001 ng to 0.2 ng.

PCB's by GC/ECD are calibrated at five levels from 1 ng to 10 ng.

In all cases reference is made to the specific SOP for preparation directions.

Continuing Calibration (GC/MS and GC)

A continuing calibration standard containing all volatile or semivolatile compounds as well as all required internal standards and surrogates, is performed each 12 hours during analysis. This applies to all matrices except air, whose requirements are detailed in EPA methods TO14A/15. Compare the RF data from the standards each 12 hours with the average RF from the initial calibration for a specific instrument. A system performance check must also be made each 12 hours. If the SPCC criteria are met, a comparison of RFs is made for all compounds. This is the same check that is applied during the initial calibration. If the minimum response factors are not met, the system should be evaluated and corrective action should be taken before sample analysis begins. See the specific SOP for criteria.

5.4.6.1.15 Calibration of the Gas Chromatograph

Calibration of the gas chromatograph (GC) for pesticide and polychlorinated biphenyl (PCB) or other organic compound analyses is performed with the standardization of the instrument. A five-point standard curve is utilized.

Response factors are to be calculated for each compound at each concentration level. These RF will be averaged to generate the mean daily RF for each compound over the range of the standard curve. The mean response factor will be used to calculate the sample concentration of the compound of interest. When sample responses exceed the range of the standard curve, the sample will be diluted to fall within range of the standard curve and be reanalyzed. The results of the daily GC standardization will be tabulated and filed with the corresponding sample analyses or batch file.

5.4.6.1.16 Calibration of Inductively Coupled Plasma Spectrometer (ICP) and Inductively Coupled Argon Plasma/Mass Spectrometer (ICP/MS) and Cold Vapor AAS

The ICP and ICP/MS are standardized for the metal of interest by the analysis of a set of calibration standards prepared by diluting a stock solution of known concentration. A single standard is used to calibrate the ICP, three standards are used for ICP/MS, while five working standards of mercury (Cold Vapor AAS) are prepared by dilution of the stock standard. The concentration of the calibration standards is chosen so as to cover the working range of the instrument. Subsequently all sample measurements are made within this working range. Once the working standards are prepared, they are analyzed on the ICP or AAS and the instrument response is calibrated to provide a direct readout in micrograms of metal per milliliter of water or parts per million.

Once the instrument has been initially calibrated, the analysis of initial calibration verification (ICV) is performed. Continuing calibration verification (CCV) standards are repeated after every ten samples during sample analysis to verify instrument response during analysis and to confirm the calibration. A typical analysis sequence is presented below:

- Working standards are prepared by dilution of a stock standard solution of the metal of interest.

- A calibration curve within the working range of the instrument is established by analysis of five working standards (one for ICP).

- The working standards (ICV, CCV and blank) are reanalyzed to confirm calibration. If the calibration is not confirmed, within SOP limits, the instrument is recalibrated.

- The samples are analyzed for the metals of interest.

- Following completion of the sample analyses, the working standards are reanalyzed to confirm calibration. If calibration is confirmed, the analysis is completed. However, if the calibration is not confirmed, the problem is corrected, and the affected samples are reanalyzed.

5.4.6.1.17 PERIODIC CALIBRATION

Periodic calibration shall be performed for instrumentation such as balances, thermometers, ovens, and furnaces that are required in analytical methods, but which are not routinely calibrated as part of the analytical procedure. Documentation of calibration is kept for each instrumentation item.

Calibration requirements are determined within the York laboratory depending upon the instrumentation used and its operating function. Following are brief example discussions for the calibration of balances and thermometers with examples of calibration data sheets to serve as a guideline for the preparation of laboratory-specific procedures.

5.4.6.1.18 Balances (Example Procedure)

All balances are verified by using weights traceable to the National Bureau of Standards (NIST) on use. Calibration weights shall be Class S or better and shall be recertified every year. If balances are calibrated by an external agency, verification of their weights shall be provided.

Calibration of balances shall be over the range in which they are most commonly used. The weighs used for calibration of each balance shall be 0.5g, 2.0g, 10.0g, 20.0g, and 100g. Acceptance for balances which are direct reading to 0.01 gram shall be ± 0.01g, to 0.0001g shall be ± 0.007g, and to 0.00001g shall be ± 0.0007g.

5.4.6.1.19 Thermometers (Example Procedure)

Certified, or reference, thermometers shall be maintained for use in calibrating working thermometers including other temperature measurement devices such as thermocouples, probes and infrared temperature sensors. Reference thermometers shall be provided with NIST traceability for initial calibration and shall be recertified every year with instrumentation directly traceable to the NIST. Working thermometers shall be compared with reference thermometers every 12 months. In addition, working thermometers shall be visually inspected by laboratory personnel prior to use.

Calibration temperatures and acceptance criteria shall be based upon the working range of the thermometer and the accuracy required for its use.

5.4.6.2 Testing Uncertainties

Policy:
The SOP ADMINESTUNCERT043010 is utilized to estimate uncertainties of measurement in testing, except when the test methods preclude such rigorous calculations. For most environmental analyses these uncertainties have been established and this procedure will be unnecessary.

In certain cases it is not possible to undertake meterologically and statistically valid estimations of uncertainty of measurement. In these cases the laboratory attempts to identify all the components of uncertainty and make the best possible estimation, and ensure that the form of reporting does not give an exaggerated impression of accuracy. Reasonable estimation is based on knowledge of the performance of the method and on the measurement scope and makes use of previous experience and validation data.

Details:
The degree of rigor needed in an estimation of uncertainty of measurement depends on factors such as:

- requirement of the test method
- requirement by the client

- if there are narrow limits on which decisions on conformity to a specification are based

In cases where a well-recognized test method specifies limits to the values of the major sources of uncertainty of measurement and specifies the form of presentation of calculated results, the laboratory is considered to have satisfied the estimation uncertainty of measurement by following the reporting instructions (see section 5.10).

5.4.6.3 Uncertainty Components

Policy:
When estimating the uncertainty of measurement, all uncertainty components that are of importance in the given situation are taken into account using accepted methods of analysis.

Details:
Sources contributing to the uncertainty include, but are not necessarily limited to, the reference standards and reference materials used, methods and instrumentation used, the environmental conditions, the item being tested or calibrated and the operator.

The predicted long-term behavior of the tested and/or calibrated item is normally not taken into account when estimating the measurement uncertainty.

For further information, see ISO 5725 and the Guide to Expression of Uncertainty in Measurement.

5.4.7 Control of Data

5.4.7.1 Calculations and Data Transfers

Policy:
Calculations and data transfers are subject to appropriate checks in a systematic manner.

Details:
Test data are validated through following SOP QC040402 to determine accuracy of calculations, conversions, and data transfers

- checks for transcription errors, omissions, and mistakes
- checks to determine consistency with normal or expected values

For those analyses where manual data reduction is required, it is performed according to the instructions provided in the test method or SOP.

5.4.7.2 Computers and Automated Instrumentation

Policy:
When computers or automated instrumentation are used for the acquisition, processing, manipulation, recording, reporting, storage or retrieval of test or calibration data, the laboratory ensures that:

- computer software developed by the user is documented in sufficient detail and suitably validated or otherwise checked as being adequate for use
- procedures are established and implemented for protecting the integrity of data; such procedures include, but are not be limited to, integrity and confidentiality of data entry or collection, data storage, data transmission, and data processing (see section 4.13.1.4)
- computers and automated instrumentation are maintained to ensure proper functioning and are provided with the environmental and operating conditions necessary to maintain the integrity of test and calibration data
- data is securely maintained by preventing unauthorized access to, and unauthorized amendment of, computer records

Details and Procedures:
Data generated using computer software programs that are interfaced directly to instruments incorporates all dilutions and calculations, thereby eliminating the need for manual data reduction.

Commercially developed software in general use within its designed application range may be considered sufficiently validated. Laboratory software configuration / modifications are validated and documented.

Electronic records, electronic signatures, and handwritten signatures executed to electronic records must be equivalent to proper records and handwritten signatures to paper and are validated by procedures in 21 CFR. Part II (Docket No. 92NO251) RIN0910-AA29; Federal Register: March 20, 1997, Volume 62, Number 54), Rules and Regulations, pages 13429-13466. For further details see:

http://www.fda.gov/ora/compliance_ref/part11/

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual
Revision 2.1	06/29/2012	Modified balance calibration procedure, tolerances.

5.5 Instrumentation

5.5.1 Required Instrumentation

Policy:
The laboratory is furnished with all items for preparation and analysis required for the correct performance of the analyses. When instrumentation is used outside the laboratory's permanent control, it ensures that the requirements of this Quality Manual are met.

Details:
Instrumentation is used in an environment appropriate to its proper performance. All instrumentation required by a test is described in each method, including the instrumentation's tolerances.

5.5.2 Required Accuracy

Policy:
Instrumentation and software used for testing are capable of achieving the accuracy required and comply with specifications relevant to the tests and/or calibrations concerned. Calibration programs are established for key quantities or values of the instruments where these properties have a significant affect on the results. When received, instrumentation, including that used for sampling, is checked to establish that it meets the laboratory's specification requirements, complies with the relevant standard specifications, and is checked and/or calibrated in accordance with section 5.6 before use.

Details:
The procedures for checking newly received instrumentation are as determined by manufacturers' specification and/or those determined by the laboratory during procurement.

5.5.3 Authorized Personnel

Policy:
Instrumentation is operated by authorized personnel. Up-to-date instructions on the use and maintenance of instrumentation (including any relevant manuals provided by the manufacturer of the instrumentation) are readily available for use by the appropriate laboratory personnel.

Details:

Access to laboratory instrumentation is controlled to ensure that only authorized personnel use instrumentation.

5.5.4 Unique Identification

Policy:
Each item of instrumentation used for testing is uniquely identified as appropriate.

Details:
Measuring and testing instrumentation is uniquely identified through an asset number of ID. Measuring and testing instrumentation includes any instrument that could affect the quality of test results. Components that can be interchanged between various instruments are tracked in instrumentation logbooks but are not assigned individual asset numbers.

5.5.5 Inventory and Maintenance Records

Policy:
Records are maintained for each item of instrumentation significant to the tests and/or calibrations performed. The records include the following:

- identity of the item of instrumentation (and its software)
- manufacturer’s name, type identification, and serial number and/or other unique identification
- checks that instrumentation complies with the specification (see section 5.5.2)
- current location, where appropriate
- the manufacturer’s instructions, if available, or reference to their location
- dates, results and copies of reports and certificates of all calibrations, adjustments, acceptance criteria, and due date of next calibration
- maintenance carried out to date and the maintenance plan (includes calibration)
- damage, malfunction, modification or repair to the instrumentation

Details:
A database is used to capture the above inventory information. The above information related to service and maintenance is kept in individual instrumentation files and/or binders. Other information kept in these files and/or binders may include:

- date received and date placed in service
- condition when received (e.g., new, used, refurbished)
- dates and results of calibration and/or verification and date of next calibration and/or verification
- performance history, where appropriate (e.g., response time, drift, noise level)

5.5.6 Instrumentation Procedures

Policy:
The laboratory has as an established plan for use and maintenance (including calibration) of measuring instrumentation, and appropriate use of correction factors to ensure proper functioning and in order to prevent contamination or deterioration.

Details and Procedures:
The procedures for each piece of measuring instrumentation are located in the appropriate room where the instrumentation is located or in the SOP. These procedures detail any information for safe handling, transport, storage, use, and maintenance of measuring instrumentation.

5.5.7 Out of Service Instrumentation

Policy:
Instrumentation that has either been subjected to overloading or mishandling, or gives suspect results, or has been shown to be defective or outside specified limits, is taken out of service, clearly marked, and appropriately stored until it has been repaired and shown by calibration or test to perform correctly.

Details:
Routine testing work is completely discontinued on instrumentation that even shows minor nonconformances. Not only do we do this for ethical reasons in support of our client, but minor nonconformances are often indicative of major breakdowns in expensive instrumentation. These breakdowns need to be avoided wherever possible.

Out of service instrumentation is clearly marked as outlined in section 5.5.8.

The laboratory examines the effect of the defect or departure from specified limits on previous test and/or calibrations and institutes the "Control of Nonconforming Work" procedure as outlined in section 4.9.

5.5.8 Calibration Status

Policy:
Instrumentation requiring calibration is labeled to indicate the calibration status and/or operational status and the date when re-calibration is due when appropriate.

Details:
Calibration labels have a write-on surface and a pressure sensitive adhesive. The areas that are filled out include the person who performed the calibration, the date it was performed, the date it is due for re-calibration, and the instrumentation's identification number.

CALIBRATION
BY__________DATE________
DUE_________ID#__________

Measuring instrumentation that has failed calibration or is deemed out of service is labeled with one of the following labels:

CALIBRATION VOID

DO NOT USE

OUT OF SERVICE

DO NOT USE

A piece of instrumentation that is not calibrated or checked is labeled with the following label:

FOR REFERENCE ONLY

5.5.9 Return to Service

Policy:
When instrumentation goes outside the direct control of the laboratory for a period, the laboratory ensures that the function and calibration status of the instrumentation are checked and validated and shown to be satisfactory before the instrumentation is returned to service.

Details and Procedures:
The procedures used to check and ensure that the function and calibration status of the instrumentation are satisfactory before the instrumentation is returned to service are outlined in the manufacturer's instrumentation manual. Any additional quality control checks are outlined in the applicable section of the appropriate SOP and/or test method.

5.5.10 Periodic Checks

Policy:
When intermediate checks are needed to maintain confidence in the calibration status of instrumentation, these checks are carried out periodically according to defined procedure.

Details and Procedures:
As stated in section 5.5.6, the procedures for each piece of measuring instrumentation are located in the appropriate room where the instrumentation is located. SOP# QSP 5-5-1 outlines a general maintenance plan for instrumentation and includes various checks. Internal quality control checks are specified in individual test methods that are located in the appropriate laboratory areas thereby providing procedures for intermediate checks.

5.5.11 Correction Factors

Policy
Calibrations that give rise to a set of correction factors are updated along with all copies of this data (e.g., in computer software).

Details and Procedures:
The updating of correction factors, including all copies, is assured by following the appropriate test method or SOP. It is the responsibility of the Group Leaders to ensure that all copies are updated.

5.5.12 Safeguards against Adjustments

Policy:
Test instrumentation, including hardware and software, are safeguarded from adjustments that invalidate test and/or calibration results/status.

Details:
Safeguards against adjustment for laboratory instrumentation include:
- detailed SOPs and manufacturer's manuals on the operation of the instrumentation
- policies permitting only fully trained and competent personnel to operate instrumentation
- access to the laboratory is restricted to authorized personnel

Safeguards against adjustment for software include:
- password protection for important files and packages
- access to the laboratory is restricted to authorized personnel

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual

5.6 Measurement Traceability

5.6.1 General

Policy:
All measurement and test instrumentation having an effect on the accuracy or validity of tests is calibrated and/or verified before being put into service.

Details:
The program includes a system for selecting, using, calibrating, checking, controlling, and maintaining:

- measurement standards
- reference standards used as measurement standards
- measuring and test instrumentation used to perform tests and calibrations

Procedures are documented where appropriate. All measurements that play a defining role in testing accuracy are based directly or indirectly on reference standards, reference materials, certified reference materials, or other standards or materials having appropriate traceability.

Records are maintained for each standard. These records include, as applicable:

- supplier, grade, batch#
- dates of preparation or verification
- measurement of weights, volumes, time intervals, temperatures, and pressures and related calculations
- relevant processes (e.g., pH adjustment, extraction)
- verification results
- identification of personnel involved

Reagents prepared in the laboratory are labelled to identify substance, concentration, solvent (where not water), any special precautions or hazards, restrictions of use, Lot no., and date of preparation and/or expiry. The person responsible for the preparation of the reagent is identified either from the label or from records.

5.6.2 Specific Requirements

5.6.2.1 Calibration

Policy:
The program for calibration of instrumentation is designed and operated to ensure that calibration measurements are traceable to the Système International (SI) units of measurement or NIST.

Details:
Traceability of measurement is assured by the use of calibration services, internal and from sources that can demonstrate competence, measurement capability and traceability. The calibration certificates issued by these sources show that there is a link to a primary standard traceable to NIST. The calibration certificates contain the measurement results including the measurement uncertainty and/or a statement of compliance with an identified metrological specification (see also section 5.10.4.2).

Calibration vendors accredited to ISO 17025 are considered competent to provide the appropriate calibration services.

The term "identified metrological specification" means that it must be clear from the calibration certificate against which specification the measurements have been compared with, by including the specification or by giving an unambiguous reference to the specification.

When the terms "international standard" or "national standard" are used in connection with traceability, it is assumed that these standards fulfil the properties of primary standards for the realization of SI units.

Maintain certificates of all reference standards, measuring instrumentation, or certified reference material used in ensuring traceability. Where traceability to national standards of measurement is not applicable, the laboratory provides satisfactory evidence of correlation of results, for example by participation in a suitable program of inter-laboratory comparisons or proficiency testing.

Reference standards, such as thermometers and weights, are traceable to a national or international standard (e.g., NIST).

5.6.2.2 Testing

5.6.2.2.1

Policy:
The requirements given in section 5.6.2.1 apply to measuring and test instrumentation with measuring functions used, unless it has been established that the associated calibration uncertainty contributes little to the total uncertainty of the test result. When this situation

arises, the laboratory ensures that instrumentation used can provide the accuracy of measurement needed.

Details:
The extent to which the requirements in section 5.6.2.1 are followed depends on the relative contribution of calibration uncertainty to the total uncertainty. If calibration is the dominant factor, the requirements are strictly followed. If, however, calibration is not one of the major contributors to the total uncertainty, other ways for providing confidence may be used, as given in section 5.6.2.2.2.

5.6.2.2.2

Policy:
Where traceability to SI units of measurement is not possible and/or not relevant, other means for providing confidence in the results are applied such as:

- the use of suitable reference materials certified to give a reliable characterization of the material
- mutual-consent standards or methods which are clearly specified and agreed upon by all parties concerned
- participation in a suitable program of inter-laboratory comparisons or proficiency testing

Details:
Reliable characterization involves an estimate of recovery.

The laboratory participates in proficiency testing and/or check sample programs. The list of programs is maintained by the Quality Assurance Officer and includes NYSDOH NELAP, CTDOH Proficiency Program, and NJDEP Office of Quality Assurance for TO-15 air.

5.6.3 Reference Standards and Reference Materials

5.6.3.1 Reference Standards

Policy:
Reference standards are obtained or calibrated by a body that can provide traceability as described in section 5.6.2.1. For our use traceability to NIST is acceptable for most applications. Such reference standards of measurement held by the laboratory are used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

Details:

Reference standards are obtained from the National Institute of Standards and Technology (NIST), if applicable.

5.6.3.2 Reference Materials

Policy:
Where possible, reference materials are traceable to SI units of measurement, or to certified reference materials. Internal reference materials are checked as far as is technically and economically practicable.

Details:
Reference materials, including calibration standards, used in chemical measurement are prepared so that the point of measurement is similar or equivalent to that of the samples. The matrix, prior to the addition of the analyte does not have a detectable concentration of the analyte. Reagents used in the preparation of reference materials, including calibration standards are of certified purity.

5.6.3.3 Intermediate Checks

Policy:
Checks needed to maintain confidence in the calibration status of reference, primary, transfer or working standards and reference materials are carried out according to defined procedures and schedules.

Details and Procedures:
The control check standards (Laboratory Control Samples) used to verify the accuracy of all the other standards are prepared independently from all the other standards used to establish the original calibration. These control check standards are prepared from a separate lot # or second source. It is the responsibility of the Group Leader to establish and maintain the individual schedule for each SOP and/or test method.

5.6.3.4 Transport and Storage

Policy:
The safe handling, transport, storage and use of reference standards and reference materials in order to prevent contamination or deterioration and in order to protect their integrity are defined.

Details:

Proper conditions are established for housing, handling, and care of reference standards/reference materials. All information needed to properly identify references appears on their housing or containers.

Revision History

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5.7 Sample Handling, Receipt and Initiation of Testing

Laboratory analyses are performed to produce data representative of conditions when the sample was obtained. To provide representative samples for analysis, both field and laboratory personnel must satisfactorily perform their activities. Although the purpose of this manual is to define the laboratory Quality Assurance Program, the interrelationship of field and laboratory operations in maintaining sample integrity is briefly discussed because the effect of field operations upon resulting data quality cannot be totally separated from laboratory operations.

5.7.1 CHAIN-OF-CUSTODY

An overriding consideration for resulting data is the ability to demonstrate that the samples have been obtained from the locations stated and that they have reached the laboratory without alteration. Evidence of collection, shipment, laboratory receipt and laboratory custody until disposal must be documented to accomplish this. Documentation is accomplished through a chain-of-custody record that records each sample and the individuals responsible for sample collection, shipment, and receipt.

- A sample is considered in custody if it is:
- In a person's actual possession.
- In view after being in physical possession.
- Secured so that no one can tamper with it after having been in physical custody.
- In a secure area, restricted to authorized personnel.

A chain-of-custody form is used by York personnel when shipping samples to subcontractors. This form is also used by all York's clients when submitting samples procured by the client. York does not accept samples collected by any outside or inside source without a correctly prepared chain-of-custody form.

The chain-of-custody form shall be signed by each individual who has the samples in their possession. Preparation of the chain-of-custody shall be as follows:

- The chain-of-custody record shall be initiated in the field by the person collecting the sample, for every sample. Every sample shall be assigned a unique identification number or name that is entered on the chain-of-custody form. Samples can be grouped for shipment and use a common form. The form allows for ten samples per page. If more than ten samples are shipped in the same container, more than one chain-of-custody form is required.

- The record shall be completed in the field to indicate project, sampling location, etc.

- If the person collecting the sample does not transport the samples to the laboratory or deliver the sample containers for shipment, the first block for Relinquished By _____, Received By _____ shall be completed in the field.

- The person transporting the samples to the laboratory or delivering them for shipment shall sign the record form as Relinquished By _____.

- If the samples are shipped to the laboratory by commercial carrier, the chain-of-custody form shall be sealed in a watertight zip-lock bag, placed in the shipping container, and the shipping container sealed prior to giving it to the carrier.

- If the samples are directly transported to the laboratory, the chain-of-custody may be kept in possession of the person delivering the samples.

- For samples shipped by commercial carrier, the waybill shall serve as an extension of the chain-of-custody record between the final field Control Group and receipt in the laboratory.

- Upon receipt in the laboratory, the Sample Control Group, or representative, shall open the shipping containers, compare the contents with the chain-of-custody record, and sign and date the record. Any discrepancies shall be noted on the chain-of-custody form. Discrepancies are immediately discussed with the Lab Manager for resolution.

- Chain-of-custody and any shipping records shall be maintained with the records for a specific project, becoming part of the project file.

5.7.2 FIELD COLLECTION AND SHIPMENT

Prior to collecting samples, the collection team must consider the analyses to be performed so that proper sample containers and shipping containers can be assembled and the proper preservatives added to containers. In addition, field logs and record sheets, chain-of-custody forms, and analysis request records must be assembled.

All records required for documentation of field collection must be completed by the client field team. Several of the documents that affect laboratory operations are discussed herein. The primary documenting record is the chain-of-custody as discussed above.

In addition to initiating the chain-of-custody form, field personnel are responsible for uniquely identifying (required on the chain-of-custody form) and labeling samples, providing proper preservation, and packaging samples to preclude breakage during transit by York couriers or client shipment.

Every sample shall be labeled to identify:

- Unique sample number (ex. 11F0565-01, -02, etc.)
- Sample Description (such as MW-1, etc.)
- Sampling date and time
- Person obtaining sample
- Container types and methods of sample preservation/conditioning
- Analyses required (e.g., VOC 8260B, etc.)

Samples must be placed in containers compatible with the intended analysis and properly preserved. Also, collection of samples must consider the time interval between acquiring the sample and analysis (holding time) so that the sample is representative. The requirements for various analytical parameters with respect to the type of container, quantity of sample, preservation method, and maximum holding time between collection and analysis, quantity of sample, are dictated by the Federal Register, EPA SW-846 or the specific Quality Assurance Project Plan.

Shipping containers are to be sealed prior to shipment, whether shipped by direct transport by field personnel or commercial carrier. The only exception to this is if sufficient holding time exists so that the samples can be held in the field and it is necessary to re-ice the containers prior to or during transport.

As soon as field personnel are ready to hand off samples from the field to the courier, the courier takes custody of them and transfers them into a cooler containing ice or ice packs sufficient to maintain 2-6°C until arrival at the laboratory. Upon receipt, the temperature (as measured by an infrared temperature probe) and condition of the samples is recorded on the Chain-of-Custody form.

It is imperative that the analyses requested be clearly provided so that analytical requirements are maintained with respect to sample holding times.

5.7.3 LABORATORY SAMPLE RECEIPT

The first step in the laboratory receipt of samples is obtaining the proper information. The information is taken by the Client Service, documented and passed on immediately to the Sample Control. The Sample Control Group shall note that the shipment is expected and notify the Lab Manager, Client Service and Group Leaders when samples are received. This is especially important for RUSH requests where coordination is essential to meet project deadlines. The communication is done via the RUSH NOTIFICATION form.

Upon sample receipt, the Sample Control Group performs the following:

5.7.3.1 Examine all samples and determine sample temperature using an Infrared thermometer. This documents that proper temperature has been maintained during shipment (if applicable). Note this on the Chain-of-Custody. If samples have been damaged during shipment, the remaining samples shall be carefully examined to determine whether they were affected. Any samples affected shall be also considered damaged. It will be noted on the chain-of-custody record that specific samples were damaged and that the samples were removed from the sampling program. Field personnel will be notified as soon as possible that samples were damaged and that they must be resampled, or the testing program changed, and an estimate of the cause of damage.

5.7.3.2 Compare samples received against those listed on the chain-of-custody. Note any deviations or problems and clarify with the Lab Manager or Client Service.

5.7.3.4 Sign and date the chain-of-custody form and attach any shipping receipts to the chain-of-custody.

5.7.3.5 Log the project into the lab LIMS system.

5.7.3.6 Open a laboratory project number and pendaflex file which will contain:

- Project identification number
- Completed Chain-of-Custody record
- Shipping receipts

- Any correspondence related to the project
- WORK ORDER which will include:

    - Client Name
    - Client Project ID
    - Lab Sample numbers
    - Client Sample Identifiers
    - Type of samples (matrix)
    - Date received in laboratory
    - Parameters to be analyzed
    - Project Pricing
    - Any special instructions (such as ASP B deliverables, etc.)

If samples collected by Clients arrive without chain-of-custody or incorrect chain-of-custody records, the following shall be done by the Sample Control Group:

If the chain-of-custody is incorrect, a memorandum to the Client Services is prepared stating the inaccuracy and correction in the form of a Corrective Action (CA). The CA must be signed and dated by the person originating the chain-of-custody and the Sample Control Group. The memorandum will serve as an amendment to the chain-of-custody. If the information on the chain-of-custody form cannot be corrected by the Sample Control Group or the field personnel, the samples affected shall be removed from the sampling program.

. If the chain-of-custody is not shipped with the samples, the Client personnel shall be contacted and a memorandum prepared which lists the persons involved in collecting, shipping, and receiving the samples and the times, dates, and events. Each person involved must sign and date this memorandum. The complete memorandum will be maintained in lieu of the chain-of-custody.

5.7.4 LABORATORY STORAGE OF SAMPLES

The primary considerations for sample storage are:

. Maintenance of prescribed temperature, if required, which is typically $4^{o}C \pm 2^{o}C$

. Extracting and/or analyzing samples within the prescribed holding time for the parameters of interest.

The requirements for temperatures and holding times shall be met. Placing of samples in the proper storage environment is the responsibility of the Sample Control Group, who should notify the Group Leaders if there are any samples which must be analyzed immediately because of holding time requirements. This is accomplished by issuing a RUSH NOTIFICATION FORM.

5.7.5 INITIATION OF TESTING PROGRAM

As stated previously, the chain-of-custody form is prepared by the client and submitted with the samples to the laboratory. If the analytical program is not defined with the sample shipment, Sample Control shall immediately notify the Client Services who will contact the client to determine/clarify the testing program.

The analytical program or any changes requested shall be re-entered onto the original chain-of-custody form, signed and dated. This record serves as the master analytical request form for samples and the clients' authorization to proceed.

Client Services and the Group Leaders are responsible for prioritizing samples on the basis of holding time and required reporting time into the laboratory sample stream.

5.7.6 SAMPLE DISPOSAL

The LIMS allows us to set a sample status for disposal. These records are then maintained on a sample basis in the database. There are several possibilities for sample disposition:

- The sample may be completely consumed during analysis.
- Samples may be returned to the client or location of sampling for disposal.
- The samples may be stored after the analysis. Proper environmental control and holding time must be observed if reanalysis is anticipated. If reanalysis is not anticipated, environmental conditions for storage will not be observed.

The samples may be transferred to proper drums or waste containers for final disposal by licensed waste disposal firms.

The Sample Control Group shall determine disposition of samples if not specified in the project file.

In general, York will not maintain samples and extracts longer than thirty (30) days beyond completion of analysis, unless otherwise specified.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.8 Assuring the Quality of Test and Calibration Results

5.8.1 Quality Control / Quality Assurance

Policy:
Quality control procedures are utilized to monitor the validity of test results. These procedures are for each test method utilized in the laboratory. The resulting data are recorded so that trends are detectable (and where practicable, statistical techniques are applied to the reviewing of the results). This monitoring is planned and reviewed and may include, but not limited to, the following:

- regular use of certified reference materials and/or internal quality control using secondary reference materials
- participation in inter-laboratory comparisons or proficiency testing programs
- replicate tests or calibrations using the same or different methods
- re-testing or re-calibration of retained items
- correlation of results for different characteristics of an item

Details:
The methods utilized from the above list will be appropriate for the type and volume of the work undertaken. Records are maintained of assurance activities and any actions taken.

As a guide, for routine analyses the level of internal quality control is typically 5% of the sample throughput. For more complex procedures, 20% is not unusual and on occasions even 50% may be required. For analyses performed infrequently the use of a reference material containing a certified or known concentration of analyte, followed by replicate analyses of the sample and spiked sample is done. For analyses undertaken more frequently, systematic quality control procedures incorporating the use of control charts and check samples are implemented. These procedures are documented in the SOP for each test method.

Internal quality control schemes using statistics include:

- design of experimental/factorial analysis
- variation/regression analysis
- safety evaluation/risk analysis
- tests of significance
- quality control charts
- statistical sampling inspection

Proficiency testing helps to highlight not only repeatability and reproducibility performance between laboratories, but also systematic errors such as bias. It is important to monitor proficiency testing results as a means of checking quality assurance and take action as necessary.

The Quality Manager maintains a list of all the current proficiency testing programs the laboratory participates in, monitors the results, and notifies the appropriate personnel of both problematic and successful results.

Technical personnel use certified reference materials and reference materials to evaluate test performance on a daily basis and include daily process control checks. These data are used to evaluate the validity of the test results.

Replicate tests may be used if suitable reference material is available. These materials and proficiency test materials are available for improving repeatability.

Re-testing of test items is performed occasionally at the discretion of the supervisor or when test results seem anomalous.

5.8.2 Correction and Prevention

Policy and Details:
Quality control data are analyzed and, where they are found to be outside pre-defined criteria, planned action is taken to correct and to prevent incorrect results from being reported.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.9 Reporting of Results

5.9.1 General

Policy:
The results of each test or series of tests are reported accurately, clearly, unambiguously and objectively, and in accordance with any specific instructions in the test or calibration methods.

The results are reported, normally in a Technical Report and include all the information requested by the client and necessary for the interpretation of the test results and all information required by the method used or regulatory body reviewing the data. This information may include what is outlined in section 5.9.2, 5.9.3 and 5.9.4.

In the case of tests performed for internal purposes, and in the case of a written agreement with the client, the results may be reported in a simplified way. The information listed in section 5.9.2 to 5.9.4, and not reported, is kept readily available.

Details:
Test reports are issued as either hard copy or by electronic data transfer.

5.9.2 Test reports

Policy:
Test reports (Technical Reports) include the following information, as appropriate:

- a title (e.g., “Technical Report”
- name and address of laboratory, and location where tests were carried out if different from the address of the laboratory
- unique identification of the test report (such as a project no.), and on each page an identification in order to ensure that the page is recognized as a part of the test report, and a clear identification of the end of the test report
- name and address of the client
- identification of the method(s) used
- description, condition, and unambiguous identification of the sample(s) tested
- date of receipt of samples and date(s) of performance of the analyses
- reference to sampling procedures used by the laboratory or other bodies where these are relevant to the validity or application of the results
- test results with, where appropriate, units of measurement
- the name(s), function(s) and signature(s) or equivalent of person(s) authorizing the test report
- a statement to the effect that the results relate only to the items tested

Details:
Signing authority for test reports is the responsibility of the Managing Director. Records for individuals with signing authority for test reports are approved by the Managing Director and maintained by the Quality Assurance Officer.

Hard copies and electronic copies of test reports include the page number and total number of pages.

A statement is included specifying that the test report is not to be reproduced except in full, without written approval of the laboratory. Data reported to the client contains the appropriate significant digits for each test method. Low level data are identified as being below specified limits by utilizing appropriate flags.

5.9.3 Test Reports

5.9.3.1

Policy and Details:
In addition to the requirements listed in section 5.9.2, test reports include the following, where necessary for the interpretation of results:

- deviations from, additions to, or exclusions from the test method
- where relevant, a statement of compliance/non-compliance with requirements and/or specifications
- where applicable, a statement on the estimated uncertainty of measurement of the test result; information on uncertainty is needed in test reports when it is relevant to the validity or application of the test results, when a client's instruction so requires, or when uncertainty affects compliance to a specification limit
- where appropriate and needed opinions and interpretations (see section 5.9.5)
- additional information required by specific methods, clients, or regulatory authorities.

5.9.3.2

Policy and Details:
In addition to the requirements listed in sections 5.9.2 and 5.9.3.1, test reports containing the results of sampling include the following, where necessary for the interpretation of test results:

- date of sampling
- unambiguous identification of substance, matrix, material sampled

- details of any environmental condition during sampling that may affect the interpretation of the test results
- any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned

5.9.5 Opinions and Interpretations

Policy:
When opinions and interpretations are included in the test report, the basis upon which the opinions and interpretations have been made is documented. Opinions and interpretations are clearly marked as such in the test report.

Note - Opinions and interpretations should not be mixed-up with inspections and product certifications as intended in ISO/IEC 17020 and ISO/IEC Guide 65.

Details:
Opinions and interpretations included in a test report may comprise, but not be limited to the following:

- opinion on conformity of the results with requirements
- fulfilment of contractual requirements
- recommendations on how to use the results
- guidance to be used for improvements

In many cases it is appropriate to communicate the opinions and interpretations by direct dialogue with the client. This dialogue is documented in writing.

5.9.6 Test Results Obtained from Subcontractors

Policy and Details:
Test reports containing the results of tests performed by subcontractors are clearly identified for the subcontracted results. The subcontractor reports the results either in writing or electronically to our laboratory.

5.9.7 Electronic Transmission of Results

Policy:
In the case of transmission of test results by telephone, facsimile or other electronic or electromagnetic means, the requirements of the policies and procedures of this Quality Manual continue to apply (see also 5.4.7).

Details:
Reports that are "published" electronically contain a digital signature.

5.9.8 Format of Reports

Policy:
The format of reports is designed to accommodate each type of test carried out and to minimize the possibility of misunderstanding or misuse.

Details:
The layout of the test report is such that the presentation of the test data facilitates ease of assimilation by the reader.

The headings are standardized as far as possible.

5.9.9 Amendments to Reports

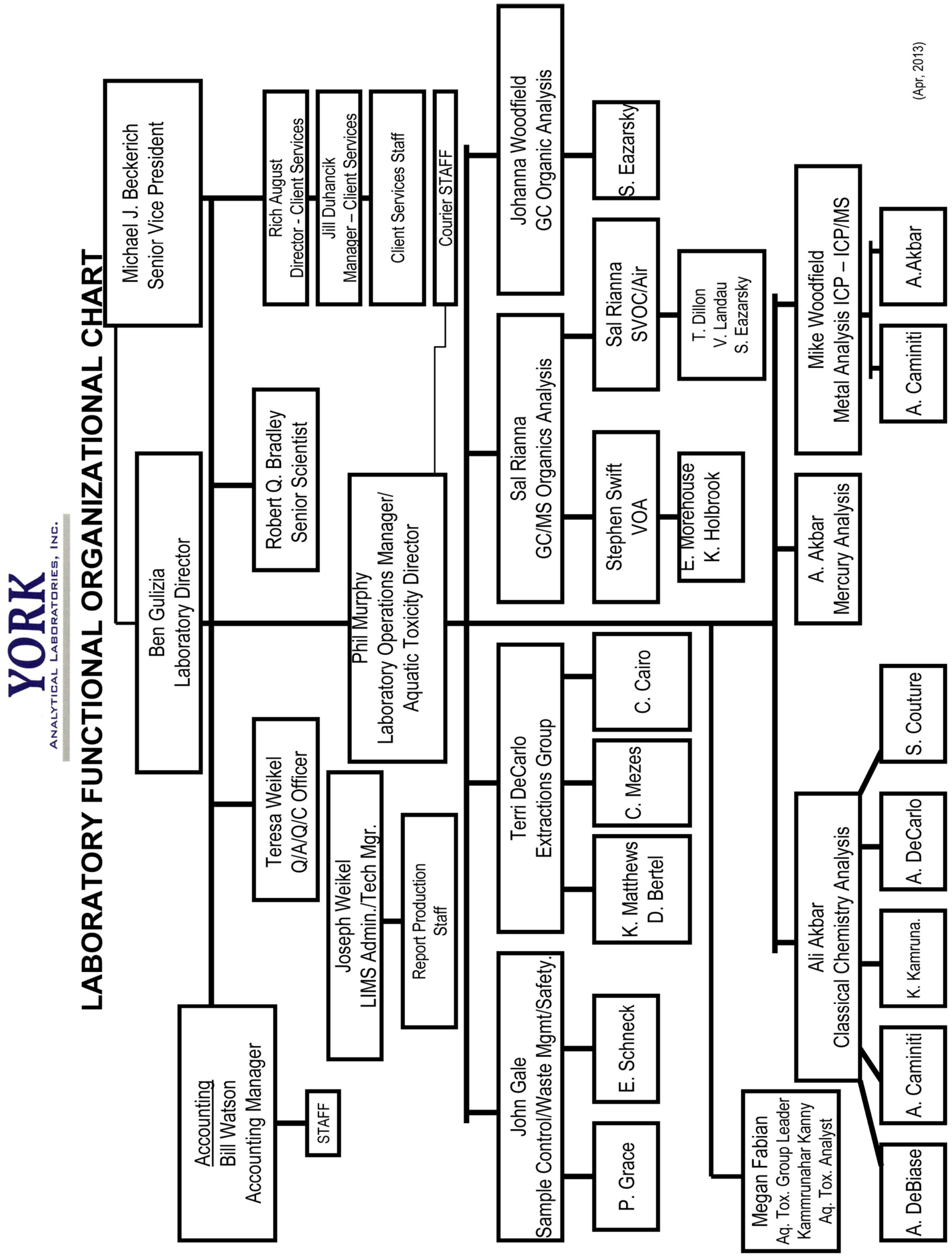
Policy:
Material amendments to a test report after issue are made only in the form of a further document, or data transfer, which includes the statement "Revision no. __. Such amendments meet all the requirements in this Quality Manual.

Details:
When it is necessary to issue a complete new test report, it is uniquely identified and contains a reference to the original that it replaces.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual

ATTACHMENT A


LABORATORY FUNCTIONAL ORGANIZATIONAL CHART

ATTACHMENT B

York Analytical Laboratories, Inc

MASTER LIST of CONTROLLED DOCUMENTS on 04/01/2013

	Description	SOP No.	Date of Issue	Revision No.	Date of Revision
	GC/MS - Air				
1	VOCs in AIR by EPA TO-14A/TO-15	GCMSAIR 111692	11/16/1992	9.2	3/12/2012
2	Cleaning of Summa Canisters	SummaClean111507	11/15/2007	1.0	
3	Calibration of Flow Controllers	FLOWCONT010312	1/3/2012	1.0	
	GC/MS - Volatiles				
1	Volatile Organics by GC/MS	GCMSVOC 011700	1/17/2000	2.7	1/9/2012
2	Volatiles in Drinking Water by GC/MS by EPA 524.2	GCMSVOC524.2 011700	1/17/2000	1.9	10/22/2012
3	Soil Sampling by EPA 5035A	GCMSVOC5035060712	6/7/2012	1.0	6/7/2012
	GC/MS - Semi-volatiles				
1	Semi-Volatiles using GC/MS by EPA 8270	GCMSSVOC 011700	1/17/2000	2.3	4/4/2012
	Gas Chromatography				
1	PCBs using GC/ECD by EPA 8082	GCPCB 011799	1/17/1999	1.5	10/19/2012
2	TPH-DRO Using Solvent Extraction Followed by GC/FID Analysis	TPHDROGC091009	9/10/2009	1.2	11/14/2012
3	Pesticides (Chlorinated) using GC/ECD by EPA 8081	GCPEST011799	1/17/1999	1.4	10/19/2012
4	Herbicides using GC/ECD by EPA 8151	GCHERB011999	1/19/1999	1.3	5/13/2010
5	Organochlorine Pesticides & PCBs in Potable Water using GC/ECD by EPA 505	505GCPEST092010	9/20/2010	1.0	
6	CT-ETPH in Environmental Extracts	GCETPH111704	11/17/2004	1.6	2/29/2012

	Extractions				
1	Preparation/Extraction of Soil Samples for the Analysis of Target Herbicides	EXTSoilherb052600	5/26/2000	1.4	10/22/2012
2	Preparation/Extraction of Aqueous Samples for the Analysis of Target Herbicides	EXTAQHRB052600	5/26/2000	1.2	4/26/2010
3	Extraction of Solid Samples for the Analysis of SVOCs using UltraSonic Extraction	EXTSSVOC052600	5/26/2000	2.1	6/29/2012
4	Extraction of Solid Samples for the Analysis of SVOCs using ASE Extraction	EXTSVOCSASE 083106	8/31/2006	1.8	6/29/2012
5	Extraction of Aqueous Samples for Analysis of Semi-Volatile Compounds	EXTAQSVOC052600	5/26/2000	2.4	6/29/2012
6	Extraction of Polyurethane Foam Sampling Media for the Analysis of Target Pesticides and PCBs	EXTSVOCASEPUF043010	4/30/2010	1.0	
7	Extraction Laboratory Glassware Washing Procedure	EXTGP052600	5/26/2000	1.1	4/3/2012
8	Extraction of Solid Samples for Analysis of PCBs using Soxhlet Techniques	EXTPCBSOX102110	10/22/2010	1.0	
9	Extraction of Aqueous and Soil Samples for the Analysis of Massachusetts EPH (MA-EPH)	EXTMAEPHAQASE121207	12/12/2007	2.0	10/22/2009
10	Spike and Surrogate Standard Preparation for Extractables	EXTSVOCStds062912	6/29/2012	1.0	
	Metals Analysis/Prep				
1	Analysis of Trace Metals in Environmental Samples using ICP/MS by EPA SW-846 6020 and EPA 200.8	ICPMS 6020 080106	8/1/2006	1.2	11/25/2008
2	Preparation of Standards for Axial ICP Analysis	ICPSTD030495	3/4/1995	1.1	4/7/2000
3	Preparation of Environmental Samples for Trace Metals Analysis by ICP and ICP/MS	METALSPrep030695	3/6/1995	1.2	9/12/2007
4	Analysis of Environmental Sample Digestates Using Axial ICP by EPA SW846 6010B and 200.7	ICP031195	3/11/1995	1.3	9/11/2007
5	Analysis of Trace Metals in Drinking Water Samples using ICP/MS by EPA 200.8	ICPMS200.8080106	8/1/2006	1.0	
6	Digestion and Analysis of Aqueous, Soil, and Sludge Samples for Mercury by Cold Vapor Technique (CV) EPA SW-846 7470 and 7471	Hg 120998	12/10/1998	1.5	10/15/2012
	Wet Chemistry/IC				
1	Chemical Oxygen Demand (COD) [SM 5220D]	WC COD 100400	10/4/2000	2.1	9/18/2012
2	TKN, Ammonia and TON [SM 4500-N_{org} C, 4500-NH_3 D]	WC TKN 100400	10/4/2000	1.4	9/11/2012

3	Reactivity-Cyanide [SW-846 Ch 7.3.3]	WC CNR 080800	8/8/2000	1.2	10/16/2012
4	Hexavalent Chromium in Aqueous Samples [SW-846 7196]	WC Cr+6 070900	7/9/2000	1.4	9/11/2012
5	Hexavalent Chromium in Soil Samples [SW-846 7196A, 3060A]	WC Cr+6S 111811	11/18/2011	1.1	9/17/2012
6	Total Cyanide [EPA 335.2]	WC CNT 070900	7/9/2000	1.5	9/17/2012
7	Reactivity-Sulfide [SW-846 Ch 7.3.3]	WC ReacSulf 061296	6/12/1996	1.3	10/19/2012
8	Alkalinity [EPA 310.1]	WC T-Alk 022600	2/26/2000	1.2	10/19/2012
9	Hexane Extractable Material [EPA 1664]	WC HemGrav 110606	11/16/2006	1.5	10/22/2012
10	Ion Chromatography [EPA 300.0]	WC IC 011400	1/14/2000	1.7	12/17/2012
11	Biochemical Oxygen Demand (BOD) [SM 5210B]	WC BOD 011700	1/17/2000	1.4	11/9/2012
12	TSS / VSS in Aqueous Samples [EPA 160.2, 160.4]	WC TSS 040795	4/7/1995	1.3	11/9/2012
13	pH [SW-846 9040C, 9045D]	WC pH 040695	4/6/1995	1.5	10/11/2012
14	T-Phosphorous and Ortho-Phosphate [EPA 365.3, SM 4500]	WC Phos 051000	5/10/2000	1.3	9/22/2012
15	TCLP / SPLP Extraction [SW-846 1311, 1312]	WC TCLPEX 010400	1/4/2000	1.3	10/11/2012
16	Cyanide Amenable to Chlorination [EPA 335.1]	WC CNA 110200	11/4/2000	1.2	9/17/2012
17	Ignitability of Solids	WC IGN 040795	4/7/1995	1.1	4/11/2000
18	Flash Point [SW-846 1010A]	WC FP 040795	4/7/1995	1.4	10/3/2012
19	Methylene Blue Active Substances (MBAS) [SM 5540C]	WC MBAS 042610	4/26/2010	1.1	10/11/2012
20	TS / TDS in Aqueous Samples [SM 2540B, C]	WC TSTDS 042610	4/26/2010	1.1	9/18/2012
21	Color	WC Color 042610	4/26/2010	1.0	
22	Glassware Washing	WC GlassPrep 090299	9/2/1999	2.0	9/2/1999
23	Total Phenols (Low Level) [EPA 420.1]	WC PhenolsLL 102711	10/27/2011	1.3	10/22/2012
24	Total Phenols [EPA 420.1]	WC Phenols 022912	2/29/2012	1.2	10/22/2012

25	Conductivity [EPA 120.1]	WC Cond 022912	2/29/2012	1.1	10/11/2012
26	Turbidity [EPA 180.1]	WC Turbidity 022912	2/29/2012	1.2	10/11/2012
27	TS, FS, VS and % Moisture in Soil Samples [SM 2540G]	WC TS%M 022912	2/29/2012	1.0	
28	Extractable Organic Halogens in solids [SW-846 9023]	WC EOX 041112	4/11/2012	1.2	11/9/2012
29	Total Organic Carbon in Aqueous Samples [SM 5310C]	WC TOC 041812	4/18/2012	1.1	11/13/2012

Aquatic Toxicity					
1	Acute Toxicity Test Method for Cyrinodon variegatus by EPA Method 821-R-02-012 / 2004.0	AT ACupV013013	01/30/2013	1.0	01/30/2013
2	Acute Toxicity Test Method for Daphnia pulex by EPA Method 821-R-02-012 / 2021.0	AT DapP013013	01/30/2013	1.0	01/30/2013
3	Acute Toxicity Test Method for Mysidopsis bahia by EPA Method 821-R-02-012 / 2007.0	AT AmysB01313	01/30/2013	1.0	01/30/2013
4	Acute Toxicity Test Method for Pimephales promelas by EPA Method 821-R-02-012/ 2000.0	AT APimP01313	01/30/2013	1.0	01/30/2013
5	Reference Toxicant Test Method using Copper Nitrate Acute- Daphnia pulex EPA Test Method 821-R-02-012/ 2021.0	AT RTADapP012313	01/30/2013	1.0	01/30/2013
6	Reference Toxicant Test Method using Copper Nitrate Acute- Pimephales promelas EPA Test Method 821-R-02-012/ 2000.0	AT RTAPimP013013	01/30/2013	1.0	01/30/2013
7	Reference Toxicant Test Method using Sodium Lauryl Sulfate Acute- Cyrinodon variegatus by EPA Method 821-R-02-012/ 2004.0	AT RTACypV013013	01/30/2013	1.0	01/30/2013
8	Reference Toxicant Test Method using Sodium Lauryl Sulfate Acute- Mysidopsis bahia by EPA Method 821-R-02-012/ 2007.0	AT RTAMysB013013	01/30/2013	1.0	01/30/2013
9	Chronic Toxicity Test Method for Cyrinodon variegatus by EPA Method 821-R-02-014 / 1004.0	AT CCypV013013	01/30/2013	1.0	01/30/2013
10	Chronic Toxicity Test Method for Ceriodaphnia dubia by EPA Method 821-R-02-013 / 1002.0	AT CCer013013	01/30/2013	1.0	01/30/2013
11	Chronic Toxicity Test Method for Mysidopsis bahia by EPA Method 821-R-02-014 1007.0	AT CMysB01313	01/30/2013	1.0	01/30/2013
12	Chronic Toxicity Test Method for Pimephales promelas by EPA Method 821-R-02-013 / 1000.0	AT CPimP01313	01/30/2013	1.0	01/30/2013

13	Reference Toxicant Test Method using Sodium Chloride Chronic- Ceriodaphnia dubia EPA Test Method 1002.0	AT RTCCer012313	01/30/2013	1.0	01/30/2013
14	Reference Toxicant Test Method using Sodiium Chloride Chronic- Pimephales promelas EPA Test Method 1000.0	AT RTCPimP013013	01/30/2013	1.0	01/30/2013
15	Reference Toxicant Test Method using Sodium Lauryl Sulfate Chronic- Cyrinodon variegatus by EPA Method 821-R-02-014 / 1004.0	AT RTCCypV013013	01/30/2013	1.0	01/30/2013
16	Reference Toxicant Test Method using Sodium Lauryl Sulfate Chronic- Mysidopsis bahia by EPA Method 821-R-02-014 / 1007.0	AT RTCMysB013013	01/30/2013	1.0	01/30/2013

	General Laboratory				
1	MDL Studies, Organics	GL MDL 113005	11/30/2005	1.3	3/12/2012
2	Chemical Expiration Dates	GL ExpDt 041812	4/18/2012	1.0	
3	LOQ/LOD Determination and Verification	GL LOQLOD 122812	12/28/2012	1.0	
	Sample Control				
1	Sample Control - Sample Receipt, Log-in, Storage, Archival and Disposal	SC011500	1/15/2000	2.1	11/19/2012
2	Sample Collection (drinking water only)	SC 08/09/2000	8/9/2000	1.0	
3	Sample Handling and Chain-of-Custody for Sample Couriers	Couriers091207	9/12/2007	1.0	
	Administration				
1	Laboratory Safety and Health	Safety011600	1/16/2000	1.0	
2	Purchasing	ADMINPurchasing 043010	4/18/2012	1.1	
3	QC Review/Evaluation of Data	QC040402	4/4/2002	1.1	4/30/2010
4	Education and Training in Ethics & Legal Responsibilities	Adm040102	4/1/2002	1.1	4/1/2002
5	Training of Personnel	Adm080206	8/6/2006	1.3	1/16/2012
6	Manual Integration of Chromatographic Data	ADMIN Integration 09/11/07	9/11/2007	2.1	2/9/2012

7	Control and Use of Laboratory Notebooks	LABNOTE091107	9/12/2007	1.0	
8	Control of Records	ADMINRECORDS043010	4/30/2010	1.1	11/9/2012
9	Preventive Action	ADMINPREVACTION043010	4/30/2010	1.0	
10	Control of Nonconforming Work	QSP 4-9-1	4/30/2010	1.0	
11	Management Review	ADMINMGMTREVIEW043010	4/30/2010	1.0	
12	Internal Quality Audit`	ADMINAUDIT043010	4/30/2010	1.0	
13	Estimation of Uncertainty	ADMINESTUNCERT043010	4/30/2010	1.0	
14	Document Control	ADMINDOC043010	4/30/2010	1.2	6/2/2012
15	Corrective Action	ADMINCORRACTION043010	4/30/2010	1.0	
16	Complaints	QSP 4-8-1	4/30/2010	1.0	
17	Review of Chromatographic Data for Detection of Manual Re-Integration Issues	ADMINManINTReview04302010	4/30/2010	1.0	
18	Additional Policies/Procedures	Additional Policies 05/07/10	5/7/2010	1.1	07/11/2012
19	EDDs and Reports for Client Connect	ADMINEDDRptCC 091610	9/16/2010	1.0	
20	Preparation of CTDEP RCP Deliverables	ADMINRCPDELIVS 080210	8/2/2010	1.0	
		Quality Manual			
1	Quality Manual	QM	1/4/1996	2.3	12/26/2012

ATTACHMENT 3

NYSDOH ELAP-CERTIFICATION FOR YORK ANALYTICAL LABORATORIES INC.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised October 21, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Acrylates

Acrylonitrile	EPA 8260C
Methyl methacrylate	EPA 8260C

Amines

1,2-Diphenylhydrazine	EPA 8270D
2-Nitroaniline	EPA 8270D
3-Nitroaniline	EPA 8270D
4-Chloroaniline	EPA 8270D
4-Nitroaniline	EPA 8270D
Aniline	EPA 8270D
Carbazole	EPA 8270D
Diphenylamine	EPA 8270D

Benzidines

3,3'-Dichlorobenzidine	EPA 8270D

Characteristic Testing

Corrosivity	EPA 9045D
Ignitability	EPA 1010A
Reactivity	SW-846 Ch7 Sec. 7.3
Synthetic Precipitation Leaching Proc.	EPA 1312
TCLP	EPA 1311

Chlorinated Hydrocarbon Pesticides

4,4'-DDD	EPA 8081B
4,4'-DDE	EPA 8081B
4,4'-DDT	EPA 8081B
Aldrin	EPA 8081B

Chlorinated Hydrocarbon Pesticides

alpha-BHC	EPA 8081B
alpha-Chlordane	EPA 8081B
Atrazine	EPA 8270D
beta-BHC	EPA 8081B
Chlordane Total	EPA 8081B
delta-BHC	EPA 8081B
Dieldrin	EPA 8081B
Endosulfan I	EPA 8081B
Endosulfan II	EPA 8081B
Endosulfan sulfate	EPA 8081B
Endrin	EPA 8081B
Endrin aldehyde	EPA 8081B
Endrin Ketone	EPA 8081B
gamma-Chlordane	EPA 8081B
Heptachlor	EPA 8081B
Heptachlor epoxide	EPA 8081B
Lindane	EPA 8081B
Methoxychlor	EPA 8081B
Toxaphene	EPA 8081B

Chlorinated Hydrocarbons

1,2,3-Trichlorobenzene	EPA 8260C
1,2,4,5-Tetrachlorobenzene	EPA 8270D
1,2,4-Trichlorobenzene	EPA 8270D
2-Chloronaphthalene	EPA 8270D
Hexachlorobenzene	EPA 8270D

Serial No.: 49723

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Chlorinated Hydrocarbons

Hexachlorobutadiene	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270D
Hexachloroethane	EPA 8270D

Chlorophenoxy Acid Pesticides

2,4,5-T	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A
2,4-D	EPA 8151A
Dicamba	EPA 8151A

Haloethers

4-Bromophenylphenyl ether	EPA 8270D
4-Chlorophenylphenyl ether	EPA 8270D
Bis(2-chloroethoxy)methane	EPA 8270D
Bis(2-chloroethyl)ether	EPA 8270D
Bis(2-chloroisopropyl) ether	EPA 8270D

Metals I

Barium, Total	EPA 6010C
	EPA 6020A
Cadmium, Total	EPA 6010C
	EPA 6020A
Calcium, Total	EPA 6010C
Chromium, Total	EPA 6010C
	EPA 6020A
Copper, Total	EPA 6010C
	EPA 6020A

Metals I

Iron, Total	EPA 6010C
Lead, Total	EPA 6010C
	EPA 6020A
Magnesium, Total	EPA 6010C
Manganese, Total	EPA 6010C
	EPA 6020A
Nickel, Total	EPA 6010C
	EPA 6020A
Potassium, Total	EPA 6010C
Silver, Total	EPA 6010C
	EPA 6020A
Sodium, Total	EPA 6010C

Metals II

Aluminum, Total	EPA 6010C
	EPA 6020A
Antimony, Total	EPA 6010C
	EPA 6020A
Arsenic, Total	EPA 6010C
	EPA 6020A
Beryllium, Total	EPA 6010C
	EPA 6020A
Chromium VI	EPA 7196A
Mercury, Total	EPA 7471B
	EPA 7473
Selenium, Total	EPA 6010C

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Metals II

Selenium, Total	EPA 6020A
Vanadium, Total	EPA 6010C
	EPA 6020A
Zinc, Total	EPA 6010C
	EPA 6020A

Metals III

Cobalt, Total	EPA 6010C
	EPA 6020A
Molybdenum, Total	EPA 6020A
Thallium, Total	EPA 6010C
	EPA 6020A
Tin, Total	EPA 6020A
Titanium, Total	EPA 6020A

Miscellaneous

Boron, Total	EPA 6020A
Cyanide, Total	EPA 9014
Extractable Organic Halides	EPA 9023

Nitroaromatics and Isophorone

2,4-Dinitrotoluene	EPA 8270D
2,6-Dinitrotoluene	EPA 8270D
Isophorone	EPA 8270D
Nitrobenzene	EPA 8270D
Pyridine	EPA 8270D

Nitrosoamines

N-Nitrosodimethylamine	EPA 8270D
N-Nitrosodi-n-propylamine	EPA 8270D
N-Nitrosodiphenylamine	EPA 8270D

Petroleum Hydrocarbons

Diesel Range Organics	EPA 8015D

Phthalate Esters

Benzyl butyl phthalate	EPA 8270D
Bis(2-ethylhexyl) phthalate	EPA 8270D
Diethyl phthalate	EPA 8270D
Dimethyl phthalate	EPA 8270D
Di-n-butyl phthalate	EPA 8270D
Di-n-octyl phthalate	EPA 8270D

Polychlorinated Biphenyls

PCB-1016	EPA 8082A
PCB-1221	EPA 8082A
PCB-1232	EPA 8082A
PCB-1242	EPA 8082A
PCB-1248	EPA 8082A
PCB-1254	EPA 8082A
PCB-1260	EPA 8082A
PCB-1262	EPA 8082A
PCB-1268	EPA 8082A

Polynuclear Aromatic Hydrocarbons

Acenaphthene	EPA 8270D

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ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
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Polynuclear Aromatic Hydrocarbons

Acenaphthylene	EPA 8270D
Anthracene	EPA 8270D
Benzo(a)anthracene	EPA 8270D
Benzo(a)pyrene	EPA 8270D
Benzo(b)fluoranthene	EPA 8270D
Benzo(ghi)perylene	EPA 8270D
Benzo(k)fluoranthene	EPA 8270D
Chrysene	EPA 8270D
Dibenzo(a,h)anthracene	EPA 8270D
Fluoranthene	EPA 8270D
Fluorene	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 8270D
Naphthalene	EPA 8270D
Phenanthrene	EPA 8270D
Pyrene	EPA 8270D

Priority Pollutant Phenols

2,3,4,6 Tetrachlorophenol	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270D
2,4,6-Trichlorophenol	EPA 8270D
2,4-Dichlorophenol	EPA 8270D
2,4-Dimethylphenol	EPA 8270D
2,4-Dinitrophenol	EPA 8270D
2-Chlorophenol	EPA 8270D
2-Methyl-4,6-dinitrophenol	EPA 8270D
2-Methylphenol	EPA 8270D

Priority Pollutant Phenols

2-Nitrophenol	EPA 8270D
4-Chloro-3-methylphenol	EPA 8270D
4-Methylphenol	EPA 8270D
4-Nitrophenol	EPA 8270D
Pentachlorophenol	EPA 8270D
Phenol	EPA 8270D

Semi-Volatile Organics

1,1'-Biphenyl	EPA 8270D
1,2-Dichlorobenzene, Semi-volatile	EPA 8270D
1,3-Dichlorobenzene, Semi-volatile	EPA 8270D
1,4-Dichlorobenzene, Semi-volatile	EPA 8270D
2-Methylnaphthalene	EPA 8270D
Acetophenone	EPA 8270D
Benzaldehyde	EPA 8270D
Benzoic Acid	EPA 8270D
Benzyl alcohol	EPA 8270D
Caprolactam	EPA 8270D
Dibenzofuran	EPA 8270D

Volatile Aromatics

1,2,4-Trichlorobenzene, Volatile	EPA 8260C
1,2-Dichlorobenzene	EPA 8260C
1,3,5-Trimethylbenzene	EPA 8260C
1,3-Dichlorobenzene	EPA 8260C
1,4-Dichlorobenzene	EPA 8260C
2-Chlorotoluene	EPA 8260C

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All approved analytes are listed below:

Volatile Aromatics

4-Chlorotoluene	EPA 8260C
Benzene	EPA 8260C
Bromobenzene	EPA 8260C
Chlorobenzene	EPA 8260C
Ethyl benzene	EPA 8260C
Isopropylbenzene	EPA 8260C
Naphthalene, Volatile	EPA 8260C
n-Butylbenzene	EPA 8260C
n-Propylbenzene	EPA 8260C
p-Isopropyltoluene (P-Cymene)	EPA 8260C
sec-Butylbenzene	EPA 8260C
Styrene	EPA 8260C
tert-Butylbenzene	EPA 8260C
Toluene	EPA 8260C
Total Xylenes	EPA 8260C

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 8260C
1,1,1-Trichloroethane	EPA 8260C
1,1,2,2-Tetrachloroethane	EPA 8260C
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260C
1,1,2-Trichloroethane	EPA 8260C
1,1-Dichloroethane	EPA 8260C
1,1-Dichloroethene	EPA 8260C
1,1-Dichloropropene	EPA 8260C
1,2,3-Trichloropropane	EPA 8260C

Volatile Halocarbons

1,2-Dibromo-3-chloropropane	EPA 8260C
1,2-Dibromoethane	EPA 8260C
1,2-Dichloroethane	EPA 8260C
1,2-Dichloropropane	EPA 8260C
1,3-Dichloropropane	EPA 8260C
2,2-Dichloropropane	EPA 8260C
2-Chloroethylvinyl ether	EPA 8260C
Bromochloromethane	EPA 8260C
Bromodichloromethane	EPA 8260C
Bromoform	EPA 8260C
Bromomethane	EPA 8260C
Carbon tetrachloride	EPA 8260C
Chloroethane	EPA 8260C
Chloroform	EPA 8260C
Chloromethane	EPA 8260C
cis-1,2-Dichloroethene	EPA 8260C
cis-1,3-Dichloropropene	EPA 8260C
Dibromochloromethane	EPA 8260C
Dibromomethane	EPA 8260C
Dichlorodifluoromethane	EPA 8260C
Hexachlorobutadiene, Volatile	EPA 8260C
Methylene chloride	EPA 8260C
Tetrachloroethene	EPA 8260C
trans-1,2-Dichloroethene	EPA 8260C
trans-1,3-Dichloropropene	EPA 8260C
Trichloroethene	EPA 8260C

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STRATFORD, CT 06615

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All approved analytes are listed below:

Volatile Halocarbons	
Trichlorofluoromethane	EPA 8260C
Vinyl chloride	EPA 8260C
Volatile Organics	
1,4-Dioxane	EPA 8260C
2-Butanone (Methylethyl ketone)	EPA 8260C
2-Hexanone	EPA 8260C
4-Methyl-2-Pentanone	EPA 8260C
Acetone	EPA 8260C
Carbon Disulfide	EPA 8260C
Cyclohexane	EPA 8260C
Methyl acetate	EPA 8260C
Methyl cyclohexane	EPA 8260C
Methyl tert-butyl ether	EPA 8260C
tert-butyl alcohol	EPA 8260C
Vinyl acetate	EPA 8260C
Sample Preparation Methods	
	EPA 3005A
	EPA 3010A
	EPA 3031
	EPA 3040A
	EPA 3050B
	EPA 3060A
	EPA 3545A
	EPA 3550C
	EPA 3580A

Sample Preparation Methods	
	EPA 3585
	EPA 5035A-H
	EPA 5035A-L
	EPA 9010C

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NEW YORK
state department of
HEALTH

Nirav R. Shah, M.D., M.P.H.
Commissioner

Sue Kelly
Executive Deputy Commissioner

LAB ID: 10854

October 21, 2013

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

Dear Mr. Bradley,

A revised certificate has been generated because of the change(s) listed below.

If the changes to your certification are due to insufficient proficiency tests and/or proficiency test (PT) failures, the expired certificates must be returned to the Environmental Laboratory Approval Program (ELAP) office within 10 days of the date of this letter. In addition, your laboratory must investigate the root cause for any insufficient and/or unsatisfactory proficiency tests.

In addition, your laboratory must investigate and document the root cause for any insufficient and/or unsatisfactory proficiency tests. If your lab lost accreditation due to two PT failures, you must submit the corrective action response to ELAP for review before accreditation will be re-instated.

AppCat	Analyte Name Method Name	Comments	Date
SW - NELAC	Titanium, Total EPA 3005A	Raised to Approved	10/17/2013
SW - NELAC	Titanium, Total EPA 3010A	Raised to Approved	10/17/2013
SW - NELAC	Titanium, Total EPA 6020A	Raised to Approved	10/17/2013
SW - NELAC	Titanium, Total EPA 3050B	Raised to Approved	10/17/2013

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NY Lab Id No: 10854

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Drinking Water Metals I

Arsenic, Total	EPA 200.8 Rev. 5.4
Barium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Cadmium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Chromium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Copper, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Iron, Total	EPA 200.7 Rev. 4.4
Lead, Total	EPA 200.8 Rev. 5.4
Manganese, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Mercury, Total	EPA 245.1 Rev. 3.0
Selenium, Total	EPA 200.8 Rev. 5.4
Silver, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Zinc, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Drinking Water Metals II

Aluminum, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Antimony, Total	EPA 200.8 Rev. 5.4
Beryllium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Drinking Water Metals II

Molybdenum, Total	EPA 200.8 Rev. 5.4
Nickel, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Thallium, Total	EPA 200.8 Rev. 5.4
Vanadium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Drinking Water Metals III

Calcium, Total	EPA 200.7 Rev. 4.4
Magnesium, Total	EPA 200.7 Rev. 4.4
Potassium, Total	EPA 200.7 Rev. 4.4
Sodium, Total	EPA 200.7 Rev. 4.4

Drinking Water Non-Metals

Alkalinity	SM 18-21 2320B (97)
Calcium Hardness	EPA 200.7 Rev. 4.4
Chloride	EPA 300.0 Rev. 2.1
Color	SM 18-21 2120B (01)
Fluoride, Total	EPA 300.0 Rev. 2.1
Nitrate (as N)	EPA 300.0 Rev. 2.1
Nitrite (as N)	EPA 300.0 Rev. 2.1
Orthophosphate (as P)	EPA 300.0 Rev. 2.1
Solids, Total Dissolved	SM 18-21 2540C (97)
Specific Conductance	EPA 120.1 Rev. 1982
Sulfate (as SO4)	EPA 300.0 Rev. 2.1

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NELAP RECOGNIZED ACCREDITATION BODY

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WADSWORTH CENTER

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All approved analytes are listed below:

Drinking Water Trihalomethanes

Bromodichloromethane	EPA 524.2
Bromoform	EPA 524.2
Chloroform	EPA 524.2
Dibromochloromethane	EPA 524.2

Fuel Additives

Methyl tert-butyl ether	EPA 524.2
Naphthalene	EPA 524.2

Volatile Aromatics

1,2,3-Trichlorobenzene	EPA 524.2
1,2,4-Trichlorobenzene	EPA 524.2
1,2,4-Trimethylbenzene	EPA 524.2
1,2-Dichlorobenzene	EPA 524.2
1,3,5-Trimethylbenzene	EPA 524.2
1,3-Dichlorobenzene	EPA 524.2
1,4-Dichlorobenzene	EPA 524.2
4-Chlorotoluene	EPA 524.2
Benzene	EPA 524.2
Bromobenzene	EPA 524.2
Chlorobenzene	EPA 524.2
Ethyl benzene	EPA 524.2
Hexachlorobutadiene	EPA 524.2
Isopropylbenzene	EPA 524.2
n-Butylbenzene	EPA 524.2
n-Propylbenzene	EPA 524.2
p-Isopropyltoluene (P-Cymene)	EPA 524.2

Volatile Aromatics

Styrene	EPA 524.2
tert-Butylbenzene	EPA 524.2
Toluene	EPA 524.2
Total Xylenes	EPA 524.2

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 524.2
1,1,1-Trichloroethane	EPA 524.2
1,1,2,2-Tetrachloroethane	EPA 524.2
1,1,2-Trichloroethane	EPA 524.2
1,1-Dichloroethane	EPA 524.2
1,1-Dichloroethene	EPA 524.2
1,1-Dichloropropene	EPA 524.2
1,2,3-Trichloropropane	EPA 524.2
1,2-Dichloroethane	EPA 524.2
1,2-Dichloropropane	EPA 524.2
1,3-Dichloropropane	EPA 524.2
2,2-Dichloropropane	EPA 524.2
Bromochloromethane	EPA 524.2
Bromomethane	EPA 524.2
Carbon tetrachloride	EPA 524.2
Chloroethane	EPA 524.2
Chloromethane	EPA 524.2
cis-1,2-Dichloroethene	EPA 524.2
cis-1,3-Dichloropropene	EPA 524.2
Dibromomethane	EPA 524.2

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CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Volatile Halocarbons

Dichlorodifluoromethane	EPA 524.2
Methylene chloride	EPA 524.2
Tetrachloroethene	EPA 524.2
trans-1,3-Dichloropropene	EPA 524.2
Trichloroethene	EPA 524.2
Trichlorofluoromethane	EPA 524.2
Vinyl chloride	EPA 524.2

Serial No.: 49896

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NELAP RECOGNIZED ACCREDITATION BODY

NEW YORK
state department of
HEALTH

Nirav R. Shah, M.D., M.P.H.
Commissioner

Sue Kelly
Executive Deputy Commissioner

LAB ID: 10854

December 20, 2013

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

Dear Mr. Bradley,

A revised certificate has been generated because of the change(s) listed below.

If the changes to your certification are due to insufficient proficiency tests and/or proficiency test (PT) failures, the expired certificates must be returned to the Environmental Laboratory Approval Program (ELAP) office within 10 days of the date of this letter. In addition, your laboratory must investigate the root cause for any insufficient and/or unsatisfactory proficiency tests.

In addition, your laboratory must investigate and document the root cause for any insufficient and/or unsatisfactory proficiency tests. If your lab lost accreditation due to two PT failures, you must submit the corrective action response to ELAP for review before accreditation will be re-instated.

AppCat	Analyte Name Method Name	Comments	Date
PW - NELAC	trans-1,2-Dichloroethene EPA 524.2	Dropped from Approved	12/05/2013
PW - NELAC	Turbidity EPA 180.1 Rev. 2.0	Dropped from Approved	12/05/2013
PW - NELAC	2-Chlorotoluene EPA 524.2	Dropped from Approved	12/05/2013

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
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Revised November 01, 2013

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Drinking Water Metals I

Arsenic, Total	EPA 200.8 Rev. 5.4
Barium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Cadmium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Chromium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Copper, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Iron, Total	EPA 200.7 Rev. 4.4
Lead, Total	EPA 200.8 Rev. 5.4
Manganese, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Mercury, Total	EPA 245.1 Rev. 3.0
Selenium, Total	EPA 200.8 Rev. 5.4
Silver, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Zinc, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Drinking Water Metals II

Aluminum, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Antimony, Total	EPA 200.8 Rev. 5.4
Beryllium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Drinking Water Metals II

Molybdenum, Total	EPA 200.8 Rev. 5.4
Nickel, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Thallium, Total	EPA 200.8 Rev. 5.4
Vanadium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Drinking Water Metals III

Calcium, Total	EPA 200.7 Rev. 4.4
Magnesium, Total	EPA 200.7 Rev. 4.4
Potassium, Total	EPA 200.7 Rev. 4.4
Sodium, Total	EPA 200.7 Rev. 4.4

Drinking Water Miscellaneous

Turbidity	EPA 180.1 Rev. 2.0

Drinking Water Non-Metals

Alkalinity	SM 18-21 2320B (97)
Calcium Hardness	EPA 200.7 Rev. 4.4
Chloride	EPA 300.0 Rev. 2.1
Color	SM 18-21 2120B (01)
Fluoride, Total	EPA 300.0 Rev. 2.1
Nitrate (as N)	EPA 300.0 Rev. 2.1
Nitrite (as N)	EPA 300.0 Rev. 2.1
Orthophosphate (as P)	EPA 300.0 Rev. 2.1
Solids, Total Dissolved	SM 18-21 2540C (97)
Specific Conductance	EPA 120.1 Rev. 1982

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WADSWORTH CENTER

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ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Drinking Water Non-Metals

Sulfate (as SO4)	EPA 300.0 Rev. 2.1

Drinking Water Trihalomethanes

Bromodichloromethane	EPA 524.2
Bromoform	EPA 524.2
Chloroform	EPA 524.2
Dibromochloromethane	EPA 524.2

Fuel Additives

Methyl tert-butyl ether	EPA 524.2
Naphthalene	EPA 524.2

Volatile Aromatics

1,2,3-Trichlorobenzene	EPA 524.2
1,2,4-Trichlorobenzene	EPA 524.2
1,2,4-Trimethylbenzene	EPA 524.2
1,2-Dichlorobenzene	EPA 524.2
1,3,5-Trimethylbenzene	EPA 524.2
1,3-Dichlorobenzene	EPA 524.2
1,4-Dichlorobenzene	EPA 524.2
2-Chlorotoluene	EPA 524.2
4-Chlorotoluene	EPA 524.2
Benzene	EPA 524.2
Bromobenzene	EPA 524.2
Chlorobenzene	EPA 524.2
Ethyl benzene	EPA 524.2
Hexachlorobutadiene	EPA 524.2

Volatile Aromatics

Isopropylbenzene	EPA 524.2
n-Butylbenzene	EPA 524.2
n-Propylbenzene	EPA 524.2
p-Isopropyltoluene (P-Cymene)	EPA 524.2
Styrene	EPA 524.2
tert-Butylbenzene	EPA 524.2
Toluene	EPA 524.2
Total Xylenes	EPA 524.2

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 524.2
1,1,1-Trichloroethane	EPA 524.2
1,1,2,2-Tetrachloroethane	EPA 524.2
1,1,2-Trichloroethane	EPA 524.2
1,1-Dichloroethane	EPA 524.2
1,1-Dichloroethene	EPA 524.2
1,1-Dichloropropene	EPA 524.2
1,2,3-Trichloropropane	EPA 524.2
1,2-Dichloroethane	EPA 524.2
1,2-Dichloropropane	EPA 524.2
1,3-Dichloropropane	EPA 524.2
2,2-Dichloropropane	EPA 524.2
Bromochloromethane	EPA 524.2
Bromomethane	EPA 524.2
Carbon tetrachloride	EPA 524.2
Chloroethane	EPA 524.2

Serial No.: 49756

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Volatile Halocarbons

Chloromethane	EPA 524.2
cis-1,2-Dichloroethene	EPA 524.2
cis-1,3-Dichloropropene	EPA 524.2
Dibromomethane	EPA 524.2
Dichlorodifluoromethane	EPA 524.2
Methylene chloride	EPA 524.2
Tetrachloroethene	EPA 524.2
trans-1,2-Dichloroethene	EPA 524.2
trans-1,3-Dichloropropene	EPA 524.2
Trichloroethene	EPA 524.2
Trichlorofluoromethane	EPA 524.2
Vinyl chloride	EPA 524.2

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All approved analytes are listed below:

Acrylates

Acrolein (Propenal)	EPA 624
	EPA 8260C
Acrylonitrile	EPA 624
	EPA 8260C
Methyl methacrylate	EPA 8260C

Amines

1,2-Diphenylhydrazine	EPA 8270D
2-Nitroaniline	EPA 8270D
3-Nitroaniline	EPA 8270D
4-Chloroaniline	EPA 8270D
4-Nitroaniline	EPA 8270D
Aniline	EPA 8270D
Carbazole	EPA 625
	EPA 8270D
Pyridine	EPA 625
	EPA 8270D

Benzidines

3,3'-Dichlorobenzidine	EPA 625
	EPA 8270D
Benzidine	EPA 625
	EPA 8270D

Chlorinated Hydrocarbon Pesticides

4,4'-DDD	EPA 608
	EPA 8081B

Chlorinated Hydrocarbon Pesticides

4,4'-DDE	EPA 608
	EPA 8081B
4,4'-DDT	EPA 608
	EPA 8081B
Aldrin	EPA 608
	EPA 8081B
alpha-BHC	EPA 608
	EPA 8081B
alpha-Chlordane	EPA 8081B
beta-BHC	EPA 608
	EPA 8081B
Chlordane Total	EPA 608
	EPA 8081B
delta-BHC	EPA 608
	EPA 8081B
Dieldrin	EPA 608
	EPA 8081B
Endosulfan I	EPA 608
	EPA 8081B
Endosulfan II	EPA 608
	EPA 8081B
Endosulfan sulfate	EPA 608
	EPA 8081B
Endrin	EPA 608
	EPA 8081B
Endrin aldehyde	EPA 608

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Chlorinated Hydrocarbon Pesticides

Endrin aldehyde	EPA 8081B
Endrin Ketone	EPA 8081B
gamma-Chlordane	EPA 8081B
Heptachlor	EPA 608
	EPA 8081B
Heptachlor epoxide	EPA 608
	EPA 8081B
Lindane	EPA 608
	EPA 8081B
Methoxychlor	EPA 608
	EPA 8081B
Toxaphene	EPA 608
	EPA 8081B

Chlorinated Hydrocarbons

1,2,3-Trichlorobenzene	EPA 8260C
1,2,4,5-Tetrachlorobenzene	EPA 8270D
1,2,4-Trichlorobenzene	EPA 625
	EPA 8270D
2-Chloronaphthalene	EPA 625
	EPA 8270D
Hexachlorobenzene	EPA 625
	EPA 8270D
Hexachlorobutadiene	EPA 625
	EPA 8270D
Hexachlorocyclopentadiene	EPA 625

Chlorinated Hydrocarbons

Hexachlorocyclopentadiene	EPA 8270D
Hexachloroethane	EPA 625
	EPA 8270D

Chlorophenoxy Acid Pesticides

2,4,5-T	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A
2,4-D	EPA 8151A
Dicamba	EPA 8151A

Demand

Biochemical Oxygen Demand	SM 18-21 5210B (01)
Carbonaceous BOD	SM 18-21 5210B (01)
Chemical Oxygen Demand	SM 18-21 5220D (97)

Fuel Oxygenates

Di-isopropyl ether	EPA 8260C
Ethanol	EPA 8260C
Methyl tert-butyl ether	EPA 8260C
tert-amyl alcohol	EPA 8260C
tert-amyl methyl ether (TAME)	EPA 8260C
tert-butyl alcohol	EPA 8260C
tert-butyl ethyl ether (ETBE)	EPA 8260C

Haloethers

4-Bromophenylphenyl ether	EPA 625
	EPA 8270D
4-Chlorophenylphenyl ether	EPA 625

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Haloethers

4-Chlorophenylphenyl ether	EPA 8270D
Bis(2-chloroethoxy)methane	EPA 625
	EPA 8270D
Bis(2-chloroethyl)ether	EPA 625
	EPA 8270D
Bis(2-chloroisopropyl) ether	EPA 625
	EPA 8270D

Low Level Polynuclear Aromatics

Acenaphthene Low Level	EPA 8270D
Acenaphthylene Low Level	EPA 8270D
Anthracene Low Level	EPA 8270D
Benzo(a)anthracene Low Level	EPA 8270D
Benzo(a)pyrene Low Level	EPA 8270D
Benzo(b)fluoranthene Low Level	EPA 8270D
Benzo(g,h,i)perylene Low Level	EPA 8270D
Benzo(k)fluoranthene Low Level	EPA 8270D
Chrysene Low Level	EPA 8270D
Dibenzo(a,h)anthracene Low Level	EPA 8270D
Fluoranthene Low Level	EPA 8270D
Fluorene Low Level	EPA 8270D
Indeno(1,2,3-cd)pyrene Low Level	EPA 8270D
Naphthalene Low Level	EPA 8270D
Phenanthrene Low Level	EPA 8270D
Pyrene Low Level	EPA 8270D

Mineral

Alkalinity	SM 18-21 2320B (97)
Calcium Hardness	EPA 200.7 Rev. 4.4
Chloride	EPA 300.0 Rev. 2.1
Fluoride, Total	EPA 300.0 Rev. 2.1
Hardness, Total	EPA 200.7 Rev. 4.4
Sulfate (as SO4)	EPA 300.0 Rev. 2.1

Nitroaromatics and Isophorone

2,4-Dinitrotoluene	EPA 625
	EPA 8270D
2,6-Dinitrotoluene	EPA 625
	EPA 8270D
Isophorone	EPA 625
	EPA 8270D
Nitrobenzene	EPA 625
	EPA 8270D

Nitrosoamines

N-Nitrosodimethylamine	EPA 625
	EPA 8270D
N-Nitrosodi-n-propylamine	EPA 625
	EPA 8270D
N-Nitrosodiphenylamine	EPA 625
	EPA 8270D

Nutrient

Ammonia (as N)	SM 19-21 4500-NH3 D or E (97)

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Nutrient

Kjeldahl Nitrogen, Total	SM 19-21 4500-NH3 D or E (97)
Nitrate (as N)	EPA 300.0 Rev. 2.1
Nitrite (as N)	EPA 300.0 Rev. 2.1
Orthophosphate (as P)	EPA 300.0 Rev. 2.1
Phosphorus, Total	SM 18-21 4500-P E

Organophosphate Pesticides

Atrazine	EPA 8270D

Petroleum Hydrocarbons

Diesel Range Organics	EPA 8015D

Phthalate Esters

Benzyl butyl phthalate	EPA 625
	EPA 8270D
Bis(2-ethylhexyl) phthalate	EPA 625
	EPA 8270D
Diethyl phthalate	EPA 625
	EPA 8270D
Dimethyl phthalate	EPA 625
	EPA 8270D
Di-n-butyl phthalate	EPA 625
	EPA 8270D
Di-n-octyl phthalate	EPA 625
	EPA 8270D

Polychlorinated Biphenyls

PCB-1016	EPA 608

Polychlorinated Biphenyls

PCB-1016	EPA 8082A
PCB-1221	EPA 608
	EPA 8082A
PCB-1232	EPA 608
	EPA 8082A
PCB-1242	EPA 608
	EPA 8082A
PCB-1248	EPA 608
	EPA 8082A
PCB-1254	EPA 608
	EPA 8082A
PCB-1260	EPA 608
	EPA 8082A
PCB-1262	EPA 8082A
PCB-1268	EPA 8082A

Polynuclear Aromatics

Acenaphthene	EPA 625
	EPA 8270D
Acenaphthylene	EPA 625
	EPA 8270D
Anthracene	EPA 625
	EPA 8270D
Benzo(a)anthracene	EPA 625
	EPA 8270D
Benzo(a)pyrene	EPA 625

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Polynuclear Aromatics

Benzo(a)pyrene	EPA 8270D
Benzo(b)fluoranthene	EPA 625
	EPA 8270D
Benzo(ghi)perylene	EPA 625
	EPA 8270D
Benzo(k)fluoranthene	EPA 625
	EPA 8270D
Chrysene	EPA 625
	EPA 8270D
Dibenzo(a,h)anthracene	EPA 625
	EPA 8270D
Fluoranthene	EPA 625
	EPA 8270D
Fluorene	EPA 625
	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 625
	EPA 8270D
Naphthalene	EPA 625
	EPA 8270D
Phenanthrene	EPA 625
	EPA 8270D
Pyrene	EPA 625
	EPA 8270D

Priority Pollutant Phenols

2,3,4,6 Tetrachlorophenol	EPA 8270D

Priority Pollutant Phenols

2,4,5-Trichlorophenol	EPA 625
	EPA 8270D
2,4,6-Trichlorophenol	EPA 625
	EPA 8270D
2,4-Dichlorophenol	EPA 625
	EPA 8270D
2,4-Dimethylphenol	EPA 625
	EPA 8270D
2,4-Dinitrophenol	EPA 625
	EPA 8270D
2-Chlorophenol	EPA 625
	EPA 8270D
2-Methyl-4,6-dinitrophenol	EPA 625
	EPA 8270D
2-Methylphenol	EPA 625
	EPA 8270D
2-Nitrophenol	EPA 625
	EPA 8270D
4-Chloro-3-methylphenol	EPA 625
	EPA 8270D
4-Methylphenol	EPA 625
	EPA 8270D
4-Nitrophenol	EPA 625
	EPA 8270D
Cresols, Total	EPA 8270D
Pentachlorophenol	EPA 625

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All approved analytes are listed below:

Priority Pollutant Phenols	
Pentachlorophenol	EPA 8270D
Phenol	EPA 625
	EPA 8270D
Residue	
Settleable Solids	SM 18-21 2540 F (97)
Solids, Total	SM 18-21 2540B (97)
Solids, Total Dissolved	SM 18-21 2540C (97)
Solids, Total Suspended	SM 18-21 2540D (97)
Semi-Volatile Organics	
1,1'-Biphenyl	EPA 8270D
1,2-Dichlorobenzene, Semi-volatile	EPA 8270D
1,3-Dichlorobenzene, Semi-volatile	EPA 8270D
1,4-Dichlorobenzene, Semi-volatile	EPA 8270D
2-Methylnaphthalene	EPA 8270D
Acetophenone	EPA 8270D
alpha-Terpineol	EPA 625
Benzaldehyde	EPA 8270D
Benzoic Acid	EPA 8270D
Benzyl alcohol	EPA 8270D
Caprolactam	EPA 8270D
Dibenzofuran	EPA 8270D
Volatile Aromatics	
1,2,4-Trichlorobenzene, Volatile	EPA 8260C
1,2,4-Trimethylbenzene	EPA 8260C

Volatile Aromatics	
1,2-Dichlorobenzene	EPA 624
	EPA 8260C
1,3,5-Trimethylbenzene	EPA 8260C
1,3-Dichlorobenzene	EPA 624
	EPA 8260C
1,4-Dichlorobenzene	EPA 624
	EPA 8260C
2-Chlorotoluene	EPA 8260C
4-Chlorotoluene	EPA 8260C
Benzene	EPA 624
	EPA 8260C
Bromobenzene	EPA 8260C
Chlorobenzene	EPA 624
	EPA 8260C
Ethyl benzene	EPA 624
	EPA 8260C
Isopropylbenzene	EPA 8260C
Naphthalene, Volatile	EPA 8260C
n-Butylbenzene	EPA 8260C
n-Propylbenzene	EPA 8260C
p-Isopropyltoluene (P-Cymene)	EPA 8260C
sec-Butylbenzene	EPA 8260C
Styrene	EPA 624
	EPA 8260C
tert-Butylbenzene	EPA 8260C
Toluene	EPA 624

Serial No.: 49757

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NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised November 01, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category
ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Volatile Aromatics

Toluene	EPA 8260C
Total Xylenes	EPA 624 EPA 8260C

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 8260C
1,1,1-Trichloroethane	EPA 624 EPA 8260C
1,1,2,2-Tetrachloroethane	EPA 624 EPA 8260C
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260C
1,1,2-Trichloroethane	EPA 624 EPA 8260C
1,1-Dichloroethane	EPA 624 EPA 8260C
1,1-Dichloroethene	EPA 624 EPA 8260C
1,1-Dichloropropene	EPA 8260C
1,2,3-Trichloropropane	EPA 8260C
1,2-Dibromo-3-chloropropane	EPA 8011 EPA 8260C
1,2-Dibromoethane	EPA 8011 EPA 8260C
1,2-Dichloroethane	EPA 624 EPA 8260C
1,2-Dichloropropane	EPA 624

Volatile Halocarbons

1,2-Dichloropropane	EPA 8260C
1,3-Dichloropropane	EPA 8260C
2,2-Dichloropropane	EPA 8260C
2-Chloroethylvinyl ether	EPA 624 EPA 8260C
Bromochloromethane	EPA 8260C
Bromodichloromethane	EPA 624 EPA 8260C
Bromoform	EPA 624 EPA 8260C
Bromomethane	EPA 624 EPA 8260C
Carbon tetrachloride	EPA 624 EPA 8260C
Chloroethane	EPA 624 EPA 8260C
Chloroform	EPA 624 EPA 8260C
Chloromethane	EPA 624 EPA 8260C
cis-1,2-Dichloroethene	EPA 624 EPA 8260C
cis-1,3-Dichloropropene	EPA 624 EPA 8260C
Dibromochloromethane	EPA 624 EPA 8260C

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Volatile Halocarbons

Dibromomethane	EPA 8260C
Dichlorodifluoromethane	EPA 624
	EPA 8260C
Hexachlorobutadiene, Volatile	EPA 8260C
Methylene chloride	EPA 624
	EPA 8260C
Tetrachloroethene	EPA 624
	EPA 8260C
trans-1,2-Dichloroethene	EPA 624
	EPA 8260C
trans-1,3-Dichloropropene	EPA 624
	EPA 8260C
trans-1,4-Dichloro-2-butene	EPA 8260C
Trichloroethene	EPA 624
	EPA 8260C
Trichlorofluoromethane	EPA 624
	EPA 8260C
Vinyl chloride	EPA 624
	EPA 8260C

Volatiles Organics

1,4-Dioxane	EPA 8260C
2-Butanone (Methylethyl ketone)	EPA 8260C
2-Hexanone	EPA 8260C
4-Methyl-2-Pentanone	EPA 8260C
Acetone	EPA 8260C

Volatiles Organics

Carbon Disulfide	EPA 8260C
Cyclohexane	EPA 8260C
Methyl acetate	EPA 8260C
Methyl cyclohexane	EPA 8260C
Vinyl acetate	EPA 8260C

Wastewater Metals I

Barium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Cadmium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Calcium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Chromium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Copper, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Iron, Total	EPA 200.7 Rev. 4.4

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All approved analytes are listed below:

Wastewater Metals I	
Iron, Total	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Lead, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Magnesium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Manganese, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Nickel, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Potassium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Silver, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Sodium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C

Wastewater Metals II	
Aluminum, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Antimony, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Arsenic, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Beryllium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Chromium VI	EPA 7196A
	SM 20-21 3500-Cr B (01)
Mercury, Total	EPA 245.1 Rev. 3.0
	EPA 245.2 Rev. 1974
	EPA 7470A
	EPA 7473
Selenium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A

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All approved analytes are listed below:

Wastewater Metals II

Vanadium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Zinc, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A

Wastewater Metals III

Cobalt, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Molybdenum, Total	EPA 200.8 Rev. 5.4
	EPA 6020A
Thallium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Tin, Total	EPA 200.8 Rev. 5.4
	EPA 6020A
Titanium, Total	EPA 200.8 Rev. 5.4
	EPA 6020A

Wastewater Miscellaneous

Boron, Total	EPA 200.8 Rev. 5.4

Wastewater Miscellaneous

Boron, Total	EPA 6020A
Bromide	EPA 300.0 Rev. 2.1
Color	SM 18-21 2120B (01)
Cyanide, Total	SM 18-21 4500-CN E (99)
Oil and Grease Total Recoverable (HEM	EPA 1664A
Organic Carbon, Total	SM 18-21 5310C (00)
Phenols	EPA 420.1 Rev. 1978
Specific Conductance	EPA 120.1 Rev. 1982
Sulfide (as S)	SM 19-21 4500-S F (00)
Surfactant (MBAS)	SM 18-21 5540C (00)
Turbidity	EPA 180.1 Rev. 2.0

Sample Preparation Methods

	EPA 3005A
	EPA 3010A
	EPA 3020A
	EPA 3510C
	EPA 5030C
	SM 18-20 4500-CN C
	SM 18-21 4500-N Org B or C (97)
	SM 18-21 4500-P b.5

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NEW YORK
state department of
HEALTH

Nirav R. Shah, M.D., M.P.H.
Commissioner

Sue Kelly
Executive Deputy Commissioner

LAB ID: 10854

November 01, 2013

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

Dear Mr. Bradley,

A revised certificate has been generated because of the change(s) listed below.

If the changes to your certification are due to insufficient proficiency tests and/or proficiency test (PT) failures, the expired certificates must be returned to the Environmental Laboratory Approval Program (ELAP) office within 10 days of the date of this letter. In addition, your laboratory must investigate the root cause for any insufficient and/or unsatisfactory proficiency tests.

In addition, your laboratory must investigate and document the root cause for any insufficient and/or unsatisfactory proficiency tests. If your lab lost accreditation due to two PT failures, you must submit the corrective action response to ELAP for review before accreditation will be re-instated.

AppCat	Analyte Name Method Name	Comments	Date
NW - NELAC	Barium, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Manganese, Total EPA 6020A	Raised to Approved	10/29/2013
NW	Magnesium, Total EPA 200.8 Rev. 5.4	Dropped from Approved	11/01/2013
NW - NELAC	Manganese, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Nickel, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Zinc, Total EPA 6020A	Raised to Approved	10/29/2013
NW - NELAC	Iron, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013

AppCat	Analyte Name Method Name	Comments	Date
NW - NELAC	Vanadium, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Aluminum, Total EPA 6020A	Raised to Approved	10/29/2013
NW - NELAC	Iron, Total EPA 6020A	Raised to Approved	10/29/2013
PW - NELAC	1,1,2,2-Tetrachloroethane EPA 524.2	Raised to Approved	10/24/2013
NW - NELAC	Aluminum, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Zinc, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Nickel, Total EPA 6020A	Raised to Approved	10/29/2013
NW - NELAC	Cobalt, Total EPA 6020A	Raised to Approved	10/29/2013
NW - NELAC	Cobalt, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Antimony, Total EPA 6020A	Raised to Approved	10/29/2013
NW - NELAC	Silver, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Silver, Total EPA 6020A	Raised to Approved	10/29/2013
NW - NELAC	Antimony, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Barium, Total EPA 6020A	Raised to Approved	10/29/2013
NW - NELAC	Vanadium, Total EPA 6020A	Raised to Approved	10/29/2013

FORM I

PREVENTIVE MAINTENANCE – LABORATORY EQUIPMENT

Instrument	Activity	Frequency
Gas Chromatographs	Clean injector for capillary column Replace injector septum Check carrier gas connections/filters Check filter flow controller Inspect / replace capillary columns Replace detector due to excessive signal Replace Injection port liner	Weekly Daily As Required As Required As Required As Required Daily
Mass Spectrometers (MS)	Inspect/replace mass analyzer assembly Clean quadruple mass analyzer Replace electron multiplier Inspect/change oil for vacuum pumps Inspect turbomolecular or Diffusion pump Clean vacuum system filter (if equipped) Clean ion source/Retune	As Required Annually As Rrequired Annually Every 3 months Weekly As Required
Mercury Cold Vapor Analyzer	Replace tubing Replace Purge bottle Replace Cell	Monthly Monthly As-needed
Ion Chromatographs (anions)	Replace or flush guard column Replace Analytical Column Perform annual PM servicing of parts	Every 6 months Every 6 months Every 12 months
ICP (Inductively Coupled Plasma), and ICP/MS	Check tubing, waste and gas flow Replace tubing/Empty waste container Change coolant water Check air filters/Change air filters Clean/replace torch Check and clean filters Clean nebulizer chamber area/Replace	Daily Daily Daily Every 2/6 months As needed Every 6 months As needed

FORM J

CALIBRATION AND CORRECTIVE ACTION – LABORATORY INSTRUMENTATION

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
GC/MS-Volatiles Including Air	BFB Tuning	Every 12 hours, if necessary	Per Method 8260 and EPA TO-15 for AIR	Perform instrument maintenance, retune instrument	1a, 1b
	Initial Calibration (minimum of 5 standards)	Startup, CCC failure, LCS failure, major maintenance	Low STD @ 0.5 ppb for water, 5.0 ppb for soil ≤15% Average RSD or “r”≥0.99 CCC ≤30% and RSD or “r”≥0.99 Contains all target analytes, min. R_f ≥ 0.05 If regression used curve must not be forced through origin	Recalibrate as required by method (1) if any of CCC %RSDs or if any one of CCC “r” <0.990 or (2) if >20% of remaining analytes have %RSD >30 or “r” < 0.990.	
	Initial Calib. Verification	After initial calibration	All compounds 80-120%; 20% of compounds can be outside of range; no compounds <65>135%.	Recalibrate	
	Continuing Calibration Check (CCC)	Every 12 hours prior to analysis of samples	Concentration level near midpoint of curve Contain all target analytes Percent difference must be ≤20% for CCC and ≤30% for other compounds.	Recalibrate as required by method (1) If %D of any CCC>20% (2) If %D of >10% of other analytes >30%	
	Method Blanks	Every 20 samples prior to running samples and after calibration STDs	Matrix and preservative specific Target analytes should be <RL except common contaminants laboratory contaminants. If not, note in narrative.	Locate the source of contamination, correct problem, reanalyze method blank	

Instrument/Analysis	**Activity**	**Frequency**	**Acceptance Criteria**	**Corrective Action**	**SOP Ref. ***
GC/MS-Volatiles	Laboratory Control Samples (LCS)	Every 20 field samples	Prepared using a std source different than initial calibration Concentration level near midpoint of curve Contain representative target analytes Matrix specific Laboratory determined recoveries must be between 70-130% for all compounds-narrative for outliers Can also be used as Cont. Cal. Verification.	Recalculate the percent recoveries, reanalyze the LCS, locate source of problem, reanalyze associated sample	1a
	Surrogates	Minimum of three at retention times across the GC run	Up to 10% outside of range acceptable as long as within 40-160%. Response must be 70-130% of the initial calibration response.Retention times must be +/- 30 seconds of initial calibration retention time	If surrogate outside lab control limits, rerun except when: (1) obvious interference documented by re-run (2) No targets detected	
	Internal Stds	3 must be used	Response must be > ½ the corres. Area in the CCC or 2x that area.		

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
GC/MS-Semi-Volatiles	DFTPP Tune	Every 12 hours	Per SW-846 Method 8270C	Perform instrument maintenance, retune instrument	2a, 2b, 2c, 2d
	Initial Calibration (minimum of 5 standards)	Startup, CCC failure, LCS failure, major maintenance	Low STD @ 5.0 ug/ml SCAN; 0.05 ug/ml SIM 1) Minimum of 5 standards. 2)Full Scan % RSD ≤ 15 or “r” ≥ 0.990 for all compounds except CCC’s, which must be ≤ 30% RSD or “r” ≥ 0.990.; SIM % RSD ≤30 or “r” ≥ 0.990. 3) Must contain all target analytes 4) If SIM is used, laboratory must monitor at least two ions/analyte for all targets, surrogates, and IS’s. 5) Minimum RF for all compounds > 0.05.	Recalibrate as required by method. (1) If any CCC RSD>20% or “r”<0.99 (2) If >20% of remaining analytes have a RSD>30% or “r”<0.99	
	Initial Calib. Verification	After Initial Calib.	1) Compounds must recover within 80-120% 2) Laboratories are allowed to have 20% of compounds out, as long as all compounds within recover 65-135%	Recalibrate system	
	Continuing Calibration Check (CCC)	Every 12 hours prior to analysis of samples	1)Contain all target analytes 2)Percent difference must be ≤20% for CCC and ≤30% for other compounds.	Recalibrate system	
	Method Blanks	Every 20 samples prior to running samples and after calibration STDs	Matrix specific Target analytes should be <RL except common phthalates, which cab be ≤ 3x RL	Locate the source of contamination, correct problem, reextract and reanalyze method blank	
	Lab Control Sample (LCS) and MS/MSD	One per Extraction batch of ≤ 20 samples Per matrix	1) Every 20 samples or each batch, whichever is more frequent. 2) Concentration level must be near or at the mid-point of the initial calibration. 3) Must contain all target analytes 4) Matrix and preservative specific 5) Laboratory determined percent recovery limits must be between 40-140% for base-neutrals and 30-130% for acid compounds. RPD ≤ 20 for waters and ≤30 for soils	Re-extract LCS and samples if >20% compounds outside acceptance criteria For Site Specific MS/MSD note outliers in narrative.	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
GC/ECD Pesticides	Endrin/DDT Breakdown	At beginning of each 12 hour clock	≤ 15% breakdown for each	Perform corrective action on injection port	3a, 2b, 2c, 2d
	Initial Calibration	Startup, CCC failure, LCS failure, major maintenance	1) Minimum of 5 stds for single response pesticides. 2) Low std at RL 3) % RSD must be ≤20% or if linear regression used “r” ≥ 0.990 4) For multi-response pesticides analysis of single std at mid-point of calibration range. 5) If curves are used, curve must NOT be forced through origin. Section 7.5 6) Curves must be verified with independent ICV prior to sample analysis.	Recalibrate after corrective action on injection port or column	
	Continuing Calibration Verification	Prior to samples, every 12-hours or 20 samples, whichever is more frequent, and at the end of the analytical sequence.	Percent difference or drift ≤15%. Verify all analytes fall in retention time windows.	1) Perform instrument maintenance, reanalyze CCAL and/or recalibrate. 2) Reanalyze associated samples if beginning or closing CCAL exhibited low response and associated pesticides not detected in samples. 3) Reanalyze associated samples if beginning or closing CCAL high and associated pesticides were detected in samples.	
	Method Blank	1) Extracted every 20 samples or every batch, whichever is greater. 2) Matrix specific	All target analytes < RL	Locate source of contamination and correct problem. Reanalyze method blank. Re-extract samples if method blank contamination found.	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
GC/ECD Pesticides	Laboratory Control Sample (LCS)	1) Extracted every 20 samples or every batch, whichever is greater. 2) Matrix specific 3) Standard source different from initial calibration source. 4) Concentration level must be near or at the mid-point of the initial calibration. 5) Must contain all single response pesticides.	Laboratory determined percent recovery limits must be between 40-140% except for difficult analytes, which must be between 30-140% recovery.	Reanalyze the LCS If MS/MSD in same batch compare to determine if problem isolated to LCS Re-extract LCS and samples if >10% compounds outside acceptance criteria and no MS/MSD with acceptable criteria Locate & correct problem, reanalyze associated samples	3a, 2b, 2c, 2d
	Site Specific Matrix Spike/Matrix Spike Duplicate	1) Every 20 samples per matrix* 2) Spike concentration in lower part of calibration curve. 3) Must contain all single response pesticides.	Laboratory determined percent recovery limits must be between 30-150% RPD's ≤ 30% for single response pesticides.	If compounds out compare to LCS; if LCS recoveries in note in narrative.	
	Surrogates	Minimum of two compounds across retention times of GC run. Recommended compounds Tetrachloro-m-xylene and decachlorobiphenyl.	Recovery limits lab generated and within 30-150% for both compounds on both columns.	1)Note exceedances in narrative. 2) If re-extraction or reanalysis confirms matrix interference or if re-extraction outside holding times report all results. 3) If re-extraction or reanalysis results in criteria and in holding time, report only compliant data.	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
GC/ECD PCBs	Initial Calibration	Startup, CCC failure, LCS failure, major maintenance	1) Minimum of 5 stds (Note 1) 2) Low std at or below reporting limit 3) % RSD must be ≤20% or if linear regression used "r" ≥ 0.990 4) 5-point cal for PCB-1016/1260. Single point for other Aroclors at mid-point within 12-hrs of sample analysis. If congeners are determined, must use 5-point for each congener. 5) If curves are used, curve must NOT be forced through origin. 6) Curves must be verified with independent ICV prior to sample analysis.	Recalibrate after corrective action on injection port or column	4a, 2b, 2c, 2d
	Continuing Calibration Verification	1) Prior to samples, every 12-hours or 20 samples, whichever is more frequent, and at the end of the analytical sequence. 2) Concentration near mid-point of curve using AR-1016/1260. Congeners; CCAL must include all congeners	Percent difference or drift ≤15%. Verify all analytes fall in retention time windows.	1) Perform instrument maintenance, reanalyze CCAL and/or recalibrate. 2) Reanalyze associated samples if beginning or closing CCAL exhibited low response and associated pesticides not detected in samples. 3) Reanalyze associated samples if beginning or closing CCAL high and associated pesticides were detected in samples.	
	Method Blank	1) Extracted every 20 samples or every batch, whichever is greater. 2) Matrix specific	All target PCBs < RL	Locate source of contamination and correct problem. Reanalyze method blank. Re-extract samples if method blank contamination found.	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
GC/ECD PCBs	Laboratory Control Sample (LCS)	1) Extracted every 20 samples or every batch, whichever is greater. 2) Matrix specific 3) Standard source different from initial calibration source. 4) Concentration level must be near or at the mid-point of the initial calibration. 5) Must contain all single response pesticides.	Laboratory determined percent recovery limits must be between 40-140%	1) Report non-conformances in case narrative. 2) If re-extraction performed within holding time, report only compliant data. If re-extraction performed outside holding time report all data.	4a, 2b, 2c, 2d
	Site Specific Matrix Spike/Matrix Spike Duplicate	1) Every 20 samples per matrix* 2) Spike concentration in middle of calibration curve. 3) Must contain PCB 1016/1260	Laboratory determined percent recovery limits must be between 40-140% RPD’s ≤ 50% for PCB.	If compounds out compare to LCS; if LCS recoveries in note in narrative.	
	Surrogates	Minimum of two compounds across retention times of GC run. Recommended compounds Tetrachloro-m-xylene and decachlorobiphenyl.	Recovery limits lab generated and within 30-150% for both compounds on both columns.	1)Note exceedances in narrative. 2) If re-extraction or reanalysis confirms matrix interference or if re-extraction outside holding times report all results. 3) If re-extraction or reanalysis results in criteria and in holding time, report only compliant data.	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
ICP or ICP/MS Metals	Initial Calibration	1) Daily following instrument profiling and prior to sample analysis. 2) Minimum of calibration blank plus one standard.	Per instrument manufacturer's specification	Recalibrate system	5a,5c
	Initial Calibration Verification (ICV)	1) Daily immediately after calibration and prior to sample analysis. 2) 2nd source standard	ICV ±10% of true value. Must use at least two replicates with RPD <5%	Re-calibrate/Re-analyze ICV as required by method.	
	Initial Calibration Blank (ICB)	1) Daily immediately after ICV. 2) Matrix matched with standards and samples.	< Reporting Limit	Re-calibrate/Re-analyze ICB as required by method.	
	Low Level Calibration Check Standard	1) Daily prior to sample analysis 2) Std concentration ≤ RL for all analytes	Recovery ±30% of true value except for antimony, arsenic, cobalt, and thallium which have a ± 50% limit	Recalibrate/Explain in Narrative	
	Continuing Calibration Verification (CCV)	1) Every 10 samples and at end of analytical sequence. 2) Can be same source or second source.	Recovery ±10% of true value, Must use at least two replicates with RPD <5%	Recalibrate and rerun all samples run after non-compliant CCV	
	Continuing Calibration Blank (CCB)	1) Every 10 samples immediately after CCV. 2)) Matrix matched with standards and samples.	< Reporting limit	Recalibrate/Re-analyze all samples since last compliant CCV	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
ICP or ICP/MS Metals	Interference Check Standards (ICSA & ICSAB)	1) Daily prior to sample analysis and at the end of the analytical sequence. 2) ICSA and ICSAB containing known amounts of analytes and/or interferents per method.	Recoveries for all analytes ±20% of true value or 2x the RL, whichever is greater. If analyte not present, its true value is zero.	May require adjustment of interelement,, correction factors, background correction and/or linear ranges	5a,5c
	Method Blanks	1) Digested every 20 or every batch, whichever is greater. If no digestion, ICB = blank 2) Matrix specific and matrix matched	Target analytes must be <RL	Locate source of contamination and correct problem. Reanalyze method blank. Reprepare samples unless all analyte concentration >10x method blank level	
	Laboratory Control Sample (LCS)	1) Every 20 samples or each batch, whichever is more frequent. If samples not digested, ICV = LCS 2) Matrix specific (solid, aqueous, etc)	LCS recoveries ±20% for aqueous media and within vendor control (95% confidence limits) for solids.	Redigest and reanalyze all samples.	
	Site Specific Matrix Spike	Every 20 samples or batch per matrix	Percent recovery limits must be between 75-125%.	If recoveries >30% and LCS in limits note in narrative If MS recoveries <30%, reprepare and reanalyze samples	
	Site Specific Matrix Duplicate	Every 20 samples or batch per matrix*	For aqueous samples, if concentration >5x the RL, RPD <20%. If concentration <5x RL, difference ±RL. 3) For solids if conc >5x RL, RPD <35%. If conc. < 5x RL, difference ± 2x RL	If LCS in criteria, narrate outliers	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
Cold Vapor Mercury	Initial Calibration	1) Daily prior to sample analysis. 2) Minimum of calibration blank plus five calibration standards.	Linear curve with "r" ≥ 0.995. Can use second order fit if "r " ≥ 0.995.	Re-optimize instrument and recalibrate as necessary.	6a
	Initial Calibration Verification (ICV)	1) Daily immediately after calibration and prior to sample analysis. 2) 2nd source std	ICV ±10% of true value.	Re-calibrate/Re-analyze ICV as required by method.	
	Initial Calibration Blank (ICB)	1) Daily immediately after ICV. 2) Matrix matched with standards and samples.	ICB must be < RL	Recalibrate/Narrate	
	Continuing Calibration Verification (CCV)	1) Every 10 samples and at end of analytical sequence. 2) Can be same source or second source.	± 20% of true value	Recalibrate/Re-analyze all samples since last compliant CCV	
	Continuing Calibration Blank (CCB)	1) Every 10 samples immediately after CCV. 2)) Matrix matched with standards and samples.	CCB must be < RL	Recalibrate/Re-analyze all samples since last compliant CCV, Narrate outliers	
	Method Blanks	1) Digested every 20 or every batch, whichever is greater. 2) Matrix specific and matrix matched	Mercury < RL	Report non-conformances in case narrative. Reprepare samples unless all analyte concentration >10x method blank level	

Instrument/Analysis	**Activity**	**Frequency**	**Acceptance Criteria**	**Corrective Action**	**SOP Ref. ***
Cold Vapor Mercury	Laboratory Control Sample (LCS)	1) Every 20 samples or each batch, whichever is more frequent 2) Standard source can be initial calibration source. 3) Matrix specific (solid, aqueous, etc).	1) Every 20 samples or each batch, whichever is more frequent 2) Standard source can be initial calibration source. 3) Matrix specific (solid, aqueous, etc).	Redigest and reanalyze all samples	6a
	Site Specific Matrix Spike	Every 20 samples or batch per matrix	Percent recovery limits must be between 75-125%.	If recoveries >30% and LCS in limits note in narrative If MS recoveries <30%, reprepare and reanalyze samples	
	Site Specific Matrix Duplicate	Every 20 samples or batch per matrix	1) For aqueous samples RPD ± 20% if conc. >5x the RL. If conc. < 5x RL, the limit is ± RL 2) For solids RPD ±35% if conc >5x the RL. If conc. < 5x the RL, limit is ± the RL.	If LCS in criteria, narrate outliers.	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
Ion Chromatograph Anions (Nitrite/Nitrate)	Initial Calibration	1) As needed when operation dictates 2) Minimum of five calibration standards.	Linear curve with "r" ≥ 0.990 and RSD < 15	Re-optimize instrument and recalibrate as necessary.	7a
	Initial Calibration Verification (ICV)	1) Daily immediately after calibration and prior to sample analysis. 2) 2nd source std	ICV ±10% of true value.	Re-calibrate/Re-analyze ICV as required by method.	
	Initial Calibration Blank (ICB)	1) Daily immediately after ICV.	ICB must be < RL	Recalibrate/Narrate	
	Continuing Calibration Verification (CCV)	1) Every 10 samples and at end of analytical sequence. 2) Can be same source or second source.	± 10% of true value	Recalibrate/Re-analyze all samples since last compliant CCV	
	Continuing Calibration Blank (CCB)	1) Every 10 samples immediately after CCV.	CCB must be < RL	Recalibrate/Re-analyze all samples since last compliant CCV, Narrate outliers	
	Lab Control Sample(LCS)	One per 20 samples	Must revocer within mfg. limits	Rerun, if still out, recalibrate.	
	Matrix Spikes	One per 20 samples	Recovery 90-110%	Narrate outliers	
	Matrix Duplicates	One per 20 samples	RPD < 15% for results > 10x RL	Narrate outliers	

Standard Operating Procedure Cross Reference

Analysis/Method	YORK SOP Number-AQUEOUS/Air	YORK SOP Number-SOILS	Table Reference
Volatile Organics 8260	GCMSVOC011700 Rev 1.9 091107	GCMSVOC011700 Rev 1.9 091107	1a
Volatile Organics by EPA TO-15	GCMSAIR111692 Rev.6.0 111709	NA	1b
Semi-Volatile Organics 8270 Scan and SIM	GCMSSVOC011700 Rev 1.9 091107	GCMSSVOC011700 Rev 1.9 091107	2a
Extraction for SVOCs/Pest/PCB- 3545A		EXTSVOCSASE083106 Rev 1.3 102406	2b
Extraction for SVOCs/Pest/PCB- 3550C		EXTSVOCS052600 Rev 1.7 010307	2c
Extraction for SVOCs/Pest/PCB- 3510C	EXTAQSVOC052600 Rev 1.9 022608		2d
Pesticides 8081	GCPEST011700 Rev 1.2 091107	GCPEST011700 Rev 1.2 091107	3a
PCBs 8082	GCPCB011700 Rev 1.3 091107	GCPCB011700 Rev 1.3 091107	4a
Metals 6010B	ICP031195 Rev 1.3 091107	ICP031195 Rev 1.3 091107	5a
Metals 6020B	ICPMS6020 080106 Rev 1.2 11/25/08	ICPMS6020 080106 Rev 1.2 11/25/08	5b
Digestion of Samples for Metals -3010A and 3050B	MetalsPrep030695 Rev 1.2 091207	MetalsPrep030695 Rev 1.2 091207	5c
Mercury 7470A, 7471B	Hg120998 Rev 1.3 091107	Hg120998 Rev 1.3 091107	6a
Anions 300.0/9056	IC011400 Rtev 1.6 101107	IC011400 Rtev 1.6 101107	7a

Standard Operating Procedure Cross Reference

Analysis/Method	YORK SOP Number-AQUEOUS/Air	YORK SOP Number-SOILS	Table Reference
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Mercury 7470A, 7471B	Hg120998 Rev 1.3 091107	Hg120998 Rev 1.3 091107	6a
Anions 300.0/9056	IC011400 Rtev 1.6 101107	IC011400 Rtev 1.6 101107	7a

Appendix 5   Storm-Water Pollution Prevention Plan

I. PROJECT DETAILS

1. Project Description

The purpose of the project is to construct a 6-story residential building with slab on grade plus stair/elevator and bulkhead and a rear yard. The entire property will be disturbed during this construction period. The Site is approximately 2,416.40 square feet located in the Astoria section of Queens, New York, on the southwest of 31st Drive (see attached Vicinity Map).

2. Site Description

The Site is entirely developed with a 1-story building with a slab on-grade. The Site is currently secured with closed roll-up gates and will be secured during remedial construction with a chain link fence. At present, there is a drainage system at the Site consisting of a floor drain discharging into municipal sewer system and a dry pit.

3. Adjacent Property

Land use in the vicinity is residential, commercial and institutions. The Site is bounded by 31st Drive to the north-northeast, a vacant land and a 1-story manufacturing building to the south-southwest, a 1-story cabinet manufacturing facility to the east-southeast and a vacant 1-story warehouse to the west-northwest.

4. Soils

The soil at the Site is mapped with fill material at shallow depth to 5 feet bgs. The fill layer is underlain by native silty sand. Silty sand are considered to have a low degree of permeability, with the coefficient of permeability (k) ranging between $10^{-3}<k<10^{-5}$. The soil erodibility factor (K value) ranges from 0.42 at the surface to 0.28 in the subsoil.

Due to the soil/fill permeability of the shallow subsoil that will be exposed during excavation, a surface wetness or runoff problems are not anticipated following significant rainfall events. The lower portion of excavations may fill with groundwater following significant rainfall events. However, this layer will consist of permeable fill material that will remain undisturbed.

II. PLANNED EROSION AND SEDIMENT CONTROL PRACTICES

1. Sediment Basin

No sediment basin will be required. Soil/fill will be excavated across the entire Site to 3 feet bgs as a result of construction.

2. Temporary Gravel Construction Entrance/Exit

A temporary gravel construction entrance will be installed on the northern side of the property towards 31st Drive. This will be done to reduce the amount of sediment transported on to roads by construction vehicles and run-off. During wet weather it may be necessary to wash vehicle tires at this location. The entrance will be graded so that runoff water will be directed to an inlet protection structure and away from the steep fill area.

3. Tree Preservation and Protection

No tree preservation and protection will be required.

4. Land Grading

No land grading will be required as soils will be excavated and disposed of as a result of construction.

5. Temporary Sediment Trap

No temporary sediment trap will be required. All soils will be excavated and disposed of as a result of construction.

6. Sediment Fence

A sediment fence will be constructed around any temporary soil stockpiles to prevent sediment from entering non-excavated areas or areas off-site.

7. Surface Stabilization

No surface stabilization will be required. Soil excavation at the Site will be limited to shallow soil to the depth of 3 feet and also to 7 feet 8 inches for the elevator pit beneath the eastern portion as a result of construction.

8. Dust Control

Dust control is not expected to be a problem due to the small area of exposure and the relatively short time of exposure (not exceeding 3 months). Should excessive dust be generated, it will be controlled by sprinkling. Street sweeping will also be employed wherever required. Additional details regarding dust control can be found in Section 4.1.6 of the RAWP (Community Air Monitoring Plan).

III. CONSTRUCTION SCHEDULE

1. Obtain plan approval and other applicable permits.
2. Maintain construction fence before start of any construction activity.
3. Hold pre-construction conference at least one week prior to starting construction.
4. Install temporary gravel construction entrance/exit.

5. Install & operate dewatering system.
6. Commence excavation and disposal.
7. Construct foundations.
8. Estimated time before final stabilization – 3 months

IV. MAINTENANCE PLAN

1. General Conditions

Any erosion and sediment control measures will be checked for stability and operation following every runoff-producing rainfall but in no case less than once every week. Any needed repairs will be made immediately to maintain all practices as designed.

2. Construction Fence

a. A temporary construction fence will be maintained to prohibit the undesirable use of the construction area.

b. The construction fence will be erected along the northern boundary of the Site.

c. The construction fence will be built to a minimum height of 8 ft.

3. Temporary Gravel Construction Entrance/Exit

a. A temporary gravel construction entrance will be constructed to reduce the amount of sediment transported on to roads by construction vehicles and run-off.

b. Clear the entrance and exit area from of all vegetation, roots and other objectable material.

c. Grade the road foundation so that entrance/exit slopes towards south of the entrance.

d. The construction entrance will be built to a minimum width of 12’, minimum length of 20’ and to minimum 6” thickness.

e. 2” to 3” washed stone will be used at the construction entrance.

f. If wet conditions are anticipated a geotextile fabric will be placed over the graded foundation to improve stability.

g. Maintain the gravel pad in a condition to prevent mud or sediment from leaving the site. Mud tracked or washed onto road, will be removed immediately.

4. Sediment Fence

a. A sediment fencing will be maintained to surround any temporary soil stockpiles.

b. Any sediment fence utilized will be inspected at the end of each day to ensure its integrity.

5. Dust Control

a. A min. 275-g water tank and 50 feet of garden hose with spray nozzle will be maintained at the construction entrance.

b. All vehicles leaving property will be inspected for dust and sprayed as necessary.

Appendix 6 Community Air Monitoring Plan

Appendix 5

COMMUNITY AIR MONITORING PLAN (CAMP)

11-28 31st Drive
Block 502; Lot 22
Queens, New York

NYSDEC BCP Number: C241159

1- Introduction

The Community Air Monitoring Plan (CAMP) has been prepared to monitor the air quality during the intrusive activities proposed as a part of the Remedial Action Work Plan at the property located at 11-28 31st Drive in Astoria section of Queens, New York. Levels of VOCs and dust in the air will be monitored continuously and periodically utilizing a Photo Ionization Detector (PID) and Real-Time Particulate Dust Tracker, respectively. For this investigation, the PID will be calibrated at the beginning of each day to the compound isobutylene, which is published by the manufacturer. The PID has a minimum detection limit of 0.1 parts per million (ppm). The Dust Tracker provides real-time measurement based on 90° light scattering. The Dust Tracker has a minimum detection limit of 0.001 mg/m^3.

Continuous real-time air monitoring for VOCs and particulate levels within the invasive work area and at the perimeter of the exclusion zone or work area will be performed for all ground intrusive activities. Ground intrusive activities include, but are not limited to the soil excavation, lagging and installation of concrete foundations.

Periodic monitoring for VOCs will be performed during non-intrusive activities such as the collection of end point samples. For instance, periodic monitoring during sample collection will consist of taking a reading upon arrival at a sample location and taking a reading prior to leaving a sample location. Depending upon the proximity of potentially exposed individuals, continuous monitoring may be performed during sampling activities. Exceedances of action levels observed during performance of the Community Air Monitoring Plan (CAMP) will be reported to the NYSDEC and recorded in a field daily log. A summary of daily logs/reports will be provided in the FER.

2- VOCs Monitoring, Response Levels And Actions

VOCs will be monitored in the immediate vicinity of the ground intrusive activities and at the downwind perimeter of the work area (i.e., the exclusion zone) on a continuous basis during invasive work. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work will be performed using a PID, which will be calibrated at least daily to the compound isobutylene. The PID will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

If the ambient air concentration of total organic vapors in the invasive work area or the downwind perimeter of the exclusion 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 invasive work area or the downwind perimeter of the exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level in the immediate vicinity of work area, 200-feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial 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 will be shutdown.

All 15-minute readings must be recorded in a daily field log. Instantaneous readings, if any, used for decision purposes will also be recorded.

3- <u>PM Monitoring, Response Levels And Actions</u>

Particulate concentrations will be monitored continuously at mobile particulate monitoring stations at the upwind and downwind perimeters of the exclusion zone and in the vicinity of the intrusive activities. The particulate monitoring will be performed using a Dust Tracker 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 equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) 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 downwind PM-10 particulate levels are not 150 mcg/m^3 or greater above the upwind level and provided that no visible dust is migrating from the work area.

If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are 150 mcg/m^3 or greater above the upwind 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 downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration. All readings will be recorded in a daily field log.

I. PROJECT DETAILS

1. Project Description

The purpose of the project is to construct a 6-story residential building with slab on grade plus stair/elevator and bulkhead and a rear yard. The entire property will be disturbed during this construction period. The Site is approximately 2,416.40 square feet located in the Astoria section of Queens, New York, on the southwest of 31st Drive (see attached Vicinity Map).

2. Site Description

The Site is entirely developed with a 1-story building with a slab on-grade. The Site is currently secured with closed roll-up gates and will be secured during remedial construction with a chain link fence. At present, there is a drainage system at the Site consisting of a floor drain discharging into municipal sewer system and a dry pit.

3. Adjacent Property

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4. Soils

The soil at the Site is mapped with fill material at shallow depth to 5 feet bgs. The fill layer is underlain by native silty sand. Silty sand are considered to have a low degree of permeability, with the coefficient of permeability (k) ranging between $10^{-3}<k<10^{-5}$. The soil erodibility factor (K value) ranges from 0.42 at the surface to 0.28 in the subsoil.

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7. Surface Stabilization

No surface stabilization will be required. Soil excavation at the Site will be limited to shallow soil to the depth of 3 feet and also to 7 feet 8 inches for the elevator pit beneath the eastern portion as a result of construction.

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Dust control is not expected to be a problem due to the small area of exposure and the relatively short time of exposure (not exceeding 3 months). Should excessive dust be generated, it will be controlled by sprinkling. Street sweeping will also be employed wherever required. Additional details regarding dust control can be found in Section 4.1.6 of the RAWP (Community Air Monitoring Plan).

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IV. MAINTENANCE PLAN

1. General Conditions

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b. Clear the entrance and exit area from of all vegetation, roots and other objectable material.

c. Grade the road foundation so that entrance/exit slopes towards south of the entrance.

d. The construction entrance will be built to a minimum width of 12’, minimum length of 20’ and to minimum 6” thickness.

e. 2” to 3” washed stone will be used at the construction entrance.

f. If wet conditions are anticipated a geotextile fabric will be placed over the graded foundation to improve stability.

g. Maintain the gravel pad in a condition to prevent mud or sediment from leaving the site. Mud tracked or washed onto road, will be removed immediately.

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a. A sediment fencing will be maintained to surround any temporary soil stockpiles.

b. Any sediment fence utilized will be inspected at the end of each day to ensure its integrity.

5. Dust Control

a. A min. 275-g water tank and 50 feet of garden hose with spray nozzle will be maintained at the construction entrance.

b. All vehicles leaving property will be inspected for dust and sprayed as necessary.

Appendix 7 Citizen Participation Plan

New York State Department of Environmental Conservation

Brownfield Cleanup Program

Citizen Participation Plan
for
11-28 31st Drive

11-28 31st Drive
Astoria
Queens, New York 11106

NYSDEC BCP Number: C241159

April 2015

Contents

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Note: The information presented in this Citizen Participation Plan was current as of the date of its approval by the New York State Department of Environmental Conservation. Portions of this Citizen Participation Plan may be revised during the site's investigation and cleanup process.

Applicant: **George Man**
Site Name: **11-28 31st Drive (“Site”)**
Site Address: **11-28 31st Drive, Astoria, NY 11106**
Site County: **Queens**
Site Number: **C241159**

1. What is New York’s Brownfield Cleanup Program?

New York’s Brownfield Cleanup Program (BCP) works with private developers to encourage the voluntary cleanup of contaminated properties known as “brownfields” so that they can be reused and developed. These uses include recreation, housing, and business.

A *brownfield* is any real property that is difficult to reuse or redevelop because of the presence or potential presence of contamination. A brownfield typically is a former industrial or commercial property where operations may have resulted in environmental contamination. A brownfield can pose environmental, legal, and financial burdens on a community. If a brownfield is not addressed, it can reduce property values in the area and affect economic development of nearby properties.

The BCP is administered by the New York State Department of Environmental Conservation (NYSDEC) which oversees Applicants that conduct brownfield site investigation and cleanup activities. An Applicant is a person who has requested to participate in the BCP and has been accepted by NYSDEC. The BCP contains investigation and cleanup requirements, ensuring that cleanups protect public health and the environment. When NYSDEC certifies that these requirements have been met, the property can be reused or redeveloped for the intended use.

For more information about the BCP, go online at: http://www.dec.ny.gov/chemical/8450.html.

2. Citizen Participation Activities

Why NYSDEC Involves the Public and Why It Is Important

NYSDEC involves the public to improve the process of investigating and cleaning up contaminated sites, and to enable citizens to participate more fully in decisions that affect their health, environment, and social well being. NYSDEC provides opportunities for citizen involvement and encourages early two-way communication with citizens before decision-makers form or adopt final positions.

Involving citizens affected and interest in site investigation and cleanup programs is important for many reasons. These include:

- Promoting the development of timely, effective site investigation and cleanup programs that protect public health and the environment

- Improving public access to, and understanding of, issues and information related to a particular site and that site's investigation and cleanup process

- Providing citizens with early and continuing opportunities to participate in NYSDEC's site investigation and cleanup process

- Ensuring that NYSDEC makes site investigation and cleanup decisions that benefit from input that reflects the interests and perspectives found within the affected community

- Encouraging dialogue to promote the exchange of information among the affected/interested public, State agencies, and other interested parties that strengthens trust among the parties, increases understanding of site and community issues and concerns, and improves decision making.

This Citizen Participation (CP) Plan provides information about how NYSDEC will inform and involve the public during the investigation and cleanup of the site identified above. The public information and involvement program will be carried out with assistance, as appropriate, from the Applicant.

Project Contacts

Appendix A identifies NYSDEC project contact(s) to whom the public should address questions or request information about the site's investigation and cleanup program. The public's suggestions about this CP Plan and the CP program for the Site are always welcome. Interested people are encouraged to share their ideas and suggestions with the project contacts at any time.

Locations of Reports and Information

The locations of the reports and information related to the site=s investigation and cleanup program also are identified in Appendix A. These locations provide convenient access to important project documents for public review and comment. Some documents may be placed on the NYSDEC website. If this occurs, NYSDEC will inform the public in fact sheets distributed about the site and by other means, as appropriate.

Site Contact List

Appendix B contains the site contact list. This list has been developed to keep the community informed about, and involved in, the site's investigation and cleanup process. The site contact list will be used periodically to distribute fact sheets that provide updates about the status of the project. These will include notifications of upcoming activities at the Site (such as fieldwork), as well as availability of project documents and announcements about public comment periods.
The site contact list includes, at a minimum:

- Chief executive officer and planning board chairperson of each county, city, town and village in which the Site is located;
- Residents, owners, and occupants of the Site and properties adjacent to the Site;
- The public water supplier which services the area in which the Site is located;
- Any person who has requested to be placed on the site contact list;
- The administrator of any school or day care facility located on or near the Site for purposes of posting and/or dissemination of information at the facility;
- Location(s) of reports and information.

The site contact list will be reviewed periodically and updated as appropriate. Individuals and organizations will be added to the site contact list upon request. Such requests should be submitted to the NYSDEC project contact(s) identified in Appendix A. Other additions to the site contact list may be made at the discretion of the NYSDEC project manager, in consultation with other NYSDEC staff as appropriate.

CP Activities

The table at the end of this section identifies the CP activities, at a minimum, that have been and will be conducted during the site's investigation and cleanup program. The flowchart in Appendix D shows how these CP activities integrate with the site investigation and cleanup process. The public is informed about these CP activities through fact sheets and notices distributed at significant points during the program. Elements of the investigation and cleanup process that match up with the CP activities are explained briefly in Section 5.

- **Notices and fact sheets** help the interested and affected public to understand contamination issues related to a site, and the nature and progress of efforts to investigate and clean up a site.

- **Public forums, comment periods and contact with project managers** provide opportunities for the public to contribute information, opinions and perspectives that have potential to influence decisions about a site's investigation and cleanup.

The public is encouraged to contact project staff at any time during the site's investigation and cleanup process with questions, comments, or requests for information.

This CP Plan may be revised due to changes in major issues of public concern identified in Section 3 or in the nature and scope of investigation and cleanup activities. Modifications may include additions to the site contact list and changes in planned citizen participation activities.

Technical Assistance Grant

NYSDEC must determine if the site poses a significant threat to public health or the environment. This determination generally is made using information developed during the investigation of the Site, as described in Section 5.

If the Site is determined to be a significant threat, a qualifying community group may apply for a Technical Assistance Grant (TAG). The purpose of a TAG is to provide funds to the qualifying group to obtain independent technical assistance. This assistance helps the TAG recipient to interpret and understand existing environmental information about the nature and extent of contamination related to the Site and the development/implementation of a remedy.

An eligible community group must certify that its membership represents the interests of the community affected by the Site, and that its members' health, economic well-being or enjoyment of the environment may be affected by a release or threatened release of contamination at the Site.

For more information about TAGs, go online at http://www.dec.ny.gov/regulations/2590.html

Note: The table identifying the citizen participation activities related to the site's investigation and cleanup program follows on the next page:

Citizen Participation Requirements (Activities)	Timing of CP Activity(ies)
Application Process:	
• Prepare site contact list • Establish document repositories • Preparation of a Remedial Investigation Report	At time of preparation of application to participate in the BCP.
• Publish notice in Environmental Notice Bulletin (ENB) announcing receipt of application and 30-day public comment period • Publish above ENB content in local newspaper • Mail above ENB content to site contact list • Conduct 30-day public comment period	When NYSDEC determines that BCP application is complete. The 30-day public comment period begins on date of publication of notice in ENB. End date of public comment period is as stated in ENB notice. Therefore, ENB notice, newspaper notice, and notice to the site contact list should be provided to the public at the same time.
After Execution of Brownfield Site Cleanup Agreement:	
• Prepare Citizen Participation (CP) Plan	Before start of Remedial Investigation
Before NYSDEC Approves Remedial Investigation (RI) Work Plan:	
• Distribute fact sheet to site contact list about proposed RI activities and announcing 30-day public comment period about draft RI Work Plan • Conduct 30-day public comment period	Before NYSDEC approves RI Work Plan. If RI Work Plan is submitted with application, public comment periods will be combined and public notice will include fact sheet. Thirty-day public comment period begins/ends as per dates identified in fact sheet.
After Applicant Completes Remedial Investigation:	
• Distribute fact sheet to site contact list that describes RI results	Before NYSDEC approves RI Report
Before NYSDEC Approves Remedial Work Plan (RWP):	
• Distribute fact sheet to site contact list about proposed RWP and announcing 45-day public comment period • Public meeting by NYSDEC about proposed RWP (if requested by affected community or at discretion of NYSDEC project manager) • Conduct 45-day public comment period	Before NYSDEC approves RWP. Forty-five day public comment period begins/ends as per dates identified in fact sheet. Public meeting would be held within the 45-day public comment period.
Before Applicant Starts Cleanup Action:	
• Distribute fact sheet to site contact list that describes upcoming cleanup action	Before the start of cleanup action.
After Applicant Completes Cleanup Action:	
• Distribute fact sheet to site contact list that announces that cleanup action has been completed and that summarizes the Final Engineering Report • Distribute fact sheet to site contact list announcing issuance of Certificate of Completion (COC)	At the time NYSDEC approves Final Engineering Report. These two fact sheets are combined if possible if there is not a delay in issuing the COC.

3. Major Issues of Public Concern

This section of the CP Plan identifies major issues of public concern that relate to the Site. Additional major issues of public concern may be identified during the course of the site's investigation and cleanup process.

Based on the results of previous environmental investigations, residual Volatile Organic Compounds (VOC) contamination in groundwater and VOCs in soil vapors represent an issue of public concern at the Site and also off-site. In addition non-volatile petroleum compounds and metals associated with urban backfill were also identified beneath the Site. The Site is not near any public water supply or private water wells. The future on-site development and remediation will not create any restrictions on community activities but will render the Site protective of public health and the environment.

It should be noted that during the proposed redevelopment activities, contaminants known to be present in the soils, especially Semi-Volatile Organic Compounds (SVOCs) and metals may become airborne and pose potential health risks to on-site workers and occupants on adjacent properties. However, a NYSDEC Community Air Monitoring Program (CAMP) is in place for the proposed development activities and will be followed to safeguard the workers and other occupants against any potential exposures.

The Site is located in an environmental justice area. Environmental justice is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

Environmental justice efforts focus on improving the environment in communities, specifically minority and low-income communities, and addressing disproportionate adverse environmental impacts that may exist in those communities.

The area immediately surrounding the Site has a large Hispanic-American population. Therefore, all future fact sheets will be translated into Spanish. Other Major Issues of Public Concern include noise/odor and truck traffic impacts to the surrounding community.

4. Site Information

Site Description

The Site is located in the Astoria section in Queens, New York and is identified as Block 502 and Lot 22 on the New York City Tax Map. The Site is 2,416.40-square feet and is bounded by 31st Drive to the north-northeast, a vacant land and a 1-story manufacturing building to the south-southwest, a 1-story cabinet manufacturing facility to the east-southeast and a vacant 1-story warehouse to the west-northwest. Currently, the Site is vacant and contains a 1-story building that was until most recently, occupied by a manufacturing facility of wood cabinets.

The Site is located in a residential, commercial and light manufacturing/industrial neighborhood. The East River is the closest water body and is located approximately 300 feet east of the subject Site. Socrates Sculpture Park, a NYC park is located within approximately 200 feet east of the subject Site.

Appendix C contains a map identifying the location of the Site.

History of Site Use, Investigation, and Cleanup

Historic Fire Insurance Maps and Regulatory Agency documents indicated the Site was utilized as an auto repair shop between 1934 and 1936, a machine shop between 1945 and 1970 and a commercial facility between 1977 and 2006. Until most recently, the Site was utilized as a manufacturing facility of wood cabinets and then became vacant during the last quarter of 2012.

The following provides a list of reports that summarize the prior environmental assessments and investigation activities conducted at the property, which have been previously provided to NYSDEC and referenced in the BCP application submitted by Applicant:

- Phase I Environmental Site Assessment Report, prepared by Hydro Tech Environmental, Corp. for Mr. George Man, dated March 8, 2013.
- RIR, by Hydro Tech Environmental, Corp. for Mr. George Man, dated January 29, 2014.
- Supplemental RIR, prepared by Hydro Tech Environmental, Corp. for Mr. George Man, dated March 20, 2015.

5. Investigation and Cleanup Process

Application

The Applicant has applied for and been accepted into New York's Brownfield Cleanup Program as a **Volunteer.** This means that the **Applicant was not responsible for the disposal or discharge of the contaminants or whose ownership or operation of the Site took place after the discharge or disposal of contaminants. The Volunteer must fully characterize the nature and extent of contamination on -site, and must conduct a Aqualitative exposure assessment, a process that characterizes the actual or potential exposures of people, fish and wildlife to contaminants on the Site and to contamination that has migrated from the Site.**

The Applicant in its Application proposes that the site will be used for **restricted** residential purposes.

To achieve this goal, the Applicant will conduct **cleanup** activities at the site with oversight provided by NYSDEC. The Brownfield Cleanup Agreement executed by NYSDEC and the Applicant sets forth the responsibilities of each party in conducting these activities at the site.

Investigation

The Applicant has completed a **full** site investigation before it entered into the BCP. **The Applicant has submitted investigation reports for the full site investigation. NYSDEC** determined that the **investigation goals and requirements of the BCP have been fully met** at this time and **no additional work is needed and a remedy can be selected.**

The site investigation has several goals:

1) Define the nature and extent of contamination in soil, surface water, groundwater and any other parts of the environment that may be affected;
2) Identify the source(s) of the contamination;
3) Assess the impact of the contamination on public health and the environment; and
4) Provide information to support the development of a proposed remedy to address the contamination or the determination that cleanup is not necessary.

NYSDEC will use the information in the investigation reports to determine if the Site poses a significant threat to public health or the environment. If the Site is a significant threat, it must be cleaned up using a remedy selected by NYSDEC from an analysis of alternatives prepared by the Applicant and approved by NYSDEC. If the Site does not pose a significant threat, the Applicant may select the remedy from the approved analysis of alternatives.

Remedy Selection

When the investigation of the Site has been determined to be complete, the project likely would proceed in one of two directions:

The Applicant may recommend in its supplemental investigation report that action needs to be taken to address site contamination. After NYSDEC approves the supplemental investigation report, the Applicant may then develop a cleanup plan, officially called a Remedial Work Plan. The Remedial Work Plan describes the Applicant's proposed remedy for addressing contamination related to the Site.

When the Applicant submits a proposed Remedial Work Plan for approval, NYSDEC would announce the availability of the proposed plan for public review during a 45-day public comment period.

Cleanup Action

NYSDEC will consider public comments, and revise the draft cleanup plan if necessary, before approving the proposed remedy. The New York State Department of Health (NYSDOH) must concur with the proposed remedy. After approval, the proposed remedy becomes the selected remedy.

The Applicant may then design and perform the cleanup action to address the site contamination. NYSDEC and NYSDOH oversee the activities. When the Applicant completes cleanup activities, it will prepare a Final Engineering Report (FER) that certifies that cleanup requirements have been achieved or will be achieved within a specific time frame. NYSDEC will review the report to be certain that the cleanup is protective of public health and the environment for the intended use of the Site.

Certificate of Completion

When NYSDEC is satisfied that cleanup requirements have been achieved or will be achieved for the site, it will approve the FER. NYSDEC then will issue a Certificate of Completion (COC) to the Applicant. The COC states that cleanup goals have been achieved, and relieves the Applicant from future liability for site-related contamination, subject to certain conditions. The Applicant would be eligible to redevelop the Site after it receives a COC.

Site Management

Site management is the last phase of the site cleanup program. This phase begins when the COC is issued. Site management may be conducted by the Applicant under NYSDEC oversight, if contamination will remain in place. Site management incorporates any institutional and engineering controls required to ensure that the remedy implemented for the Site remains protective of public health and the environment. All significant activities are detailed in a Site Management Plan.

An institutional control is a non-physical restriction on use of the Site, such as a deed restriction that would prevent or restrict certain uses of the property. An institutional control may be used when the cleanup action leaves some contamination that makes the Site suitable for some, but not all uses.

An engineering control is a physical barrier or method to manage contamination. Examples include: caps, covers, barriers, fences, and treatment of water supplies.

Site management also may include the operation and maintenance of a component of the remedy, such as a system that is pumping and treating groundwater. Site management continues until NYSDEC determines that it is no longer needed.

Appendix A
Project Contacts and Locations of Reports and Information

Project Contacts

For information about the site's investigation and cleanup program, the public may contact any of the following project staff:

New York State Department of Environmental Conservation (NYSDEC):

Sondra Martinkat
Project Manager
NYSDEC, Region 2 Office
Division of Environmental Remediation
47-40 21st Street
Long Island City NY 11101
Tel: (718) 482-4891
Email: smmartin@gw.dec.state.ny.us

Thomas Panzone
Citizen Participation Specialist
Office of Communications Services
NYSDEC, Region 2 Office
47-40 21st Street
Long Island City NY 11101
Tel: (718) 482-4900
Email:tvpanzon@gw.dec.state.ny.us

New York State Department of Health (NYSDOH):
Justin Deming
Project Manager
NYSDOH
Empire State Plaza
Corning Tower Room 1787
Albany, NY 12237
Tel: (518) 402-7860
Email: beei@health.ny.gov

Locations of Reports and Information

The facilities identified below are being used to provide the public with convenient access to important project documents:

Queens Library - Astoria Branch, 14-01
Astoria Blvd, Astoria, NY 11102
Attn: Gus Stekenis
Phone: (718) 278-2220
Hours:
Mon, Thu and Fri: 11:00 AM to 7:00 PM
Tue: 2:00 PM to 7:00 PM
Wed: 1:00 PM to 7:00 PM

Sat and Sun Closed

NYS DEC
Region 2 Division of Environmental
Remediation
47-40 21st Street
Long Island City, NY 11101

Queens Community District
Attn: Joseph Risi
45-02 Ditmas Boulevard , Suite 1052
Astoria NY 11106
Phone: (718) 626-1021

Appendix B
Site Contact List

1. **LOCAL AND STATE OFFICIALS**

NYS DOH-Albany
Justin Deming, BEEI
Empire State Plaza Corning Tower
Albany, NY 12237

Queens Borough President
Melinda Katz, Borough President
120-55 Queens Boulevard
Kew Gardens, NY 11424

Queens Community Board 1
Lucille Hartmann, District Manager
45-02 Ditmars Boulevard
LL Suite 125
Astoria, NY 11105

Joan Asselin, Environmental Protection
Committee Chairwoman
Queens Community Board 1
45-02 Ditmars Boulevard, LL Suite 1025
Astoria, NY 11105

Queens Community Board 1
Vinicio Donato, Chairman
45-02 Ditmars Boulevard
LL Suite 125
Astoria, NY 11105
Thomas V. Panzone
NYSDEC Region 2
Regional Citizen Participation
Specialist

New York City Mayor
Hon. Bill De Blasio
City Hall
New York, NY 10007

NYC MOER
Dan Walsh, Director
100 Gold Street – 2nd Floor
New York, NY 10038

NYC Chair:
Commissioner; NYC Dept. Of Planning
22 Read Street
New York, NY 10007

New York City Department of Planning – Queens Office
John Young, Borough Director
120-55 Queens Blvd., Room 201
Kew Gardens, NY 11424

NYC DOHMH
Maureen Little
Acting Director
NYC Office of Environmental Coordination
100 Gold Street - 2nd Floor
New York, NY 10038

John Wuthenow
Office of Environmental Assessment & Planning
NYC Dept. of Environmental Protection
96-05 Horace Harding Expressway
Flushing, NY 11373

Hon. Michael Gianaris
NYS Senator
21-77 31st Street
Astoria, NY 11105

Hon. Cathy Nolan
NYS Assemblymember
41-02 Queens Boulevard, Suite 2B
Sunnyside, NY 11104

Hon. Charles Schumer
U.S. Senator
780 Third Avenue, Suite 2301
New York, NY 10017

Hon. Kirsten Gillibrand
U.S. Senator
780 Third Avenue, Suite 2601
New York, NY 10017

Hon. Carolyn Maloney
U.S. House of Representatives
31-19 Newtown Avenue
Astoria, NY 11102

BY EMAIL:

Email: mlittle@health.nyc.gov

Email: dwalsh@cityhall.nyc.gov

NYC DOHMH Nathan Graber, MD, MPH
Email: Ngraber1@health.nyc.gov

NYC DOHMH
Christopher D'Andrea
Email: cdandrea@health.nyc.gov

NYC DOS
Thomas Milora
Email: tmilora@dsny.nyc.gov

NYSDEC
Dennis Farrar
Email: dennis.farrar@dec.ny.gov

NYS DEC Region 2
Jane O'Connell
Email: jane.oconnell@dec.ny.gov
Sondra.martinkat@dec.ny.gov
Paul.john@dec.ny.gov
Thomas.Panzone@dec.ny.gov

NYSDEC-Albany
Bob Cozzy
Email: robert.cozzy@dec.ny.gov

Queens community Board 1
Email: qn01@cb.nyc.gov

2. OWNERS, RESIDENTS, AND OCCUPANTS ON OR ADJACENT TO THE SITE

George Man
11-28 31st Drive
Queens, NY, 11106

11-11 Broadway, LLC.
11-24 31st Drive
Queens, NY, 11106

Eagle Square Realty LLC.
11-32 31st Drive
Queens, NY, 11106

11-11 Broadway, LLC.
11-11 Broadway
Queens, NY, 11106

1115 Broadway LLC. .
11-15Broadway
Queens, NY, 11106

11-38/40 31 Drive Realty
11-38 31st Drive
Queens, NY, 11106

Kenneth Trading Corp
11-35 31st Drive
Queens, NY, 11106

Fulgencio Gonzalez
11-27 31st Drive
Queens, NY, 11106

38th Street Realty Co.
31-57 Vernon Boulevard
Queens, NY, 11106

Current Occupant
11-35 31st Drive
Queens, NY, 11106

Important Notice for All Building Occupants
11-32 31st Drive
Queens, NY, 11106

Important Notice for All Building Occupants 31-57
Vernon Boulevard
Queens, NY, 11106

Important Notice for All Building Occupants
11-27 31st Drive
Queens, NY, 11106

Empire Holdings Group
11-25 31st Drive
Queens, NY, 11106

Important Notice for All Building Occupants
11-25 31st Drive
Queens, NY, 11106

Important Notice for All Building Occupants
11-38 31st Drive
Queens, NY, 11106

3. LOCAL NEWS MEDIA

New York Post
1211 Avenue of Americas
New York, New York 10036-8790
Phone: 212-930-8000

NY 1 News
75 Ninth Avenue
New York, NY 10011

Queens Tribune
150-50 14th Road
Whitestone, NY 11357

Western Queens Gazette
42-16 34th Avenue
Long Island City, NY 11101

Times-Ledger Newspapers
41-02 Bell Boulevard, 2nd Floor
Bayside, NY 11361

Queens Chronicle
P.O. Box 74-7769
Rego Park, NY 11374

LIC/Astoria Journal
69-60 Grand Avenue
Maspeth, NY 11378

ImpreMedia - East Coast Office
1 MetroTech Center, 18th Floor
Brooklyn, NY 11201

4. PUBLIC WATER SUPPLIER

NYC Department of Environmental Protection
Emily Lloyd , Commissioner
59-17 Junction Blvd.
Flushing, NY 11373

5. ANY PERSON, COMMUNITY BASED ORGANIZATION, BOA GROUP, OR LOCAL MEDIA WHO HAS REQUESTED TO BE PLACED ON THE CONTACT LIST.

At this point, no requests have been made to be placed on the site contact list.

6. ADMINISTRATOR/OPERATOR OF ANY SCHOOL OR DAY CARE FACILITY LOCATED ON OR NEAR THE SITE.

Principal: Samaya Serozi
Ideal Islamic School
31-29 12th Street
Astoria, NY 11106

Principal: Vivian Selenikas
Long Island City High School
1430 Broadway
Long Island City, NY 11106
718-545-7095

Principal: Alexander Angueria
Albert Shanker School for Visual and Performing Arts
31-51 21st Street
Long Island City, NY 11106
718-274-8316

7. DOCUMENT REPOSITORY

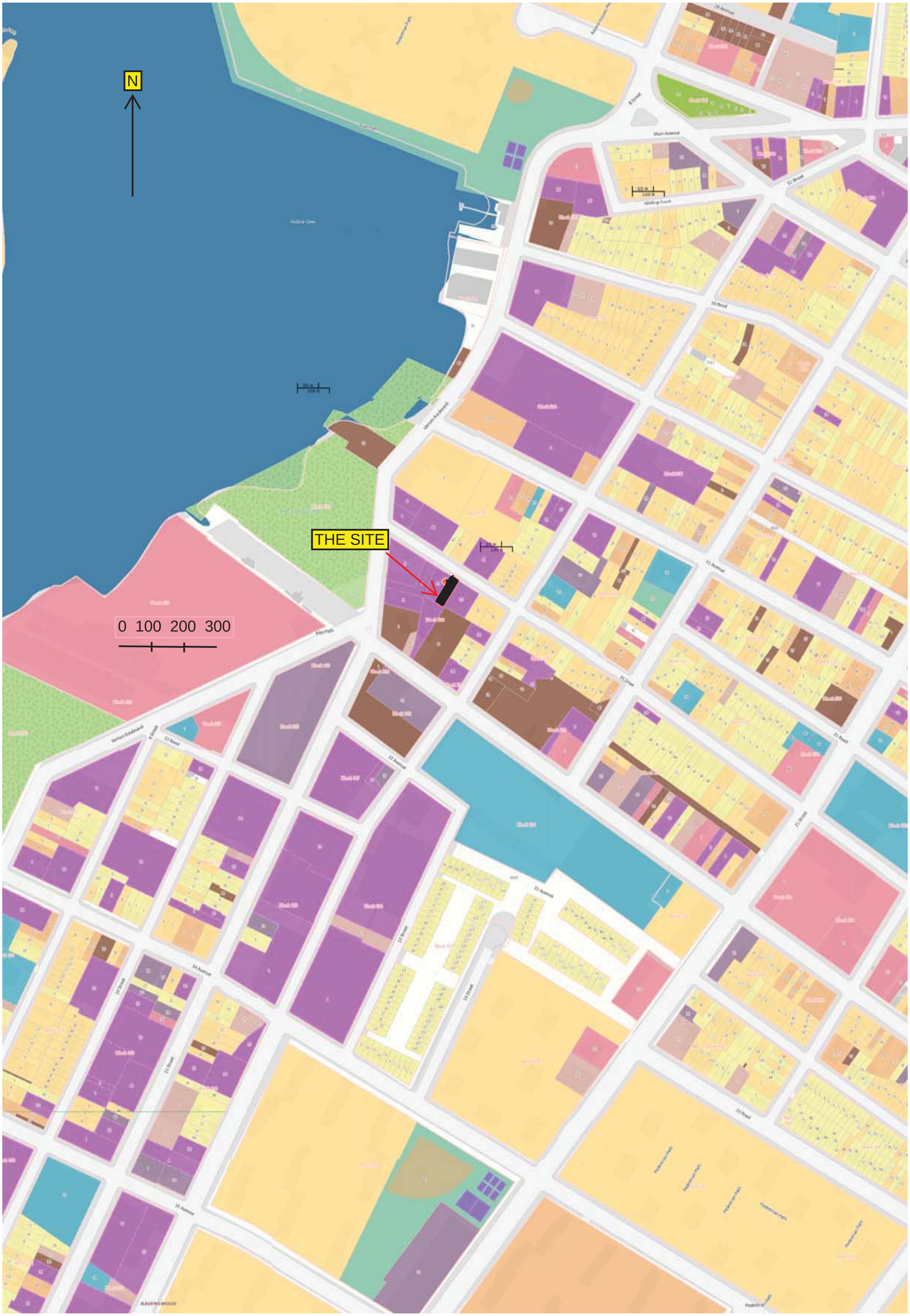
Queens Library -Astoria Branch
14-01 Astoria Blvd
Astoria, NY
Attn: Gus Stekenis
Phone: (718) 278-2220
Hours:
Mon, Thu and Fri: 11:00 AM to 7:00 PM
Tue: 2:00 PM to 7:00 PM
Wed: 1:00 PM to 7:00 PM
Sat and Sun Closed

NYS DEC
Region 2 Division of Environmental Remediation
47-40 21st Street
Long Island City, NY 11101

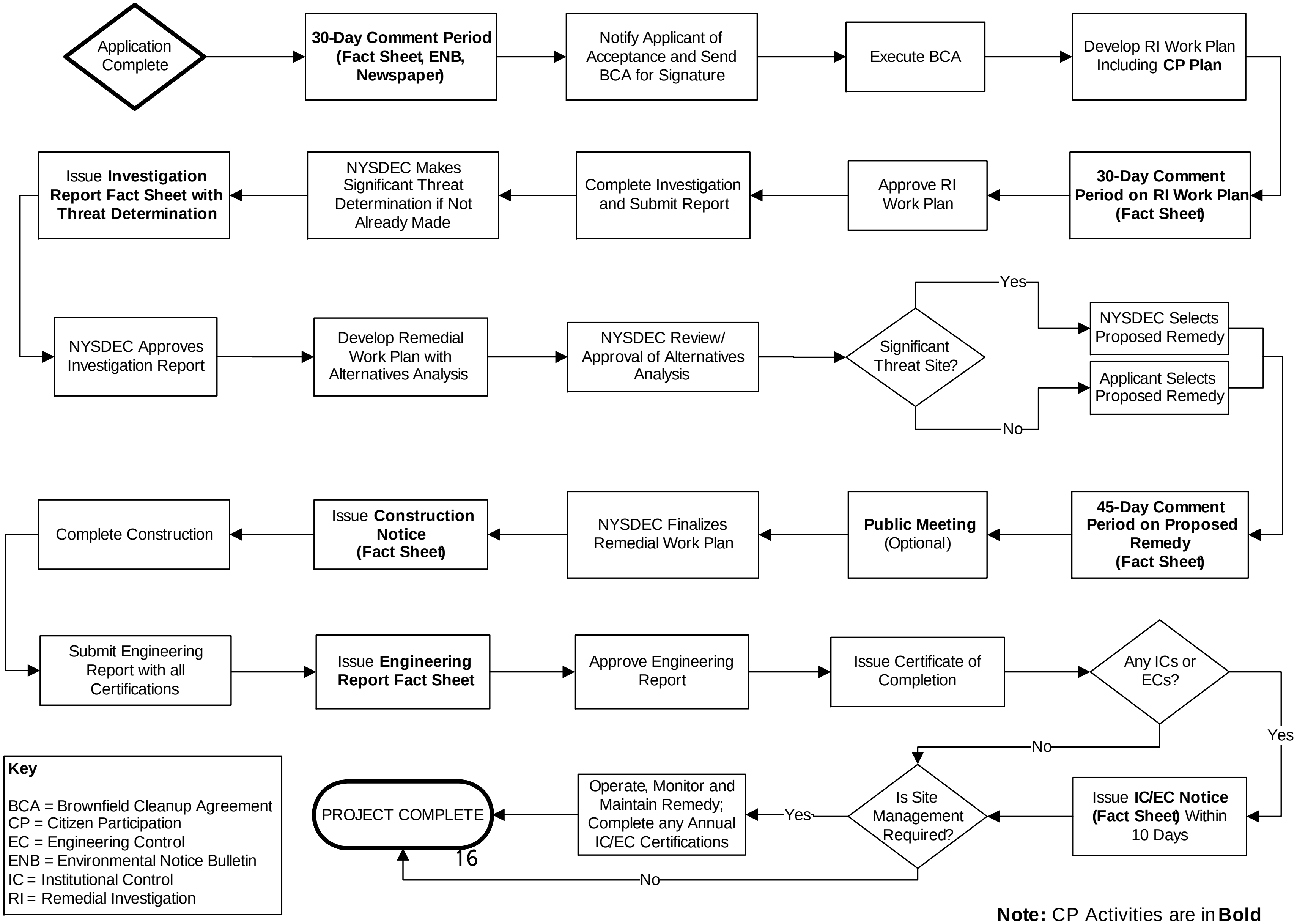
8. COMMUNITY, CIVIC, RELIGIOUS AND OTHER EDUCATIONAL INSTITUTIONS

Socrates Sculpture Park
Attn: John Hatfield, Executive Director
P.O. Box 6259
32-01 Vernon Boulevard
Long Island City, NY 11106

Appendix C
Site Location Map


N
THE SITE
0 100 200 300
Vernon Boulevard
Main Avenue
8 Street
30 Road
31 Avenue
31 Drive
31 Road
33 Road
33 Avenue
34 Avenue
35 Avenue
12 Street
14 Street
21 Street
RAVENSWOOD

Appendix D– Brownfield Cleanup Program Process



Key

BCA = Brownfield Cleanup Agreement
CP = Citizen Participation
EC = Engineering Control
ENB = Environmental Notice Bulletin
IC = Institutional Control
RI = Remedial Investigation

Note: CP Activities are in **Bold**

Appendix 8   Resumes of Key Personnel

ARIEL CZEMERINSKI, P.E.
191 Parkway Drive
Roslyn Heights, NY 11577
mobile (516) 987-1662
fax (516) 706-3214
Email: info@C2env.com

SUMMARY:

New York State Professional Engineer. Results-oriented Chemical and Environmental Engineer, with 21 years of experience in the chemical and environmental areas. Areas of expertise include inspections and sign off on Large Scale Vapor Barrier Installations at Various NYC schools, Design and inspections of Sub Slab Depressurization Systems, wastewater treatment systems, process control and automation, process optimization, productivity improvement, quality systems, environmental compliance, Phase I Environmental Site Assessments, Phase II Environmental Investigations, Phase III: Remedial Activities, process and plant safety, and management of a production facility. Special Inspector with New York City Department of Buildings. Registered PE in NY.

WORK EXPERIENCE:

2012-present C Squared Environmental Corp. Jericho, NY (Incorporated in 2012).

President

- Provide environmental and geotechnical services.
- Obtain soil and water samples.
- Conduct environmental monitoring activities.

1997-present AMC Engineering, PLLC. Jericho, NY (Organized in 2000).

Principal. Clients range from small car wash and Laundromat operators to large chemical process companies.

- Engineering Consulting Services.
- Design and Inspection of SubSlab Depressurization Systems
- Design of Subsurface Drainage Systems.
- SPDES and SWPPP Inspections
- Environmental Compliance.
- Phase I ESA, Phase II ESI. Remedial Investigations, Remediation of contaminated sites.
- Wastewater Treatment systems.
- Design of cleaning compounds for the Transportation industry.
- Zoning regulations. Expediting Services. NYFD, NYC Buildings, NYSDEC, Suffolk County
- Permitting: NYSDoB, NYCDEP, NYFD, NYSDEC
- NYCDOB Special Inspector: for heating system, chimneys and fire stops, and mechanical systems
- Safety and environmental training.
- Soil and Water characterization and sampling
- Inspections and sign off on Large Scale Vapor Barrier Installations at Various NYC schools

1994-2001 Axel Plastics Research Laboratories, Woodside, NY

Plant Manager

- Responsible for all day-to-day operations.
- Designed and installed a powders blending facility, including materials handling, dust collection systems, mixers, and other processing equipment.

- Implemented a safety program, based on OSHA standards.
- Implemented a Company-wide Quality Management system (ISO 9000).
- Successfully addressed all environmental-related issues with local authorities.
- Wrote all operating procedures and instructions. Designed and implemented an Intranet system with all information pertaining to day-to-day operations, for Company wide use.
- Planned production for the two plants and more than 140 lines of products.
- Managed all shipping/receiving operations. Managed all equipment and process maintenance.

1992-1994 Millennium Chemicals (SCM, Colors & Silica), Baltimore, MD.
Process Engineer and Project Manager.

- Process engineering, design, manufacturing and environmental control for the Silica Gel plant.
- Responsible for ISO 9000 certification. Wrote all procedures and instructions for the plant and maintenance.
- Conducted capital asset planning.
- Responsible for Health, Safety and Environmental compliance.

1990-1992 CROMPTON (WITCO) CORPORATION, POLYMER ADDITIVES, Taft, LA.
Process Development Engineer.

- Routine responsibilities were to develop new processes and optimize existing ones.
- Successfully designed and installed a distributed control system to remotely control an organic peroxides facility (Marshall, TX).
- Designed, erected and operated a Pilot Plant. It successfully brought to the market a pesticide, patented by Dupont and commercialized by Witco (Seenox).
- Conducted process simulation to identify process and product optimization.
- Designed process equipment (reactors, heat exchangers, pumps)

1987-1988 VINISA S.A.I.C. - PVC COMPOUNDING, Buenos Aires, Argentina.
Production and Project Manager.
Coordinated production in VINISA's 3 compounding plants. Routine responsibilities included: Technical assistance to PVC compounders, Production organization, planning and control, production management.

EDUCATION:

1988-1990 COLUMBIA UNIVERSITY, New York, NY
M.S. Chemical Engineering, Feb. 1990.
Awarded Fellowship as a Teaching Assistant. Thesis: Optimal Periodic Control.

1981-1987 UNIVERSITY OF BUENOS AIRES, Buenos Aires, Argentina.
Chemical Engineer (six year program).
Teaching Assistant Inorganic Chemistry.

Continuing Education Courses attended: (partial list)

- Building Inspections Course
- Environmental Regulation
- Design of Subsurface Drainage Systems
- Process Hazard Analysis
- Hazardous Materials Regulations

- Supervisors Training
- OSHA regulations
- ISO 9000
- Lead auditor training
- Wastewater Treatment System

ADDITIONAL INFORMATION

Speaker at Water Conferences: Long Island Water, wastewater and aquifers. Director, Metro New York Section, AIChE

Mark E. Robbins, C.P.G., C.E.I.
Vice President, Senior Geologist

Mr. Robbins has over nine (9) years experience in geology and hydrogeology, involving such activities as Phase I Environmental Site Assessments, Phase II Environmental Site Assessments, Subsurface Investigations, Remedial Actions, data acquisition, evaluation and contouring, and geotechnical investigations. Mr. Robbins has performed over 400 Phase I Assessments involving residential through heavy industrial properties and over 200 Subsurface Investigations throughout the United States. Mr. Robbins has also designed and implemented over 20 remediation systems for both public and private sectors.

Representative Occupational Experience

- *Environmental Site Assessments*
  Conducted Phase I and II Environmental Site Assessments, analysis of site investigation reports, identifying contamination locations and sources. Soil, soil-vapor and water sampling, analyzing laboratory results for QA/QC, magnetometer and Ground-Penetrating Radar surveys for locating buried drums and underground storage tanks (USTs), estimating UST and other subsurface leaks, monitoring well logging, Project Management, liability assessments and estimating costs to attain compliance.

- *Remedial Investigation and Feasibility Studies*
  Oversight/planning of site investigations; data analysis, including statistical analysis and geostatistical contouring utilizing SURFER; performance of feasibility studies, including technology evaluations, alternatives development and evaluation and cost estimations.

- *Due- Diligence Programs*
  Designed and implemented due-diligence programs (ranging from Phase I Assessment to Comprehensive Hydrogeologic Investigations) to assess environmental liabilities for numerous land development clientele.

- *Delineation of Chlorinated Organic Plumes*
  Supervised the delineation of a dissolved chlorinated organic plume from underground tank loss. Developed a remedial action program in accordance with New York State regulatory guidelines to abate soil and groundwater contamination.

- *Remedial Action*
  Prepared numerous Remedial Action Plans. Designed and implemented hydrocarbon and chlorinated solvent remediation systems for soil and groundwater.

- *Pump Test Aquifer Analysis*
  Conducted several pump tests and pump test analysis and field coordination in relation to dewatering permit requirements for Keyspan Energy and the private sector.

Employment

2001 - Present Vice President, Senior Geologist
Hydro Tech Environmental Corp., Commack, New York

2000 – 2001	Assistant Director, Professional Services Fenley & Nicol Environmental, Inc., Deer Park, New York
1999 – 2000	Senior Geologist Fenley & Nicol Environmental, Inc. Deer Park, New York
1995 – 1999	Operations Director Advanced Cleanup Technologies, Inc., Farmingdale, New York
1992 – 1995	Project Geologist Advanced Cleanup Technologies, Inc., Roslyn Heights, New York

Education

B.S. Geology, State University of New York at Oneonta, 1991

Affiliations and Certifications

- American Institute of Professional Geologists
- American Association of Petroleum Geologists
- Long Island Geologist Organization
- Geological Society of America
- American Standards in Testing Materials – E50 Committee Member
- Environmental Assessment Association
- OSHA 40-Hour & 8-Hour, Supervisor

Registrations and Certifications

- Certified Professional Geologist (C.P.G. # 10527)
- Certified Environmental Inspector (C.E.I. # 73383)
- GPR Operator's Course, Geophysical Survey Systems, Inc., 1993.

Publications/Presentations

- *A Case Study of the Impact of MTBE on the Investigation and Remediation of a Fuel Oil Release,* National Groundwater Focus Conference MTBE in Groundwater: Assessment, Remediation Technologies & Public Policy, Baltimore, MD June 4-5, 2001.
- *Is MTBE in Fuel Oil? Why MTBE Plays a Major Concern on Long Island,* Long Island Business News, February 2001.

Paul I. Matli (Ph.D.)

EXPERIENCES

Senior Project Manager
Hydro Tech Environmental Corp. - USA
Apr. 2005 - Nov. 2005 & July 2006 - Present
Completed Environmental Assessment Statements, Phase I Environmental Site Assessments, Phase II Investigations Work Plans, environmental monitoring programs of groundwater and indoor air quality, field sampling of soil, water, air, soil gas, mold and solid wastes, data evaluation through Quality Assurance and Quality Control programs and reports writing. Prepared and engineered Phase III Remedial Action Work Plans for regulated developments, superfund sites and hazardous waste facilities by implementing in-situ bio-chemical remedial technologies, ex-situ disposal of impacted media and on-site mitigation methods of soil vapor intrusion. Supervised and coordinated the closure and removal of petroleum storage tanks. Fulfilled the task of Health and Safety Officer and the duties of a Geologist at a New York State Brownfield Cleanup Program site and multiple New York City Brownfield Cleanup Program sites.

Vocational Lecturer of the Course "Ecology and Environment"
Saint Joseph University – Lebanon
Nov. 2003 - Feb. 2004
Introduced undergraduate students in the School of Agriculture Engineering and the Nursing School to advanced knowledge in the fields of ecology, environment, ecosystem management, earth science and multivariate statistical analytical methods.

Agriculture Engineer in the Italian Rural Development Project in the Upper Bekaa Valley, Baalbek-Hermel Region
Lebanese Agricultural Research Institute - Lebanon
May 2003 - Jan. 2004
Contributed to boosting agricultural production in rural communities in a semi-arid region by identifying deficient production and marketing elements in their farming system and promoting sustainbale agriculture by introducing drought tolerant crops and the construction and management of engineered water reservoirs.

Teaching Assistant
Tokyo University of Agriculture and Technology - Japan
Apr.1999-Sept. 2002
Played a key role in the completion of research thesis of graduate research students by instructing and assisting them in their experimental designs and the application of statistical analytical methods.

Environmental Manager of Ammiq Private Wetlands in the Bekaa Valley - Lebanon
Oct.1997 - Sept. 1998
Successfully managed the exploitation of natural resources of privately owned wetlands by local stakeholders and implemented the United Nations strategies to suppress hunting of endangered bird species and waterfawls in coordination with government and international non-government organizations.

EDUCATION

Ph.D. in Environmental Sciences (a)
Tokyo University of Agriculture and Technology- Japan
Apr. 1999 - Sept. 2002
Research Theme: Conducted field research of crop physiological responses to micro-climatic conditions and developed empirical and multivariate statistical models predicting the impact of future global warming on crop production.

M.Sc. in Environmental Sciences [(b)]
International Center for Advanced Mediterranean Agronomic Studies - Greece
Sept. 1995 - Sept. 1997
Research Theme: Performed field surveys and laboratory analytical studies of the physico-chemical properties of forest and plant species in promoting wildland fires and developed empirical statistical models predicting their inputs into forest fire behavior prediction systems.

D.S.P.G.S. in Management and Conservation of Mediterranean Ecosystems
International Center for Advanced Mediterranean Agronomic Studies - Greece
Nov. 1994 - Aug. 1995
Top second among 15% of students successfully passing a one-year postgraduate program of intensive multidisciplinary courses for the major of management and conservation of natural renewable resources with a GPA of 4.0.

Diploma of Agricultural Engineer [(c)]
University of Saint Joseph - Lebanon
Sept. 1989 - July 1994
Successfully passed a five-year engineering program in agronomy and ranked first in the 1994 class graduation with a GPA of 3.69.
Research Theme: Collected and established a socio-economic database of the impact of trout fish farms on the bio-chemical property and microbial quality of fresh watercourses.

PEER-REVIEWED PUBLICATIONS

Matli P.I., Aoki M., Ozawa Y., Hideshima Y., Nakayama H., and Maruya S. 2002. Characterization of canopy photosynthetic CO_2 flux and leaf stomatal conductance responses of potato crop to changing field meteorological conditions in Hokkaido (in English). Journal of Agricultural Meteorology, **58**(3)115-122.

Dimitrakopoulos A.P., and **Matli P.** 2001. Bulk density and physical properties of *Sarcopoterium spinosum* (L.) Spach as fuel characteristics (in English). Journal of Mediterranean Ecology, **2**:75-82.

Elzein G., **Matli P.**, and Darwish S. 1997. The Study of physico-chemical and biological parameters of fresh water in fisheries in the Bekaa Valley (in French). Lebanese Scientific Bulletin, **10**(1):3-20.

Matli P. 1998. Measures and strategies to prevent and manage forest fires in Lebanon (in Arabic). Al Nahar Newspaper; Nahar El Shabab, Sept. 22, pp.2-3.

Matli P. 1997. A preliminary planning of managerial strategies for the conservation and management of Ammiq private wetlands (in English). Technical report submitted to the owners committee of Ammiq Estates-Lebanon, 10p.

EXTRACURRICULAR TRAININGS AND SKILLS

40 Hours OSHA training Course in Health & Safety Methods in Handling Hazardous Materials, USA, Feb. 2010.

10 Hours OSHA Training Course in Construction Safety & Health, Feb. 2013.

Turbo Training in pursuing environmental remedial activities at hazardous sites in compliance with the New York City Mayor's Office of Environmental Remediation, Feb. 2015.

[(a), (b), (c)] Accredited US Educational Equivalence, *Globe Language Services, Inc*.

Education

BS Geology, SUNY Stony Brook, 2001

Affiliations / Certifications

- Long Island Geologist Organization
- 40 Hour OSHA, 8-Hour Supervisor
- First Responder, First Aid (CPR)
- Health & Safety operations at Hazardous Material Sites 29 CFR 1910. 120, New York

Appendix 9   Health and Safety Plan

Appendix 8

Health & Safety Plan
for
11-28 31st Drive

11-28 31st Drive
Astoria
Queens, New York 11106

NYSDEC BCP Number: C241159

Table of Contents

Figures

Attachments

1.0 INTRODUCTION

This Construction Health & Safety Plan (CHASP) has been prepared by Hydro Tech Environmental, Corp. (Hydro Tech) as a part of the Remedial Action Work Plan (RAWP) for 11-28 31st Drive (Block 502, Lot 22)and situated at in the borough of Queens, New York.

This CHASP will conform to applicable regulations, safe work practices and the project's requirements, and addresses those activities associated with the development of a 6-story residential building with a slab-on grade and a landscaped rear yard.

The Hydro Tech Project Manager (PM), Site Safety Officer (SSO) and field staff (when necessary) will implement the Plan during construction. Compliance with this HASP is required of all persons and third parties who perform the scope of work documented for this project. Assistance in implementing this CHASP can be obtained from the SSO. The content of this CHASP may change or undergo revisions based upon additional information that is made available to health and safety personnel, monitoring results, or changes in the technical scope of work.

It should be noted that this CHASP does not apply to any other scopes of work that may be performed at the Site that are not specifically outlined in this report. Through preparation of this HASP, Hydro Tech and all Subcontractors (if any) do not guarantee the health or safety of any person entering this Site. Due to the nature of this Site and the activities occurring thereon, it is not possible to discover, evaluate and provide protection for all possible hazards that may be encountered. Only those portions of this CHASP that specifically apply to the activities at the Site will be enacted by authorized personnel of Hydro Tech. Strict adherence to the applicable portions of these health and safety guidelines set forth herein will reduce, but not eliminate the potential for injury at this Site. The health and safety guidelines in this CHASP were prepared specifically for this Site and should not be utilized for any other site without prior research and evaluation by trained health and safety specialists and approval by Hydro Tech.

2.0 SCOPE OF WORK

This Construction HASP has been prepared as a part of the RAWP to be implemented during the upcoming development of the Site. Prior environmental assessments identified Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs) and Metals including lead in groundwater and soil/fill beneath the Site at concentrations exceeding their respective Unrestricted Use Soil Cleanup Objectives (SCOs). A range of vapors associated with organic solvents and petroleumconstituents were also detected beneath the Site.

The portions of the construction activities specifically addressed in this Construction HASP will include the following and will be performed in the following sequence:

- Supervision of the excavation of soil/fill and other material
- Supervision of the installation of concrete foundations
- Supervision of the installation of vapor barrier and active sub-slab depressurization system

Prior to any fieldwork, the New York City One-Call Unit will be contacted so that all public utilities can be marked out. The proposed schedule of fieldwork will be coordinated with the developer and the OER.

3.0 STAFFING

This section briefly describes the personnel involved in Site remedial activities, their contact information and their health and safety responsibilities. This section also provides directions to hospital in the case of a health emergency.

EMERGENCY NUMBERS

Contact	Phone Number
Mount Sinai Hospital	(718) 932-6000
New York City EMS	911
NYPD	911
NYFD	911
National Response Center	(800) 424-8802
Poison Information Center	(800) 562-8816
Chemtree	(800) 424-9555

Site Contacts

Title	Contact	Phone Number
Site Manager	Timothy Li	347-838-0846
Site Supervisor	George Man	212-625-0820
Site Emergency	George Man	212-625-0820

Project Management/Health and Safety Personnel

Title	Contact	Phone Number	Cell Phone
Geologist	Paul I. Matli	(631) 462-5866	(631) 457-0032
Site Safety Officer	Paul I. Matli	(718) 636-0800	(631) 241-7264
Project Manager	Paul I. Matli	(718) 636-0800	(631) 241-7165

Directions ToMount Sinai Hospital (See Attached Figure 1)

Upon leaving the Site, start going southeast on 31St Drive Avenue toward 12th Street. Turn right at the third cross street onto 21st Street and then turn right onto 30th Avenue. The hospital will be on the right side.

PROJECT MANAGER

As necessary, the Project Manager will perform the following:
- Has the overall responsibility for the health and safety of site personnel
- Ensures that adequate resources are provided to the field staff to carry out their responsibilities as outlined below.
- Ensures that fieldwork is scheduled with adequate personnel and equipment resources to complete the job in a safe manner.
- Ensures that adequate communication between field crews and emergency response personnel is maintained.
- Ensures that field site personnel are adequately trained and qualified to work at the Site.

SITE SAFETY OFFICER

As necessary, the Site Safety Officer will perform the following:
- Directs and coordinates health and safety monitoring activities.
- Ensures that field teams utilize proper personal protective equipment (PPE).
- Conducts initial on-Site, specific training prior to personnel and/or subcontractors proceeding to work.
- Conducts and documents periodic safety briefings; ensures that field team members comply with this Construction HASP.
- Completes and maintains Accident/Incident Report Forms.
- Notifies corporate administration of all accidents/incidents.
- Determines upgrade or downgrade of PPE based on site conditions and/or downgrade of PPE based on site conditions and/or real-time monitoring results.
- Ensures that monitoring instruments are calibrated daily or as determined by manufacturer's suggested instructions.
- Maintains health and safety field log books.
- Develops and ensures implementation of the Construction HASP.
- Approves revised or new safety protocols for field operations.
- Coordinates revisions of this Construction HASP with field personnel and the SSO Division Contracting Officer.
- Responsible for the development of new company safety protocols and procedures and resolution of any outstanding safety issues which may arise during the conduction of site work.
- Reviews personnel and subcontractors current and up-to-date medical examination and acceptability of health and safety training.

FIELD PERSONNEL AND SUBCONTRACTORS (IF ANY)

- Reports any unsafe or potentially hazardous conditions to the SSO
- Maintains knowledge of the information, instructions, and emergency response actions contained in this Construction HASP.

- Comply with rules, regulations and procedures as set forth in this Construction HASP and any revisions that are instituted.
- Prevents admittance to work sites by unauthorized personnel.

4.0 CHEMICAL & WASTE DESCRIPTION/CHARACTERIZATION

The following list of compounds is based on the results of the recent subsurface investigation:

Heavy Metals in soil:

- Chromium Trivalent
- Chromium, Hexavalent
- Copper
- Lead
- Zinc
- Selenium

Volatile Organic Compounds in Groundwater:

Tetrachloroethylene

Dissolved metals in Groundwater:

- Magnesium
- Sodium

Volatile Organic Compounds in soil vapors:

- Tetrachloroethylene
- Chloroform
- Acetone
- Carbon disulfide
- Methylene chloride
- Tetrahydrofuran
- Ethyl acetate
- Ethyl Benzene
- 1,2,4-Trimethylbenzene
- o-Xylene
- p- & m- Xylenes
- n-Heptane
- n-Heptane
- Toluene

Appendix A contains Material Safety Data Sheets

The following information references are presented in order to identify the properties, characteristics and hazards of the compounds and metals that may/will be encountered at the Site.

- * Dangerous Properties of Industrial Materials - Sax
- * Chemical Hazards of the Workplace - Proctor/Hughes
- * Condensed Chemical Dictionary - Hawley
- * Rapid Guide to Hazardous Chemical in the Workplace - Lewis 1990.
- * NIOSH Guide to Chemical Hazards – 1990.
- * ACGIH TLV Values and Biological Exposure Indices - 1991-1992.

5.0 HAZARD ASSESSMENT AND MITIGATION

The potential hazards associated with planned site activities include chemical, physical and biological hazards associated with the construction. This section discusses those hazards that are anticipated to be encountered during the activities listed in the scope of work.

The potential to encounter chemical hazards is dependent upon the work activity performed (invasive or non-invasive), the duration, and location of the work activity. Such hazards could include inhalation or skin contact with chemicals that could cause: dermatitis, skin burn, being overcome by vapors, or asphyxiation. In addition, the handling of contaminated materials and chemicals could result in fire and/or explosion.

The potential to encounter physical hazards during site work includes: heat stress, exposure to excessive noise, loss of limbs, being crushed, head injuries, cuts and bruises, and other physical hazards due to motor vehicle operation, heavy equipment and power tools.

CHEMICAL HAZARDS

The potential for personnel and subcontractors to come in contact with chemical hazards may occur during the following tasks:

- Excavation
- Installation of vapor barrier and SSD systems
- Pouring of concrete foundation(s)

Exposure Pathways

Exposure to these compounds during ongoing activities may occur through inhalation of contaminated dust particles, inhalation of volatile vapor fume compounds, by way of dermal absorption, and accidental ingestion of the contaminant by either direct or indirect cross contamination activities (eating, smoking, poor hygiene). Indirectly, inhalation of contaminated dust particles can occur during adverse weather conditions (high or changing wind directions) or during operations that may generate airborne dust such as excavation.

Dust Suppression

The following techniques have been shown to be effective for the controlling of the generation and migration of dust during construction activities.

1. Applying water on haul roads.
2. Wetting equipment and excavation faces.
3. Spraying water on buckets during excavation and dumping.
4. Hauling materials in properly sealed or watertight containers.
5. Restricting vehicle speeds to 10mph.
6. Covering excavated areas and material after excavation activity ceases.
7. Reducing the excavation size and/or number of excavations.
8. Applying a dust suppressant, such as calcium chloride, in high vehicle traffic areas.

To evaluate the effectiveness if the dust suppression measures, air monitoring utilizing real-time dust-monitoring equipment will be performed. The requirements for air monitoring during post-remediation soil disturbance activities are presented in Section 5.0.

Additional Precautions

Dermal absorption or skin contact with chemical compounds is possible during invasive activities at the Site, including the excavation and/or capping of soils. The use of PPE in accordance with Section 9.0 and strict adherence to proper decontamination procedures should significantly reduce the risk of skin contact.

The potential for accidental ingestion of potentially hazardous chemicals is expected to be remote, when good hygiene practices are used. Unauthorized personnel, including all children, will not be allowed access to the Site.

PHYSICAL HAZARDS

A variety of physical hazards may be present during Site activities. These hazards are similar to those associated with any construction type project and include digging or boring operations and excavation activities in the vicinity of underground utility locations. These physical hazards are due to motor vehicles, and heavy equipment operation, the use of improper use of power and hand tools, misuse of pressurized cylinders, walking on objects, tripping over objects, working on surfaces which have the potential to promote falling, mishandling and improper storage of solid and hazardous materials, skin burns, crushing of fingers, toes, limbs, hit on the head by falling objects or hit one's head due to not seeing the object of concern, temporary loss of one's hearing and/or eyesight. Theses hazards are not unique and are generally familiarly to most hazardous waste site workers at construction sites. Additional task specific safety requirements will be covered during safety briefings.

6.0 SPILL PREVENTION AND CONTROL PLAN

Accidental spill and leaks of hazardous and non-hazardous materials will be properly controlled so that they do not adversely impact storm drain systems or receiving waters. A spill prevention and control plan will include the following:

Spill/Leak Prevention Measures;
-Place any material under cover (tarp) and away from storm drains or sensitive water bodies
-Properly label all containers so that the contents are easily identifiable
-Berm storage areas so that if a spill or leak occur they are easily contained

Spill Response Procedures
- Assessment of the Site and potential impacts by the SSO
- Containment of the material
- Notification of the personnel present at the Site and ensure evacuation procedure if necessary.

Spill Cleanup Procedures
-If small non-hazardous spill, use cleanup materials such as absorbents or rags and damp cloths and dispose of properly;
-If large non-hazardous spill or hazardous spill, a private hazmat team may need to be contacted to assess the situation and conduct the cleanup and proper disposal of the material.

Reporting
-Petroleum spills will be reported immediately to the NYSDEC Spill Hotline.
-If material is unknown or hazardous, contact the local Fire Department.

Training
-The SSO is responsible for providing refreshment training to all employees working on-site about spill prevention, spill response and cleanup on a routine basis.
-The SSO will identify key spill response personnel to assist in the spill control and cleanup procedures.

7.0 TRAINING

GENERAL HEALTH AND SAFETY TRAINING

In accordance with 29 CFR 1910.120, all construction personnel involved with the portions of the scope of work described in Section 2.0 will be briefed by the Project Manager on the potential hazards and the overall requirements in meeting the specifications of this Construction HASP.

The SSO will have the responsibility of ensuring that personnel assigned to this project comply with these requirements. Written certification of completion of any required training, if necessary, will be provided to the SSO.

MANAGER/SUPERVISOR TRAINING

In accordance with 29 CFR 1910.120, on-Site management and supervisors who will be directly responsible for, or who supervise employees engaged in hazardous waste operation shall receive training as required in this Construction HASP and at least eight (8) additional hours of specialized training on managing such operations at the time of job assignment.

ANNUAL 8-HOUR REFRESHER TRAINING

Annual 8-hour refresher training will be required of all hazardous waste site field personnel in order to maintain their qualification for fieldwork. The following topics will be reviewed: toxicology, respiratory protection, including air purifying devices and self-contained breathing apparatus (SCBA), medical surveillance, decontamination procedures and personnel protective clothing. In addition, topics deemed necessary by the SSO may be added to the above list.

SITE SPECIFIC TRAINING

Prior to commencement of field activities, all personnel assigned to the project will be provided training that will specifically address the activities, procedures, monitoring, and equipment for the site operations. It will include Site and facility layout, hazards, and emergency services at the Site, and will highlight all provisions contained within this Construction HASP. This training will also allow field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity.

ON-SITE SAFETY BRIEFINGS

Project personnel and visitors will be given periodic on-site health and safety briefings by the SSO, or their designee, to assist site personnel in safely conducting their work activities. The briefings will include information on new operations to be conducted, changes in work practices, or changes in the Site's environmental conditions. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety audits.

ADDITIONAL TRAINING

Additional training may be required by the SSO for participation in certain field tasks during the course of the project. Such additional training could be in the safe operation of heavy or power tool equipment or hazard communication training.

HAZWOPER TRAINING

All remedial personnel that will be in direct contact with the native soil/fill materials must complete an initial 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and, where necessary, a current 8-hour refresher course

SUBCONTRACTOR TRAINING

Subcontractor personnel working on-site may be exempted from the contents of this Construction HASP. The SSO will determine if this exemption is allowed. In any case, the subcontractor personnel who are exposed to hazards are not exempted from the contents of this Construction HASP.

8.0 MEDICAL SURVEILLANCE

GENERAL

No general or specific medical surveillance or other medical requirements are set forth in this Construction HASP.

9.0 SITE CONTROL, PPE & COMMUNICATIONS

SITE CONTROL

The area where the activities of the scope of work will be performed is considered to be the Exclusion Zone (EZ). All areas where excavation and handling of contaminated materials take place are considered the EZ. This zone will be clearly delineated by cones, tape, or other means. The SSO may establish more than one EZ where different levels of protection may be employed or where different hazards exist. Personnel are not allowed in the EZ without:

- A buddy
- Appropriate personal protective equipment (as necessary)

The remaining portions of the Site outside of the EZ will consist of a Support Zone (SZ) and a Contamination Reduction Zone (CRZ). Appropriate sanitary facilities, safety equipment, packaged/decontaminated and labeled samples will be located in SZ. Potentially contaminated personnel or materials will be allowed in the CRZ for decontamination as necessary.

PERSONAL PROTECTIVE EQUIPMENT

General

The level of protection worn by field personnel will be enforced by the SSO. Levels of protection may be upgraded or downgraded at the discretion of the SSO. The decision shall be based on real-time air monitoring, site history data, and prior site experience. Any changes in the level of protection shall be recorded in the health and safety field logbook.

PPE Specifications

For tasks requiring Level C PPE, the following equipment shall be used:

- Cotton or disposable coveralls
- Disposable outer coveralls (Poly-coated Tyvek)
- Gloves, inner (latex)
- Gloves, outer (Nitrile®)
- Boots (PVC), steel toe/shank
- Boot covers (as needed)
- Hard Hat
- Hearing protection (as needed)
- Splash suit and face shield for decontamination operations (as needed)

For tasks requiring Level D PPE, the following equipment shall be used:

- Cotton or disposable coveralls
- Gloves, inner (latex)
- Gloves, outer (Nitrile®)
- Boots (PVC) steel toe/shank
- Boot covers (as needed)
- Hard hat
- Hearing protection (as needed)
- Safety glasses

For tasks requiring Level D PPE, the following equipment shall be used:

- Cotton or disposable coveralls
- Gloves, inner (latex)
- Gloves, outer (Nitrile®)
- Boots (PVC) steel toe/shank
- Boot covers (as needed)
- Hard hat
- Hearing protection (as needed)
- Safety glasses

For tasks requiring respiratory protection, the following equipment shall be used:

Level D - No respiratory protective equipment necessary except for a dust mask
Level C - A full-face air-purifying respirator equipped with organic vapor/pesticide-HEPA cartridges
Level B - An air line respirator or a self-contained breathing apparatus (SCBA)

LEVEL OF PERSONAL PROTECTIVE EQUIPMENT REQUIRED

Activity	Level of Protection Respiratory/PPE
Excavations	C/D
Foundation Construction	C/D

COMMUNICATIONS

Communications is the ability to talk with others. While working in Level C Protection, personnel may find that communication become a more difficult task and process to accomplish. This is further complicated by distance and space. In order to address this problem, electronic instruments, mechanical devices or hand signals will be used as follows:

- Walkie-Talkies - Hand held radios would be utilized as much as possible by field teams for communication between downrange operations and the Command Post base station.

- Telephones - A mobile telephone will be located in the Command Post vehicle in the Support Zone for communication with emergency support services/facilities. If a telephone is demobilized, the nearest public phones will be identified.

- Air Horns - A member of the downrange field team will carry an air horn and another will be evident in the Support Zone to alert field personnel to an emergency situation.

- Hand Signals - Members of the field team using the buddy system will employ this communication method. Signals become especially important when in the vicinity of heavy moving equipment and when using Level B respiratory equipment. The signals shall become familiar to the entire field team before site operations commence and they will be reinforced and reviewed during site-specific training.

HAND SIGNALS FOR ON-SITE COMMUNICATION

Signal	Meaning
Hand gripping throat	Out of air, can't breathe
Grip partners' wrist	Leave area immediately; no debate
Hands on top of head	Need assistance
Thumbs up	OK, I'm all right; I understand
Thumbs down	No; negative, unable to understand you. I'm not all right

10.0 AIR MONITORING PLAN

GENERAL

Continuous air monitoring in the EZ during invasive tasks will accompany site operations, as indicated in this HASP or as required by the SSO. Monitoring will be performed to verify the adequacy of respiratory protection, to aid in site layout and to document work exposure. All monitoring instruments shall be operated by qualified personnel only and will be calibrated daily prior to use, or more often as necessary. For additional references and information, see Hydro Tech's Site-Specific Air Monitoring Program.

REAL-TIME MONITORING

Instrumentation

A PID (to monitor total volatile organic concentrations) will be used to measure worker breathing zone ambient on-site concentrations during on-site activities. The equipment will be calibrated daily and the results noted in the project field book. A background level will be established, at a minimum, on a daily basis, and recorded in the field book.

The following response actions will be taken based on PID readings in the breathing zone. All work will be performed in level D PPE unless breathing zone volatile organic concentrations exceed 5 ppm. Once levels of 25 ppm are measured, work will be stopped.

Volatile Organics	Photoionization Detector (PID)	>5ppm	Temporarily halt work activities & monitor until readings decrease to below 5ppm.
		>5ppm<25ppm	Halt work activities, upgrade to level C continue monitoring.
		>25ppm	Shut down work activities

During soil excavation, particulate monitoring will be performed using a real-time particulate monitor that will monitor particulate matter less than ten microns (PM10) with the following minimum performance standards:

Object to be measured: Dust. Mists, Aerosols
Size range: < 0.1 to 10 microns
Sensitivity: 0.001 mg/m3
Overall Accuracy: = 10% as compared to gravimetric analysis of stearic acid or reference dust.

Particulate levels will be monitored immediately downwind at the working site and integrated over a period not to exceed 15 minutes. The action level will be established at 150 ug/m3 over the integrated period not to exceed 15 minutes.

Action Levels

Action levels for upgrading of PPE in this Construction HASP will apply to all site work during the duration of field activities at the Site. The action level is the presence of visible airborne dust. When airborne dust is observed, specific dust-mitigating procedures will be implemented. These dust-mitigating procedures are documented in Section 6.0.

11.0 SAFETY CONSIDERATIONS

GENERAL

In addition to the specific requirements of this HASP, common sense should be used at all times. The general safety rules and practices below will be in effect at the Site at the discretion of the Project Manager, SSO or other authorized personnel.

- The site will be suitably marked or barricaded as necessary to prevent unauthorized visitors but not hinder emergency services if needed.

- As needed, all open holes, trenches, and obstacles will be properly barricaded in accordance with local site requirements. These requirements will be determined by proximity to traffic ways, both pedestrian and vehicular, and site of the hole, trench, or obstacle. If holes are required to be left open during non-working hours, they will be adequately decked over or barricaded and sufficiently lighted.

- Before any digging or boring operations are conducted, underground utility locations will be identified. All boring, excavation, and other site work will be planned and performed with consideration for underground lines. Any excavation work will be performed in accordance with Hydro Tech's Standard Operating Procedures for Excavations.

- Either workers or other people will enact dust-mitigating procedures when the potential for the inhalation of dust particles is present.

- The act of smoking and/or ignition sources in the vicinity of potentially flammable or contaminated material is strictly prohibited.

- Drilling, boring, and use of cranes and drilling rigs, erection of towers, movement of vehicles and equipment and other activities will be planned and performed with consideration for the location, height, and relative position of aboveground utilities and fixtures, including signs; canopies; building and other structures and construction; and natural features such as trees, boulders, bodies of water, and terrain.

- When working in areas where flammable vapors may be present, particular care shall be exercised with tools and equipment that may be sources of ignition. All tools and equipment provided must be properly bonded and/or grounded. Metal buttons and zippers are prohibited on safety clothing for areas that may contain a flammable or explosive atmosphere.

- Approved and appropriate safety equipment (as specified in this Construction HASP), such as eye protection, hard hats, foot protection, and respirators, must be worn in areas where required. In addition, eye protection must be worn when sampling soil or water that may be contaminated.

- No smoking, eating, chewing tobacco, gum chewing, or drinking will be allowed in the contaminated areas.

- Contaminated tools and hands must be kept away from the face.

- Personnel must use personal hygiene safe guards (washing up) at the end of the shift or as soon as possible after leaving the Site.

- Each sample must be treated and handled as though it were contaminated.

- Persons with long hair and/or loose fitting clothing that could become entangled in power equipment must take adequate precautions.

- Horseplay is prohibited in the work area.

- Work while under the influence of intoxicants, narcotics, or controlled substances is prohibited.

POSTED SIGNS

Posted danger signs will be used where an immediate hazard exists. Caution signs will be posted to warn against potential hazards and to caution against unsafe practices. Traffic control methods and barricades will be used as needed. Wooden stakes and flagging tape, or equally effective material will be used to demarcate all restricted areas.

Other postings may include the OSHA poster, emergency hospital route, and telephone numbers of contact personnel.

INVASIVE OPERATIONS

The SSO will be present on-Site during all invasive work (e.g. excavations and capping). The SSO will ensure that appropriate monitoring, levels of protection, and safety procedures are followed. No personnel will enter any excavations for any reasons. All non-essential personnel will stay at least 10 feet back from the edge of the excavation and out of the swing radius of the backhoe. No drums or other potential sources will be sampled or removed during this phase without further additions to the Construction HASP.

The proximity of water, sewer, and electrical lines will be identified prior to invasive operations. The possibility of the presence of underground conduits or vessels containing materials under pressure will also be investigated prior to invasive operations. Properly-sized containment systems will be utilized and consideration of the potential volume of liquid or waste released during operations will be discussed with members of the field team to minimize the potential for spills and provide a method for collection of waste materials. Emergency evacuation procedures and the location of safety equipment will be established prior to start up operations. The use of protective clothing, especially hard hats, boots, and gloves will be required during drilling and other heavy equipment work.

SOIL, GROUNDWATER AND LIQUID WASTE SAMPLING

During Site invasive excavation, soil sampling for waste characterization may be required for disposal purposes. No groundwater or liquid waste sampling is anticipated during site remediation.

HEAVY EQUIPMENT DECONTAMINATION

Personnel steam cleaning heavy equipment, if necessary shall use the prescribed level of protection and adhere to the buddy system. Initially this task usually employs Level C. The heavy equipment decontamination shall be restricted to authorized personnel only. Special consideration will be given to wind speed and direction. Downwind areas are to be kept free of personnel to avoid unnecessary exposure to potential airborne contamination.

ADDITIONAL SAFETY CONSIDERATIONS

No other additional safety considerations at this time.

12.0 DECONTAMINATION AND DISPOSAL PROCEDURES

CONTAMINATION PREVENTION

One of the most important aspects of decontamination is the prevention of contamination. Good contamination prevention should minimize worker exposure and help ensure valid sample results by precluding cross-contamination. Procedures for contamination avoidance include:

Personnel:
Do not walk through areas of obvious or known contamination.
Do not directly handle or touch contaminated materials.
Make sure that there are no cuts or tears on PPE.
Fasten all closures in suits; cover with tape if necessary.

Particular care should be taken to prevent any skin injuries.
Stay upwind of airborne contaminants.
Do not carry cigarettes, cosmetics, gum, etc. into contaminated areas.

Sampling and Monitoring:
When required by the SSO, cover instruments with clear plastic, leaving openings for sampling ports. Keep all decontaminated sampling materials in bags prior to emplacement of sample matrix.

Heavy Equipment:
Care should be taken to limit the amount of contamination that comes in contact with heavy equipment (tires). Dust control measures may be needed on roads inside the site boundaries.

PERSONNEL DECONTAMINATION

All personnel shall pass through an outlined decontamination procedure when exiting the hot zone at each location. A field wash for equipment and PPE shall be set up at each work location. The system will include a gross wash and rinse for all disposable clothing and boots worn in the EZ. Upon exiting the EZ, all personnel will wash their hands, arms, neck, and face before entering the Support Zone.

EQUIPMENT DECONTAMINATION

Equipment used at the Site that is potentially contaminated shall be decontaminated to prevent hazardous materials from leaving the Site. All heavy equipment will be decontaminated at the decontamination pad and inspected by the SSO and Project Manager before it leaves the Site. The decontamination area will provide for the containment of all wastewater from the decontamination process. Respirators, airline and any other personnel equipment that comes in contact with contaminated soils shall pass through a field wash.

DECONTAMINATION DURING MEDICAL EMERGENCIES

If emergency life-saving first aid and/or medical treatment are required, normal decontamination procedures may need to be abbreviated or omitted. The Site SSO or designee will accompany contaminated victims to the medical facility to provide advice on matters involving decontamination, when necessary. The outer garments can be removed if they do not cause delays, interfere with treatment, or aggravate the problem. Respiratory equipment must always be removed. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed, a plastic barrier between the individual and clean surfaces should be used to help prevent contaminating the inside of ambulances and /or medical personnel. Outer garments are then removed at the medical facility.

No attempt will be made to wash or rinse the victim, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material that could also cause severe injury or loss of life to emergency response personnel. For minor medical problems or injuries, the normal decontamination procedures will be followed. Note that heat stroke requires prompt treatment to prevent irreversible damage or death. Protective clothing must be promptly removed. Less serious forms of heat stress also require prompt attention and removal of protective clothing immediately. Decontamination should be omitted or minimized and treatment begun immediately unless the victim is obviously contaminated.

DISPOSAL PROCEDURES

The SSO and Project Manager will develop a segregating system of non-hazardous waste and hazardous waste. All discarded material, waste materials, or other objects shall be handled in such a way as to preclude the potential for spreading contamination, creating sanitary hazards, or

causing litter to be left on site. All potentially contaminated materials, e.g. clothing, gloves, etc., will be bagged or drummed as necessary, labeled and segregated for disposal. All non-contaminated materials shall be collected and bagged for appropriate disposal as normal domestic waste.

13.0 EMERGENCY PLAN

The potential for the development of an emergency situation is low considering the low concentrations of hazardous substances at the work site. Nevertheless, an emergency situation could occur. All personnel, prior to the start of work, will know the emergency plan outlined in this section. The emergency plan will be available for use at all times during site work.

Various individual site characteristics will determine preliminary actions taken to assure that this emergency plan is successfully implemented in the event of a site emergency. Careful consideration must be given to the proximity of neighborhood housing or places of employment, and to the relative possibility of site fire, explosion or release of vapors or gases that could affect the surrounding community.

The Project Manager shall make contact with local fire, police, and other emergency units prior to beginning work on site. In these contacts, the Project Manager will inform the emergency units about the nature and duration of work expected to the Site and the type of contaminants and the possible health or safety effects of emergencies involving these contaminants. At this time, the Project Manager and the emergency response units shall make the necessary arrangements to be prepared for any emergencies that could occur.

The Project Manager shall implement the contingency plan whenever conditions at the Site warrant such action. The Project Manager will be responsible for coordination of the evacuation emergency treatment, and transportation of site personnel as necessary, and notification of emergency response units and the appropriate management staff.

EVACUATION

In the event of an emergency situation, such as fire, explosion, or significant release of toxic gases, an air horn or other appropriate device will be sounded for approximately 10 second intervals indicating the initiation of evacuation procedures. All personnel will evacuate and assemble near the entrance to the site. The location shall be upwind of the Site where possible.

For efficient and safe site evacuation and assessment of the emergency situation, the Project Manager will have authority to initiate action if outside services are required. Under no circumstances will incoming personnel or visitors be allowed to proceed into the area once the emergency signal has been given. The SSO or designated SSO must ensure that access for emergency equipment is provided and that all combustion apparatuses have been shut down once the alarm has been sounded. Once the safety of all personnel is established, the Fire Department and other emergency response groups as necessary will be notified by telephone of the emergency.

POTENTIAL OR ACTUAL FIRE OR EXPLOSION

Immediately evacuate the Site (air horn will sound for 10-second intervals), notify the local fire and police departments, and other appropriate emergency response groups if an actual fire or explosion has taken place.

PERSONNEL INJURY

Emergency first aid shall be applied on site as deemed necessary. If necessary, the individual shall be decontaminated and transported to the nearest medical facility.

The ambulance/rescue squad shall be contacted for transport as necessary in an emergency. However, since some situations may require transport of an injured party by other means, the hospital route is identified below. A map to this facility provided with this HASP in Section 2.2.3.

ACCIDENT/INCIDENT REPORTING

As soon as first aid and/or emergency response needs have been met, the employer of the injured party must be immediately notified of any incident. Written confirmation of verbal reports is to be submitted within 24 hours. A standard report form entitled “Accident Data Report” is to be used for this purpose.

For reporting purposes, the term accident refers to fatalities, lost time injuries, spill, or exposure to hazardous materials (toxic materials, explosive or flammable materials).

Any information released from the health care provider, which is not deemed confidential patient information, is to be attached to the appropriate form. Any medical information that is released by patient consent is to be filed in the individuals’ medical records and treated as confidential.

OVERT PERSONNEL EXPOSURE

SKIN CONTACT: Use copious amounts of soap and water. Wash/rinse affected area thoroughly, and then provide appropriate medical attention. Eyes should be rinsed for 15 minutes upon chemical contamination.

INHALATION: Move personnel to fresh air and if necessary, decontaminate and transport to hospital.

INGESTION: Decontamination and transport to emergency medical facility.

PUNCTURE WOUND OR LACERATION: Decontaminate and transport to emergency medical facility.

ADVERSE WEATHER CONDITIONS

In the event of adverse weather conditions, the SSO or designee will determine if work can continue without sacrificing the health and safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

* Potential for heat stress and heat-related injuries
* Potential for cold stress and cold-related injuries
* Treacherous weather-related conditions
* Limited visibility
* Potential for electrical storms

Site activities will be limited to daylight hours and acceptable weather conditions. Inclement working conditions include heavy rain, fog, high winds, and lighting. Observe daily weather reports and evacuate if necessary in case of inclement weather conditions.

EMERGENCY RESPONSE EQUIPMENT LIST

Some or all of the following will either be available on-Site or be able to be brought to the Site within a 2-hour period:

* 55 Gallon Drums
* 85 Gallon Drums
* Absorbent Pads
* Absorbent Booms
* Speedy-Dry
* Plastic Sheeting
* Hay Bales
* Pneumatic Nibbler
* Back Hoe
* Pressure Washer

- Air Compressor
- Wilden Pumps
- Equipment Storage Trailer
- Submersible Pumps
- Miscellaneous Hand Tools
- Portable Lighting

LARGE EQUIPMENT
If necessary, the following large equipment will be brought to the Site within 2-hours:

- Large Vacuum Truck
- Super Sucker
- Dump Trucks
- Drill Rig
- Utility Vehicle

14.0 LOGS, REPORTS AND RECORD KEEPING

Medical and Training Records

The Site Superintendent keeps medical and training records. All subcontractors must provide verification of training and medical qualifications to the Site Superintendent. The Site Superintendent will keep a log of personnel meeting appropriate training and medical qualifications for site work. The log will be kept in the project file. Medical records will be maintained in accordance with 29 CFR 1910.20.

Onsite Log

A log of personnel onsite each day will be kept by the Site Superintendent. Originals will be kept in the project file.

Exposure Records

Any monitoring results, laboratory reports, calculations and air sampling data sheets are part of an employee exposure record. These records will be kept in accordance with 29 CFR 1910.20. The originals will be sent to the Hydro Tech records coordinator. For subcontractor employees, the original will be sent to the subcontractor employer and a copy kept in the project file.

Accident/Incident Reports

An accident/incident report must be completed for all accidents and incidents. Hydro Tech will send the originals to the appropriate Hydro Tech records coordinator for maintenance. Copies will be distributed as stated. A copy of the forms will be kept in the project file.

OSHA Form 200

An OSHA Form 200 (Log of Occupational Injuries and Illnesses) will be kept at the Site. All recordable injuries or illnesses will be recorded on this form. At the end of the project, the original will be sent to the Hydro Tech corporate records administrator for maintenance. Subcontractor employers must also meet the requirements of maintaining an OSHA 200 form. The Hydro Tech accident/incident report meets the requirements of the OSHA Form 101 (Supplemental Record) and must be maintained with the OSHA Form 200 for all recordable injuries or illnesses.

Health and Safety Field Log Book

The SSO or designee will maintain the logbook in accordance with standard Hydro Tech procedures. Daily site conditions, activities, personnel, calibration records, monitoring results and significant events will be recorded. The original logbooks will become part of the exposure records file.

15.0 SANITATION

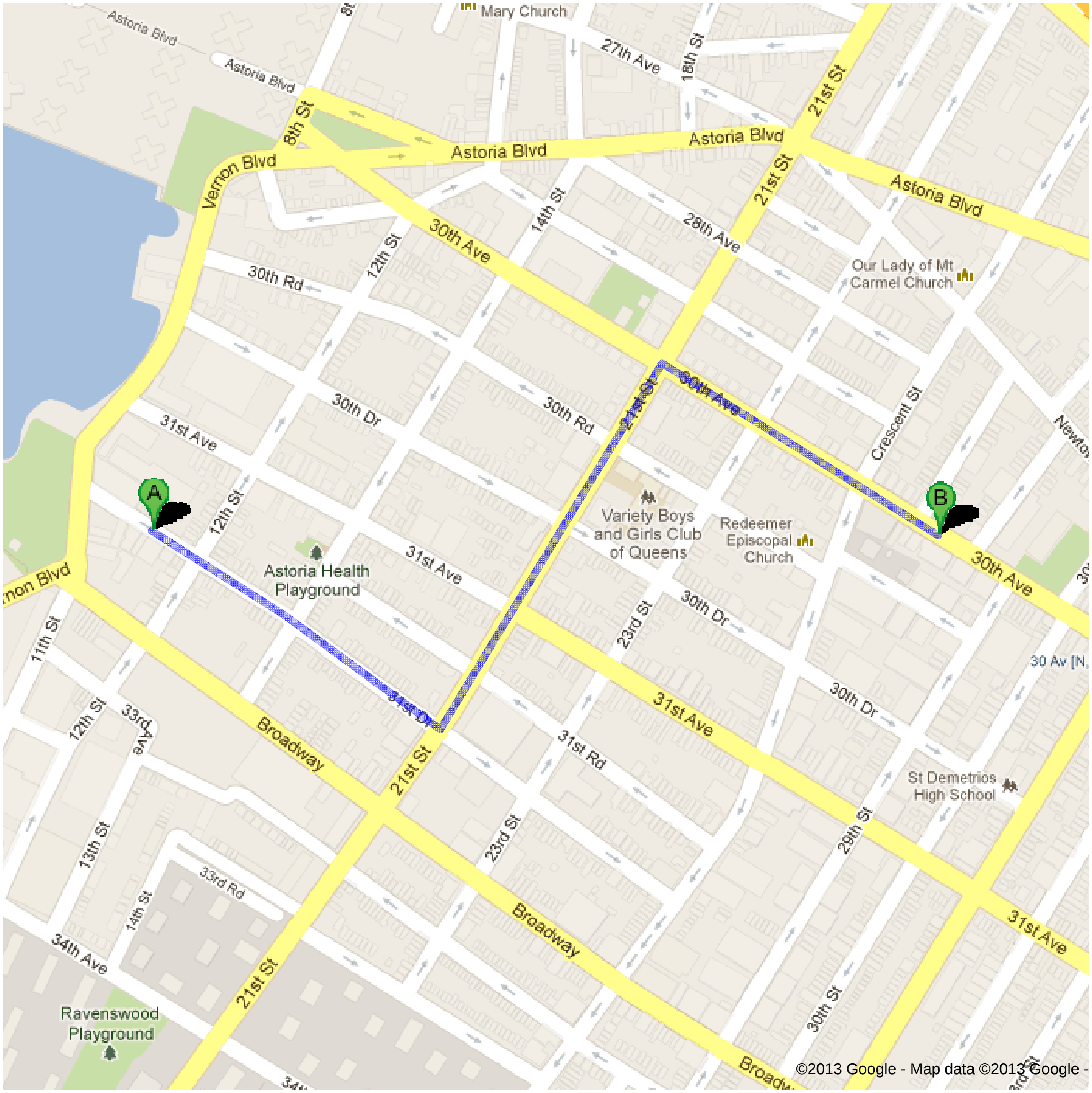
Since sanitary sewer connection has not been established, provisions shall be made for access to sanitary systems by using nearby public facilities consistent with provisions of governing local ordinance codes. This will include the use of outside firms providing and maintaining “Porta Potties” or similar devices.

If a commercial/industrial laundry is used to clean or launder clothing that is potentially contaminated, they shall be informed of the potential harmful effects of exposure to hazardous substances related to the affected clothing.

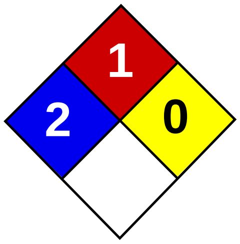
Personnel and subcontractors sites shall follow decontamination procedures described in the Construction HASP. This will generally include, when necessary, site-specific training in shower usage and cleanup, personal hygiene requirements and the donning of protective equipment/clothing.

FIGURE 1
DIRECTIONS TO HOSPITAL

Directions to Mount Sinai Hospital Queens
25-10 30th Ave, Long Island City, NY 11102
0.8 mi – about **4 mins**



ATTACHMENT A
HEALTH AND SAFETY FACT SHEETS



Health	2
Fire	1
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Trichloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Trichloroethylene

Catalog Codes: SLT3310, SLT2590

CAS#: 79-01-6

RTECS: KX4560000

TSCA: TSCA 8(b) inventory: Trichloroethylene

CI#: Not available.

Synonym:

Chemical Formula: C2HCl3

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Trichloroethylene	79-01-6	100

Toxicological Data on Ingredients: Trichloroethylene: ORAL (LD50): Acute: 5650 mg/kg [Rat]. 2402 mg/kg [Mouse]. DERMAL (LD50): Acute: 20001 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified A5 (Not suspected for human.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to kidneys, the nervous system, liver, heart, upper respiratory tract. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 420°C (788°F)

Flash Points: Not available.

Flammable Limits: LOWER: 8% UPPER: 10.5%

Products of Combustion: These products are carbon oxides (CO, CO2), halogenated compounds.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/

spray. Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Carcinogenic, teratogenic or mutagenic materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 50 STEL: 200 (ppm) from ACGIH (TLV) TWA: 269 STEL: 1070 (mg/m3) from ACGIH Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 131.39 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 86.7°C (188.1°F)

Melting Point: -87.1°C (-124.8°F)

Critical Temperature: Not available.

Specific Gravity: 1.4649 (Water = 1)

Vapor Pressure: 58 mm of Hg (@ 20°C)

Vapor Density: 4.53 (Air = 1)

Volatility: Not available.

Odor Threshold: 20 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, acetone.

Solubility:
Easily soluble in methanol, diethyl ether, acetone. Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity:
Extremely corrosive in presence of aluminum. Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
Acute oral toxicity (LD50): 2402 mg/kg [Mouse]. Acute dermal toxicity (LD50): 20001 mg/kg [Rabbit].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified A5 (Not suspected for human.) by ACGIH. The substance is toxic to kidneys, the nervous system, liver, heart, upper respiratory tract.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Passes through the placental barrier in human. Detected in maternal milk in human.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Trichloroethylene : UN1710 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Trichloroethylene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Trichloroethylene Pennsylvania RTK: Trichloroethylene Florida: Trichloroethylene Minnesota: Trichloroethylene Massachusetts RTK: Trichloroethylene New Jersey: Trichloroethylene TSCA 8(b) inventory: Trichloroethylene CERCLA: Hazardous substances.: Trichloroethylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R36/38- Irritating to eyes and skin. R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

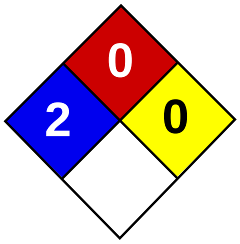
Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:54 PM

Last Updated: 11/01/2010 12:00 PM



Health	2
Fire	0
Reactivity	0
Personal Protection	G

Material Safety Data Sheet
Tetrachloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Tetrachloroethylene

Catalog Codes: SLT3220

CAS#: 127-18-4

RTECS: KX3850000

TSCA: TSCA 8(b) inventory: Tetrachloroethylene

CI#: Not available.

Synonym: Perchloroethylene; 1,1,2,2-Tetrachloroethylene; Carbon bichloride; Carbon dichloride; Ankilostin; Didakene; Dilatin PT; Ethene, tetrachloro-; Ethylene tetrachloride; Perawin; Perchlor; Perclene; Perclene D; Percosolvel; Tetrachloroethene; Tetraleno; Tetralex; Tetravec; Tetroguer; Tetropil

Chemical Name: Ethylene, tetrachloro-

Chemical Formula: C2-Cl4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Tetrachloroethylene	127-18-4	100

Toxicological Data on Ingredients: Tetrachloroethylene: ORAL (LD50): Acute: 2629 mg/kg [Rat]. DERMAL (LD): Acute: >3228 mg/kg [Rabbit]. MIST(LC50): Acute: 34200 mg/m 8 hours [Rat]. VAPOR (LC50): Acute: 5200 ppm 4 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (anticipated carcinogen) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, peripheral nervous system, respiratory tract, skin, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with skin. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, metals, acids, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:
Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 25 (ppm) from OSHA (PEL) [United States] TWA: 25 STEL: 100 (ppm) from ACGIH (TLV) [United States] TWA: 170 (mg/m3) from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Ethereal.

Taste: Not available.

Molecular Weight: 165.83 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 121.3°C (250.3°F)

Melting Point: -22.3°C (-8.1°F)

Critical Temperature: 347.1°C (656.8°F)

Specific Gravity: 1.6227 (Water = 1)

Vapor Pressure: 1.7 kPa (@ 20°C)

Vapor Density: 5.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 5 - 50 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.4

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Miscible with alcohol, ether, chloroform, benzene, hexane. It dissolves in most of the fixed and volatile oils. Solubility in water: 0.015 g/100 ml @ 25 deg. C It slowly decomposes in water to yield Trichloroacetic and Hydrochloric acids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, metals, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Oxidized by strong oxidizing agents. Incompatible with sodium hydroxide, finely divided or powdered metals such as zinc, aluminum, magnesium, potassium, chemically active metals such as lithium, beryllium , barium. Protect from light.

Special Remarks on Corrosivity: Slowly corrodes aluminum, iron, and zinc.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2629 mg/kg [Rat]. Acute dermal toxicity (LD50): >3228 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5200 4 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (Some evidence.) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. May cause damage to the following organs: kidneys, liver, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Publishe Lethal Dose/Conc: LDL [Rabbit] - Route: Oral; Dose: 5000 mg/kg LDL [Dog] - Route: Oral; Dose: 4000 mg/kg LDL [Cat] - Route: Oral; Dose: 4000 mg/kg

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects(teratogenic). May affect genetic material (mutagenic). May cause cancer.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation with possible dermal blistering or burns. Symtoms may include redness, itching, pain, and possible dermal blistering or burns. It may be absorbed through the skin with possible systemic effects. A single prolonged skin exposure is not likely to result in the material being absorbed in harmful amounts. Eyes: Contact causes transient eye irritation, lacrimation. Vapors cause eye/conjunctival irritation. Symptoms may include redness and pain. Inhalation: The main route to occupational exposure is by inhalation since it is readily absorbed through the lungs. It causes respiratory tract irritation, . It can affect behavior/central nervous system (CNS depressant and anesthesia ranging from slight inebriation to death, vertigo, somnolence, anxiety, headache, excitement, hallucinations, muscle incoordination, dizziness, lightheadness, disorentiation, seizures, enotional instability, stupor, coma). It may cause pulmonary edema Ingestion: It can cause nausea, vomiting, anorexia, diarrhea, bloody stool. It may affect the liver, urinary system (proteinuria, hematuria, renal failure, renal tubular disorder), heart (arrhythmias). It may affect behavior/central nervous system with symptoms similar to that of inhalation. Chronic Potential Health Effects: Skin: Prolonged or repeated skin contact may result in excessive drying of the skin, and irritation. Ingestion/Inhalation: Chronic exposure can affect the liver(hepatitis,fatty liver degeneration), kidneys, spleen, and heart (irregular heartbeat/arrhythmias, cardiomyopathy, abnormal EEG), brain, behavior/ central nervous system/peripheral nervous system (impaired memory, numbness of extremeties, peripheral neuropathy and other

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 18.4 mg/l 96 hours [Fish (Fatthead Minnow)]. 18 mg/l 48 hours [Daphnia (daphnia)]. 5 mg/l 96 hours [Fish (Rainbow Trout)]. 13 mg/l 96 hours [Fish (Bluegill sunfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Tetrachloroethylene UNNA: 1897 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Tetrachloroethylene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Tetrachloroethylene Connecticut hazardous material survey.: Tetrachloroethylene Illinois toxic substances disclosure to employee act: Tetrachloroethylene Illinois chemical safety act: Tetrachloroethylene New York release reporting list: Tetrachloroethylene Rhode Island RTK hazardous substances: Tetrachloroethylene Pennsylvania RTK: Tetrachloroethylene Minnesota: Tetrachloroethylene Michigan critical material: Tetrachloroethylene Massachusetts RTK: Tetrachloroethylene Massachusetts spill list: Tetrachloroethylene New Jersey: Tetrachloroethylene New Jersey spill list: Tetrachloroethylene Louisiana spill reporting: Tetrachloroethylene California Director's List of Hazardous Substances: Tetrachloroethylene TSCA 8(b) inventory: Tetrachloroethylene TSCA 8(d) H and S data reporting: Tetrachloroethylene: Effective date: 6/1/87; Sunset date: 6/1/97 SARA 313 toxic chemical notification and release reporting: Tetrachloroethylene CERCLA: Hazardous substances.: Tetrachloroethylene: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects. R51/53- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. S23- Do not breathe gas/fumes/vapour/spray S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S37- Wear suitable gloves. S61- Avoid release to the environment. Refer to special instructions/Safety data sheets.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: g

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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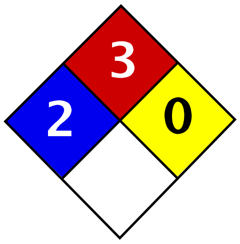

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
p-Xylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: p-Xylene

Catalog Codes: SLX1120

CAS#: 106-42-3

RTECS: ZE2625000

TSCA: TSCA 8(b) inventory: p-Xylene

CI#: Not applicable.

Synonym: p-Methyltoluene

Chemical Name: 1,4-Dimethylbenzene

Chemical Formula: $C_6H_4(CH_3)_2$

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{p-}Xylene	106-42-3	100

Toxicological Data on Ingredients: p-Xylene: ORAL (LD50): Acute: 5000 mg/kg [Rat.]. DERMAL (LD50): Acute: 12400 mg/kg [Rabbit.]. VAPOR (LC50): Acute: 4550 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant).
Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to blood, kidneys, the nervous system, liver.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 527°C (980.6°F)

Flash Points: CLOSED CUP: 25°C (77°F). OPEN CUP: 28.9°C (84°F) (Cleveland).

Flammable Limits: LOWER: 1.1% UPPER: 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapor may travel considerable distance to source of ignition and flash back. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Toxic flammable liquid, insoluble or very slightly soluble in water.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as oxidizing agents.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 150 (ppm) from ACGIH (TLV)
TWA: 434 STEL: 651 (mg/m3) from ACGIHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Liquid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 138°C (280.4°F)

Melting Point: 12°C (53.6°F)

Critical Temperature: Not available.

Specific Gravity: 0.86 (Water = 1)

Vapor Pressure: 9 mm of Hg (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.62 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether.

Solubility:
Easily soluble in methanol, diethyl ether.
Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 5000 mg/kg [Rat.].
Acute dermal toxicity (LD50): 12400 mg/kg [Rabbit.].
Acute toxicity of the vapor (LC50): 4550 ppm 4 hour(s) [Rat].

Chronic Effects on Humans: The substance is toxic to blood, kidneys, the nervous system, liver.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant).
Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:

0347 Animal: embryotoxic, foetotoxic, passes through the placental barrier.
0900 Detected in maternal milk in human.
Narcotic effect; may cause nervous system disturbances.

Special Remarks on other Toxic Effects on Humans: Material is irritating to mucous membranes and upper respiratory tract.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Xylene : UN1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: p-Xylene
Florida: p-Xylene
Massachusetts RTK: p-Xylene
New Jersey: p-Xylene
TSCA 8(b) inventory: p-Xylene
SARA 313 toxic chemical notification and release reporting: p-Xylene
CERCLA: Hazardous substances.: p-Xylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).
CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R10- Flammable.
R38- Irritating to skin.
R41- Risk of serious damage to eyes.
R48/20- Harmful: danger of serious

damage to health by prolonged
exposure through inhalation.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du rÃ¨glement sur le transport des marchandises dangeureuses au canada. Centre de conformitÃ© internatinal LtÃ©e. 1986.

Other Special Considerations: Not available.

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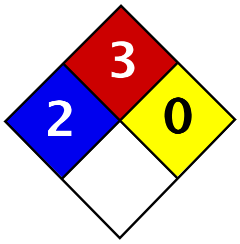

Health	2
Fire	3
Reactivity	0
Personal Protection	J

Material Safety Data Sheet
m-Xylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: m-Xylene

Catalog Codes: SLX1066

CAS#: 108-38-3

RTECS: ZE2275000

TSCA: TSCA 8(b) inventory: m-Xylene

CI#: Not applicable.

Synonym: m-Methyltoluene

Chemical Name: 1,3-Dimethylbenzene

Chemical Formula: $C_6H_4(CH_3)_2$

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{m-}Xylene	108-38-3	100

Toxicological Data on Ingredients: m-Xylene: ORAL (LD50): Acute: 5000 mg/kg [Rat.]. DERMAL (LD50): Acute: 14100 mg/kg [Rabbit.].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant).
Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to blood, kidneys, the nervous system, liver.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 527°C (980.6°F)

Flash Points: CLOSED CUP: 25°C (77°F). OPEN CUP: 28.9°C (84°F) (Cleveland).

Flammable Limits: LOWER: 1.1% UPPER: 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapor may travel considerable distance to source of ignition and flash back. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid, insoluble in water.

Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as oxidizing agents.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection: Splash goggles. Lab coat. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 150 (ppm) from ACGIH (TLV)
TWA: 434 STEL: 651 (mg/m3) from ACGIHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Liquid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 139.3°C (282.7°F)

Melting Point: -47.87°C (-54.2°F)

Critical Temperature: Not available.

Specific Gravity: 0.86 (Water = 1)

Vapor Pressure: 6 mm of Hg (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.62 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether.

Solubility:
Easily soluble in methanol, diethyl ether.
Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact.

Toxicity to Animals:
Acute oral toxicity (LD50): 5000 mg/kg [Rat.].
Acute dermal toxicity (LD50): 14100 mg/kg [Rabbit.].

Chronic Effects on Humans: The substance is toxic to blood, kidneys, the nervous system, liver.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant).
Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
0347 Animal: embryotoxic, foetotoxic, passes through the placental barrier.
0900 Detected in maternal milk in human.
Narcotic effect; may cause nervous system disturbances.

Special Remarks on other Toxic Effects on Humans: Material is irritating to mucous membranes and upper respiratory tract.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Xylene : UN1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: m-Xylene
Massachusetts RTK: m-Xylene
TSCA 8(b) inventory: m-Xylene
SARA 313 toxic chemical notification and release reporting: m-Xylene
CERCLA: Hazardous substances.: m-Xylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).
CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R10- Flammable.
R38- Irritating to skin.
R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du rÃ¨glement sur le transport des marchandises dangeureuses au canada. Centre de conformitÃ© internatinal LtÃ©e. 1986.

Other Special Considerations: Not available.

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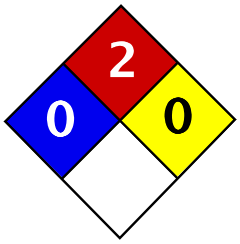

Health	0
Fire	2
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Mesitylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Mesitylene

Catalog Codes: SLM2410

CAS#: 108-67-8

RTECS: OX6825000

TSCA: TSCA 8(b) inventory: Mesitylene

CI#: Not available.

Synonym: 1,3,5-Trimethylbenzene

Chemical Formula: C_9H_{12}

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Mesitylene	108-67-8	100

Toxicological Data on Ingredients: Mesitylene: VAPOR (LC50): Acute: 4881.9 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of eye contact (irritant), of ingestion, of inhalation (lung irritant). Slightly hazardous in case of skin contact (irritant, permeator), .

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes,

keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 559°C (1038.2°F)

Flash Points: CLOSED CUP: 43°C (109.4°F).

Flammable Limits: Not available.

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Be careful that the product is not present at a

concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. Avoid contact with eyes Wear suitable protective clothing If ingested, seek medical advice immediately and show the container or the label.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. Keep container dry. Keep in a cool place.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 25 CEIL: 35 (ppm)
TWA: 125 CEIL: 170 (mg/m3)
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Aromatic.

Taste: Not available.

Molecular Weight: 120.2 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: 164.7°C (328.5°F)

Melting Point: -44.8°C (-48.6°F)

Critical Temperature: Not available.

Specific Gravity: 0.8637 (Water = 1)

Vapor Pressure: 1.86 mm of Hg (@ 20°C)

Vapor Density: 4.14 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.23 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute toxicity of the vapor (LC50): 4881.9 ppm 4 hour(s) [Rat].

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans:
Hazardous in case of ingestion, of inhalation (lung irritant).
Slightly hazardous in case of skin contact (irritant, permeator), .

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : 1,3,5-Trimethylbenzene : UN2325 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Florida: Mesitylene
New Jersey: Mesitylene
TSCA 8(b) inventory: Mesitylene

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-3: Combustible liquid with a flash point between 37.8°C (100°F) and 93.3°C (200°F).

DSCL (EEC):
R10- Flammable.
R36/37- Irritating to eyes and respiratory system.

HMIS (U.S.A.):

Health Hazard: 0

Fire Hazard: 2

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 0

Flammability: 2

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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International Chemical Safety Cards

BENZO(B)FLUORANTHENE

ICSC: 0720

BENZO(B)FLUORANTHENE
Benzo(e)acephenanthrylene
2,3-Benzofluoroanthene
$C_{20}H_{12}$
Molecular mass: 252.3

CAS # 205-99-2
RTECS # CU1400000
ICSC # 0720

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Water spray, powder.
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
• **INHALATION**		Local exhaust or breathing protection.	Fresh air, rest.
• **SKIN**	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention. Wear protective gloves when administering first aid.
• **EYES**		Safety goggles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**		Do not eat, drink, or smoke during work.	Wear protective gloves when inducing vomiting. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.	Provision to contain effluent from fire extinguishing. Tightly closed.	Unbreakable packaging; put breakable packaging into closed unbreakable container.

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0720

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities

International Chemical Safety Cards

BENZO(B)FLUORANTHENE

ICSC: 0720

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** COLOURLESS TO YELLOW CRYSTALS. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** Upon heating, toxic fumes are formed. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of its aerosol and through the skin. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly. **EFFECTS OF SHORT-TERM EXPOSURE:** **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** This substance is possibly carcinogenic to humans.
PHYSICAL PROPERTIES	Melting point: 168°C Solubility in water: none	Vapour pressure, Pa at 20°C: <10 Octanol/water partition coefficient as log Pow: 6.04
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to the total environment. In the food chain important to humans, bioaccumulation takes place, specifically in oils and fats.	

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. Data are insufficiently available on the effect of this substance on human health, therefore utmost care must be taken. Do NOT take working clothes home.

ADDITIONAL INFORMATION

ICSC: 0720 **BENZO(B)FLUORANTHENE**

IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

BENZO(K)FLUORANTHENE

ICSC: 0721

BENZO(K)FLUOROANTHENE
11,12-Benzofluoroanthene
Dibenzo(b,j,k)fluorene
$C_{20}H_{12}$
Molecular mass: 252.3

CAS # 207-08-9
RTECS # DF6350000
ICSC # 0721

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Water spray, powder.
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
• **INHALATION**		Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention. Wear protective gloves when administering first aid.
• **EYES**		Safety goggles or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**		Do not eat, drink, or smoke during work.	Wear protective gloves when inducing vomiting. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.	Provision to contain effluent from fire extinguishing. Separated from strong oxidants. Tightly closed.	

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0721

International Chemical Safety Cards

BENZO(K)FLUORANTHENE

ICSC: 0721

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** YELLOW CRYSTALS. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** Upon heating, toxic fumes are formed. Reacts with strong oxidants. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of its aerosol and through the skin. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly. **EFFECTS OF SHORT-TERM EXPOSURE:** **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** This substance is possibly carcinogenic to humans.
PHYSICAL PROPERTIES	Boiling point: 480°C Melting point: 215.7°C	Solubility in water: none Octanol/water partition coefficient as log Pow: 6.84
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to the total environment. In the food chain important to humans, bioaccumulation takes place, specifically in oils and fats.	

NOTES

Data are insufficiently available on the effect of this substance on human health, therefore utmost care must be taken. Do NOT take working clothes home.

ADDITIONAL INFORMATION

ICSC: 0721 **BENZO(K)FLUORANTHENE**

IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

BENZ(a)ANTHRACENE

ICSC: 0385

BENZ(a)ANTHRACENE
1,2-Benzoanthracene
Benzo(a)anthracene
2,3-Benzphenanthrene
Naphthanthracene
$C_{18}H_{12}$
Molecular mass: 228.3

CAS # 56-55-3
RTECS # CV9275000
ICSC # 0385
EC # 601-033-00-9

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.		Water spray, powder. In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		AVOID ALL CONTACT!	
• **INHALATION**		Local exhaust or breathing protection.	Fresh air, rest.
• **SKIN**		Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**		Safety goggles, face shield, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**		Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into sealable containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place (extra personal protection: complete protective clothing including self-contained breathing apparatus).	Well closed.	T symbol R: 45 S: 53-45

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0385	Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

International Chemical Safety Cards

BENZ(a)ANTHRACENE

ICSC: 0385

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** COLOURLESS TO YELLOW-BROWN FLUORESCENT FLAKES OR POWDER. **PHYSICAL DANGERS:** Dust explosion possible if in powder or granular form, mixed with air. **CHEMICAL DANGERS:** **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation, through the skin and by ingestion. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly. **EFFECTS OF SHORT-TERM EXPOSURE:** **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** This substance is probably carcinogenic to humans.
PHYSICAL PROPERTIES	Sublimation point: 435°C Melting point: 162°C Relative density (water = 1): 1.274	Solubility in water: none Vapour pressure, Pa at 20°C: 292 Octanol/water partition coefficient as log Pow: 5.61
ENVIRONMENTAL DATA	In the food chain important to humans, bioaccumulation takes place, specifically in seafood.	

NOTES

This substance is one of many polycyclic aromatic hydrocarbons - standards are usually established for them as mixtures, e.g., coal tar pitch volatiles. However, it may be encountered as a laboratory chemical in its pure form. Insufficient data are available on the effect of this substance on human health, therefore utmost care must be taken. Do NOT take working clothes home. Tetraphene is a common name.

ADDITIONAL INFORMATION

ICSC: 0385 **BENZ(a)ANTHRACENE**

Material Safety Data Sheet

Benzo[a]pyrene, 98%

ACC# 37175

Section 1 - Chemical Product and Company Identification

MSDS Name: Benzo[a]pyrene, 98%
Catalog Numbers: AC105600000, AC105600010, AC105601000, AC377200000, AC377200010, AC377201000 AC377201000
Synonyms: 3,4-Benzopyrene; 3,4-Benzpyrene; Benzo[def]chrysene.
Company Identification:

Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410

For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
50-32-8	Benzo[a]pyrene	>96	200-028-5

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: yellow to brown powder.
Danger! May cause harm to the unborn child. May impair fertility. May cause eye, skin, and respiratory tract irritation. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. Cancer hazard. May cause allergic skin reaction. May cause heritable genetic damage.
Target Organs: Reproductive system, skin.

Potential Health Effects

Eye: May cause eye irritation.
Skin: May cause skin irritation. May be harmful if absorbed through the skin. May cause an allergic reaction in certain individuals.
Ingestion: May cause irritation of the digestive tract. The toxicological properties of this substance have not been fully investigated. May be harmful if swallowed.
Inhalation: May cause respiratory tract irritation. The toxicological properties of this substance have not been fully investigated. May be harmful if inhaled.
Chronic: May cause cancer in humans. May cause reproductive and fetal effects. Laboratory experiments have resulted in mutagenic effects.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.
Ingestion: Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water.
Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: Use water spray, dry chemical, carbon dioxide, or appropriate foam.
Flash Point: Not available.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 2; Flammability: 0; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Clean up spills immediately, observing precautions in the Protective Equipment section. Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions. Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Use with adequate ventilation. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation.
Storage: Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs

Benzo[a]pyrene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (as benzene soluble fraction) (listed under Coal tar pitches).

OSHA Vacated PELs: Benzo[a]pyrene: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant respirator use.

Section 9 - Physical and Chemical Properties

Physical State: Powder
Appearance: yellow to brown
Odor: faint aromatic odor
pH: Not available.
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 495 deg C @ 760 mm Hg
Freezing/Melting Point:175 - 179 deg C
Decomposition Temperature: Not available.
Solubility: 1.60x10-3 mg/l @25°C
Specific Gravity/Density: Not available.
Molecular Formula:$C_{20}H_{12}$
Molecular Weight:252.31

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Dust generation.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 50-32-8: DJ3675000
LD50/LC50:

Not available.

Carcinogenicity:
CAS# 50-32-8:

- **ACGIH:** A2 - Suspected Human Carcinogen
- **California:** carcinogen, initial date 7/1/87
- **NTP:** Suspect carcinogen
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

Epidemiology: No information found
Teratogenicity: No information found
Reproductive Effects: Adverse reproductive effects have occurred in experimental animals.
Mutagenicity: Mutagenic effects have occurred in humans.Mutagenic effects have occurred in experimental animals.
Neurotoxicity: No information found
Other Studies:

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series:
CAS# 50-32-8: waste number U022.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	NOT REGULATED FOR DOMESTIC TRANSPORT	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOL (Benzo{a} pyrene)
Hazard Class:		9
UN Number:		UN3077
Packing Group:		III

Section 15 - Regulatory Information

US FEDERAL

TSCA

CAS# 50-32-8 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 50-32-8: 1 lb final RQ; 0.454 kg final RQ

SARA Section 302 Extremely Hazardous Substances

None of the chemicals in this product have a TPQ.

SARA Codes

CAS # 50-32-8: immediate, delayed.

Section 313

This material contains Benzo[a]pyrene (CAS# 50-32-8, >96%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
CAS# 50-32-8 is listed as a Priority Pollutant under the Clean Water Act.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 50-32-8 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California Prop 65

The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act:

WARNING: This product contains Benzo[a]pyrene, a chemical known to the state of California to cause cancer.
California No Significant Risk Level: CAS# 50-32-8: 0.06 æg/day NSRL

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

T N

Risk Phrases:

R 43 May cause sensitization by skin contact.
R 45 May cause cancer.
R 46 May cause heritable genetic damage.
R 60 May impair fertility.
R 61 May cause harm to the unborn child.
R 50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Safety Phrases:

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

S 53 Avoid exposure - obtain special instructions before use.
S 60 This material and its container must be disposed of as hazardous waste.
S 61 Avoid release to the environment. Refer to special instructions /safety data sheets.

WGK (Water Danger/Protection)
CAS# 50-32-8: No information available.
Canada - DSL/NDSL
CAS# 50-32-8 is listed on Canada's DSL List.
Canada - WHMIS
This product has a WHMIS classification of D2A.
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.
Canadian Ingredient Disclosure List
CAS# 50-32-8 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 9/02/1997
Revision #7 Date: 6/30/2006

Material Safety Data Sheet

Chrysene, 98%

ACC# 95251

Section 1 - Chemical Product and Company Identification

MSDS Name: Chrysene, 98%
Catalog Numbers: AC224140000, AC224140010, AC224140050, AC224145000
Synonyms: 1,2-Benzophenanthrene; Benzo(a)phenanthrene; 1,2,5,6-Dibenzonaphthalene.
Company Identification:

Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410

For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
218-01-9	Chrysene	98	205-923-4

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: very light beige solid.
Caution! May cause eye and skin irritation. May cause respiratory tract irritation. May cause cancer in humans.
Target Organs: Liver, skin.

Potential Health Effects

Eye: May cause eye irritation.
Skin: May cause skin irritation.
Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea.
Inhalation: May cause respiratory tract irritation.
Chronic: May cause cancer according to animal studies.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin: Get medical aid. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.
Ingestion: Do not induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.
Inhalation: Get medical aid immediately. Remove from exposure and move to fresh air

immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. This material in sufficient quantity and reduced particle size is capable of creating a dust explosion.
Extinguishing Media: Use water spray, dry chemical, carbon dioxide, or chemical foam.
Flash Point: Not applicable.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: ; Flammability: 1; Instability:

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Vacuum or sweep up material and place into a suitable disposal container. Clean up spills immediately, observing precautions in the Protective Equipment section. Wear a self contained breathing apparatus and appropriate personal protection. (See Exposure Controls, Personal Protection section). Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Wash hands before eating. Avoid contact with eyes, skin, and clothing. Use only with adequate ventilation. Avoid breathing dust.
Storage: Store in a tightly closed container. Store in a cool, dry area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use process enclosure, local exhaust ventilation, or other engineering controls to control airborne levels.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Chrysene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (as benzene soluble fraction) (listed under Coal tar pitches).

OSHA Vacated PELs: Chrysene: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance: very light beige
Odor: Not available.
pH: Not available.
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 448 deg C @ 760 mm Hg
Freezing/Melting Point:250-255 deg C
Decomposition Temperature: Not available.
Solubility: insoluble
Specific Gravity/Density: Not available.
Molecular Formula:$C_{18}H_{12}$
Molecular Weight:228.29

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Dust generation.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 218-01-9: GC0700000
LD50/LC50:
Not available.

Carcinogenicity:
CAS# 218-01-9:

- **ACGIH:** A3 - Confirmed animal carcinogen with unknown relevance to humans

- **California:** carcinogen, initial date 1/1/90
- **NTP:** Known carcinogen (listed as Coal tar pitches).
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

Epidemiology: No information found
Teratogenicity: No information found
Reproductive Effects: No information found
Mutagenicity: Chrysene was mutagenic to S. Typhimurium in the presence of an exogenous metabolic system.
Neurotoxicity: No information found
Other Studies:

Section 12 - Ecological Information

Ecotoxicity: Water flea LC50 = 1.9 mg/L; 2 Hr.; Unspecified Fish toxicity : LC50 (96hr) Neauthes arenacedentata >1ppm.(Rossi,S.S. et al Marine Pollut. Bull. 1978) Invertebrate toxicity : lethal treshold concentration (24hr) Daphnia Magna 0,7æg/l.(* Newsted,J.L. et al Environ. Toxicol. Chem. 1987) Bioaccumulation : 24hr Daphnia Magna log bioconcentration factor 3.7845 (*)
Environmental: Degradation studies : biodegradated by white rot fungus (Proc.Annu.Meet.Am.Wood-Preserv.Assoc.1989) May be utilised by axenic cultures of microorganisms e.g. Pseudomonas pancimobilis EPA505, which may have novel degradative systems(Mueller,J.G. et al ppl.Environ.Microbiol.1990; Mueller, J.G. et al Environ.Sci.Technol.1991).
Physical: Not found.
Other: No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series:
CAS# 218-01-9: waste number U050.

Section 14 - Transport Information

	US DOT	**Canada TDG**
Shipping Name:	Not regulated as a hazardous material	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA

CAS# 218-01-9 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 218-01-9: 100 lb final RQ; 45.4 kg final RQ

SARA Section 302 Extremely Hazardous Substances

None of the chemicals in this product have a TPQ.

Section 313

This material contains Chrysene (CAS# 218-01-9, 98%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
CAS# 218-01-9 is listed as a Priority Pollutant under the Clean Water Act.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 218-01-9 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California Prop 65
The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act:
WARNING: This product contains Chrysene, a chemical known to the state of California to cause cancer.
California No Significant Risk Level: CAS# 218-01-9: 0.35 æg/day NSRL (oral)

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

T

Risk Phrases:

R 45 May cause cancer.
R 50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Safety Phrases:

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S 53 Avoid exposure - obtain special instructions before use.
S 60 This material and its container must be disposed of as hazardous waste.

S 61 Avoid release to the environment. Refer to special instructions /safety data sheets.

WGK (Water Danger/Protection)

CAS# 218-01-9: No information available.

Canada - DSL/NDSL

CAS# 218-01-9 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of D2A.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

CAS# 218-01-9 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 6/30/1999
Revision #4 Date: 10/03/2005

Material Safety Data Sheet

Fluoranthene, 98%

ACC# 80991

Section 1 - Chemical Product and Company Identification

MSDS Name: Fluoranthene, 98%
Catalog Numbers: AC119170000, AC119170250, AC119171000, AC119175000
Synonyms: 1,2-(1,8-Naphthalenediyl)benzene; 1,2-(1,8-Naphthylene)benzene; 1,2-Benzacenaphthene; Benzene, 1,2-(1,8-naphthylene)-; Benzo(j,k)fluorene; Benzo(jk)fluoranthene; Benzo(jk)fluorene
Company Identification:

Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410

For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
206-44-0	Fluoranthene	98	205-912-4

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: yellow needles.
Caution! Harmful. Causes eye and skin irritation and possible burns. May be harmful if absorbed through the skin. May be harmful if swallowed. May cause heart and liver injury.
Target Organs: Heart, liver, lungs.

Potential Health Effects

Eye: Causes eye irritation and possible burns.
Skin: May be harmful if absorbed through the skin. Causes severe skin irritation and possible burns.
Ingestion: May be harmful if swallowed. May cause rapid heartbeat and cardiac arrythmias. May cause liver injury, pulmonary edema, and respiratory arrest. May cause gastrointestinal disturbances such as nausea.
Inhalation: May cause effects similar to those described for ingestion. May produce cardiac failure and pulmonary edema.
Chronic: Prolonged or repeated skin contact may cause defatting and dermatitis.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the

upper and lower eyelids. Get medical aid immediately. Do NOT allow victim to rub eyes or keep eyes closed. Extensive irrigation with water is required (at least 30 minutes).
Skin: Get medical aid immediately. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Remove contaminated clothing and shoes.
Ingestion: Never give anything by mouth to an unconscious person. Get medical aid immediately. Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water.

Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: In case of fire, use water, dry chemical, chemical foam, or alcohol-resistant foam.
Flash Point: Not applicable.
Autoignition Temperature: Not applicable.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 2; Flammability: 0; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions. Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well-ventilated area. Do not get in eyes, on skin, or on clothing. Do not ingest or inhale. Use only in a chemical fume hood. Do not breathe dust.
Storage: Keep containers tightly closed. Store in a cool, dry area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Fluoranthene	none listed	none listed	none listed

OSHA Vacated PELs: Fluoranthene: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves and clothing to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant respirator use.

Section 9 - Physical and Chemical Properties

Physical State: Needles
Appearance: yellow
Odor: None reported.
pH: Not available.
Vapor Pressure: 0.01 mm Hg @ 20 deg C
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 384 deg C @ 760.00mmHg
Freezing/Melting Point:107.00 - 110.00 deg C
Decomposition Temperature: Not available.
Solubility: insoluble
Specific Gravity/Density:1.252 g/cm3
Molecular Formula:$C_{16}H_{10}$
Molecular Weight:202.25

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Incompatible materials, strong oxidants.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide, acrid smoke and fumes.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 206-44-0: LL4025000
LD50/LC50:
CAS# 206-44-0:
    Oral, rat: LD50 = 2 gm/kg;

Skin, rabbit: LD50 = 3180 mg/kg;

.

Carcinogenicity:
CAS# 206-44-0: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

Epidemiology: IARC Group 3: Limited or insufficient evidence for carcinogenicity in both animals and humans.Experimental tumorigenic data has been reported.
Teratogenicity: No information found
Reproductive Effects: No information found
Mutagenicity: Mutation in microorganisms: Salmonella typhimurium = 5ug/plate.Mutation in mammalian somatic cells: Human Lymphocyte = 2 umol/L.
Neurotoxicity: No information found
Other Studies:

Section 12 - Ecological Information

Ecotoxicity: Fish: Bluegill/Sunfish: 3980 um/L; 96 H; (not specified) No data available.
Environmental: Remains in the upper few cm of soil, but can be transported to groundwater. Biodegrades from soil in a few years. Will not volatilize from soil or water. Rapidly absorbed to sediment and particulates and will readily bioconcentrate. Unadsorbed substance in water will degrade by photolysis in a days to weeks. Stable in sediment for decades or more. In the atmostphere, photodegrades with half life of 4 - 5 days, but may transport long distances without settling or raining out.
Physical: No information available.
Other: No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series:
CAS# 206-44-0: waste number U120.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	Not regulated as a hazardous material	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 206-44-0 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
CERCLA Hazardous Substances and corresponding RQs
CAS# 206-44-0: 100 lb final RQ; 45.4 kg final RQ
SARA Section 302 Extremely Hazardous Substances
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 206-44-0: immediate.
Section 313
This material contains Fluoranthene (CAS# 206-44-0, 98%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:
This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA.
CAS# 206-44-0 is listed as a Priority Pollutant under the Clean Water Act. CAS# 206-44-0 is listed as a Toxic Pollutant under the Clean Water Act.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
CAS# 206-44-0 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Massachusetts.

California Prop 65

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives
Hazard Symbols:
XN
Risk Phrases:
R 21/22 Harmful in contact with skin and if swallowed.

Safety Phrases:
S 22 Do not breathe dust.
S 24/25 Avoid contact with skin and eyes.

WGK (Water Danger/Protection)
CAS# 206-44-0: No information available.
Canada - DSL/NDSL
CAS# 206-44-0 is listed on Canada's NDSL List.
Canada - WHMIS

This product has a WHMIS classification of D2B.
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

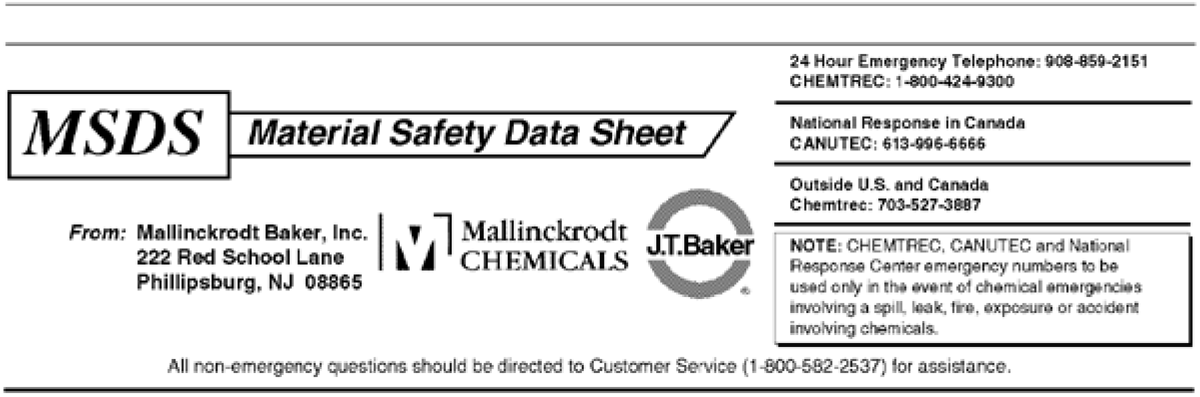
Canadian Ingredient Disclosure List

CAS# 206-44-0 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 9/02/1997
Revision #5 Date: 10/03/2005

MSDS Number: **L2347** * * * * * *Effective Date:* ***08/10/04*** * * * * * *Supercedes:* ***11/02/01***



MSDS *Material Safety Data Sheet*

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

LEAD METAL

1. Product Identification

Synonyms: Granular lead, pigment metal; C.I. 77575
CAS No.: 7439-92-1
Molecular Weight: 207.19
Chemical Formula: Pb
Product Codes:
J.T. Baker: 2256, 2266
Mallinckrodt: 5668

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Lead	7439-92-1	95 - 100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! MAY BE FATAL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. NEUROTOXIN. AFFECTS THE GUM TISSUE, CENTRAL NERVOUS SYSTEM, KIDNEYS, BLOOD AND REPRODUCTIVE SYSTEM. POSSIBLE CANCER HAZARD. MAY CAUSE CANCER BASED ON ANIMAL DATA. Risk of cancer depends on duration and level of exposure.

J.T. Baker SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Life)
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:

Lead can be absorbed through the respiratory system. Local irritation of bronchia and lungs can occur and, in cases of acute exposure, symptoms such as metallic taste, chest and abdominal pain, and increased lead blood levels may follow. See also Ingestion.

Ingestion:

POISON! The symptoms of lead poisoning include abdominal pain and spasms, nausea, vomiting, headache. Acute poisoning can lead to muscle weakness, "lead line" on the gums, metallic taste, definite loss of appetite, insomnia, dizziness, high lead levels in blood and urine with shock, coma and death in extreme cases.

Skin Contact:

Lead and lead compounds may be absorbed through the skin on prolonged exposure; the symptoms of lead poisoning described for ingestion exposure may occur. Contact over short periods may cause local irritation, redness and pain.

Eye Contact:

Absorption can occur through eye tissues but the more common hazards are local irritation or abrasion.

Chronic Exposure:

Lead is a cumulative poison and exposure even to small amounts can raise the body's content to toxic levels. The symptoms of chronic exposure are like those of ingestion poisoning; restlessness, irritability, visual disturbances, hypertension and gray facial color may also be noted.

Aggravation of Pre-existing Conditions:

Persons with pre-existing kidney, nerve or circulatory disorders or with skin or eye problems may be more susceptible to the effects of this substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.
Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard. Powder/dust is flammable when heated or exposed to flame.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire. Do not allow water runoff to enter sewers or waterways.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Can produce toxic lead fumes at elevated temperatures and also react with oxidizing materials.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Areas in which exposure to lead metal or lead compounds may occur should be identified by signs or appropriate means, and access to the area should be limited to authorized persons. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For lead, metal and inorganic dusts and fumes, as Pb:
-OSHA Permissible Exposure Limit (PEL): 0.05 mg/m3 (TWA)
For lead, elemental and inorganic compounds, as Pb:
-ACGIH Threshold Limit Value (TLV): 0.05 mg/m3 (TWA), A3 animal carcinogen
ACGIH Biological Exposure Indices (BEI): 30 ug/100ml, notation B (see actual Indices for more information).
For lead, inorganic:
-NIOSH Recommended Exposure Limit (REL): 0.1 mg/m3 (TWA)

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a half-face high efficiency particulate respirator (NIOSH type N100 filter) may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece high efficiency particulate respirator (NIOSH type N100 filter) may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

Other Control Measures:
Eating, drinking, and smoking should not be permitted in areas where solids or liquids containing lead compounds are handled, processed, or stored. See OSHA substance-specific standard for more information on personal protective equipment, engineering and work practice controls, medical surveillance, record keeping, and reporting requirements. (29 CFR 1910.1025).

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9. Physical and Chemical Properties

Appearance:
Small, white to blue-gray metallic shot or granules.
Odor:
Odorless.
Solubility:
Insoluble in water.
Density:
11.34
pH:
No information found.
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
1740C (3164F)
Melting Point:
327.5C (622F)
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
1.77 @ 1000C (1832F)
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Does not decompose but toxic lead or lead oxide fumes may form at elevated temperatures.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Ammonium nitrate, chlorine trifluoride, hydrogen peroxide, sodium azide, zirconium, disodium acetylide, sodium acetylide and oxidants.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

---

11. Toxicological Information

Toxicological Data:
Investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
Lead and other smelter emissions are human reproductive hazards. (Chemical Council on

Environmental Quality; Chemical Hazards to Human Reproduction, 1981).
Carcinogenicity:
EPA / IRIS classification: Group B2 - Probable human carcinogen, sufficient animal evidence.

```
--------\Cancer Lists\------------------------------------------------------
                                       ---NTP Carcinogen---
Ingredient                             Known    Anticipated    IARC Category
------------------------------------   -----    -----------    -------------
Lead (7439-92-1)                        No          No             2B
```

12. Ecological Information

Environmental Fate:
When released into the soil, this material is not expected to leach into groundwater. This material may bioaccumulate to some extent.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

```
--------\Chemical Inventory Status - Part 1\---------------------------------
Ingredient                                       TSCA  EC   Japan  Australia
-----------------------------------------------  ----  ---  -----  ---------
Lead (7439-92-1)                                  Yes  Yes   Yes      Yes

--------\Chemical Inventory Status - Part 2\---------------------------------
                                                        --Canada--
```

Ingredient	Korea	DSL	NDSL	Phil.
Lead (7439-92-1)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------------

	-SARA 302-		------SARA 313------	
Ingredient	RQ	TPQ	List	Chemical Catg.
Lead (7439-92-1)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------------

		-RCRA-	-TSCA-
Ingredient	CERCLA	261.33	8(d)
Lead (7439-92-1)	10	No	No

Chemical Weapons Convention: No   TSCA 12(b): No   CDTA: No
SARA 311/312: Acute: Yes   Chronic: Yes Fire: No Pressure: No
Reactivity: No   (Pure / Solid)

WARNING:
THIS PRODUCT CONTAINS CHEMICALS KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER AND BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM.

Australian Hazchem Code: None allocated.
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **3** Flammability: **1** Reactivity: **0**
Label Hazard Warning:
POISON! DANGER! MAY BE FATAL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. NEUROTOXIN. AFFECTS THE GUM TISSUE, CENTRAL NERVOUS SYSTEM, KIDNEYS, BLOOD AND REPRODUCTIVE SYSTEM. POSSIBLE CANCER HAZARD. MAY CAUSE CANCER BASED ON ANIMAL DATA. Risk of cancer depends on duration and level of exposure.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe dust.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not

breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.

Product Use:

Laboratory Reagent.

Revision Information:

No Changes.

Disclaimer:

****

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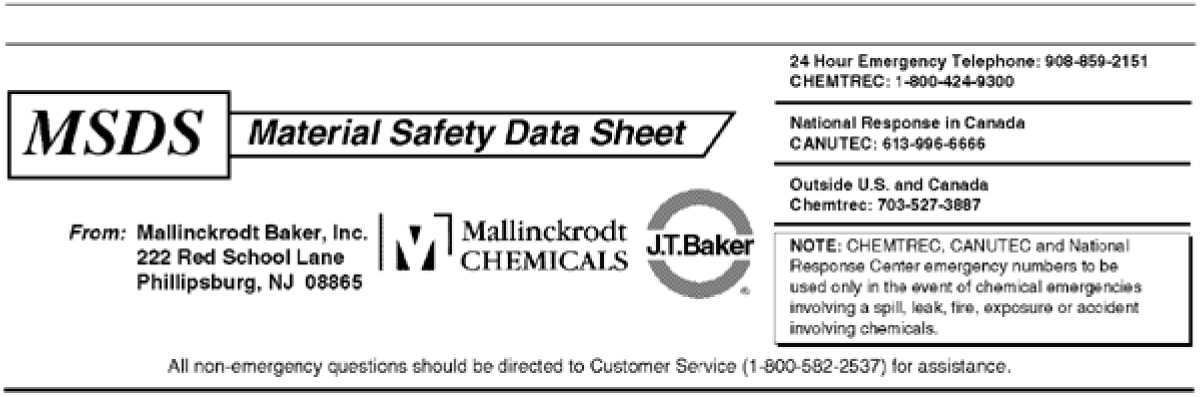
****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Number: **M1599** * * * * * *Effective Date:* ***12/19/05*** * * * * * *Supercedes:* ***08/10/04***



MSDS *Material Safety Data Sheet*

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

MERCURY

1. Product Identification

Synonyms: Quicksilver; hydrargyrum; Liquid Silver
CAS No.: 7439-97-6
Molecular Weight: 200.59
Chemical Formula: Hg
Product Codes:
J.T. Baker: 2564, 2567, 2569
Mallinckrodt: 1278, 1280, 1288

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Mercury	7439-97-6	90 - 100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! CORROSIVE. CAUSES BURNS TO SKIN, EYES, AND RESPIRATORY TRACT. MAY BE FATAL IF SWALLOWED OR INHALED. HARMFUL IF ABSORBED THROUGH SKIN. AFFECTS THE KIDNEYS AND CENTRAL NERVOUS SYSTEM. MAY CAUSE ALLERGIC SKIN REACTION.

SAF-T-DATA$^{\mathbf{(tm)}}$ Ratings (Provided here for your convenience)

Health Rating: 4 - Extreme (Life)
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 3 - Severe (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Mercury vapor is highly toxic via this route. Causes severe respiratory tract damage. Symptoms include sore throat, coughing, pain, tightness in chest, breathing difficulties, shortness of breath, headache, muscle weakness, anorexia, gastrointestinal disturbance, ringing in the ear, liver changes, fever, bronchitis and pneumonitis. Can be absorbed through inhalation with symptoms similar to ingestion.
Ingestion:
May cause burning of the mouth and pharynx, abdominal pain, vomiting, corrosive ulceration, bloody diarrhea. May be followed by a rapid and weak pulse, shallow breathing, paleness, exhaustion, tremors and collapse. Delayed death may occur from renal failure. Gastrointenstinal uptake of mercury is less than 5% but its ability to penetrate tissues presents some hazard. Initial symptoms may be thirst, possible abdominal discomfort.
Skin Contact:
Causes irritaton and burns to skin. Symptoms include redness and pain. May cause skin allergy and sensitization. Can be absorbed through the skin with symptoms to parallel ingestion.
Eye Contact:
Causes irritation and burns to eyes. Symptoms include redness, pain, blurred vision; may cause serious and permanent eye damage.
Chronic Exposure:
Chronic exposure through any route can produce central nervous system damage. May cause muscle tremors, personality and behavior changes, memory loss, metallic taste, loosening of the teeth, digestive disorders, skin rashes, brain damage and kidney damage. Can cause skin allergies and accumulate in the body. Repeated skin contact can cause the skin to turn gray in color. A suspected reproductive hazard; may damage the developing fetus and decrease fertility in males and females.
Aggravation of Pre-existing Conditions:
Persons with nervous disorders, or impaired kidney or respiratory function, or a history of allergies or a known sensitization to mercury may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire. Do not allow water runoff to enter sewers or waterways.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Undergoes hazardous reactions in the presence of heat and sparks or ignition. Smoke may contain toxic mercury or mercuric oxide. Smoke may contain toxic mercury or mercuric oxide.

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6. Accidental Release Measures

Ventilate area of leak or spill. Clean-up personnel require protective clothing and respiratory protection from vapor.

Spills: Pick up and place in a suitable container for reclamation or disposal in a method that does not generate misting. Sprinkle area with sulfur or calcium polysulfide to suppress mercury. Do not flush to sewer. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker CINNASORB® and RESISORB® are recommended for spills of this product.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Do not use or store on porous work surfaces (wood, unsealed concrete, etc.). Follow strict hygiene practices. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
- OSHA Acceptable Ceiling Concentration:
mercury and mercury compounds: 0.1 mg/m3 (TWA), skin
- ACGIH Threshold Limit Value (TLV):
inorganic and metallic mercury, as Hg: 0.025 mg/m3 (TWA) skin, A4 Not classifiable as a human carcinogen.
- ACGIH Biological Exposure Indices:
total inorganic mercury in urine (preshift): 35 ug/g creatinine;
total inorganic mercury in blood (end of shift): 15 ug/l.

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a half-face respirator with a mercury vapor or chlorine gas cartridge may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece respirator with a mercury vapor or chlorine gas cartridge may be worn up to 50 times the exposure limit, or the maximum use concentraiton specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Silver-white, heavy, mobile, liquid metal.
Odor:
Odorless.
Solubility:
Insoluble in water.
Density:
13.55
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
356.7C (675F)
Melting Point:
-38.87C (-38F)
Vapor Density (Air=1):
7.0
Vapor Pressure (mm Hg):
0.0018 @ 25C (77F)
Evaporation Rate (BuAc=1):
4

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
At high temperatures, vaporizes to form extremely toxic fumes.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Acetylenes, ammonia, ethylene oxide, chlorine dioxide, azides, metal oxides, methyl silane, lithium, rubidium, oxygen, strong oxidants, metal carbonyls.
Conditions to Avoid:
Heat, flames, ignition sources, metal surfaces and incompatibles.

11. Toxicological Information

Toxicological Data:
Investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
All forms of mercury can cross the placenta to the fetus, but most of what is known has

been learned from experimental animals. See Chronic Health Hazards.
Carcinogenicity:
EPA / IRIS classification: Group D1 - Not classifiable as a human carcinogen.

```
--------\Cancer Lists\------------------------------------------------------
                                           ---NTP Carcinogen---
Ingredient                                 Known    Anticipated    IARC Category
------------------------------------       -----    -----------    -------------
Mercury (7439-97-6)                         No          No              3
```

12. Ecological Information

Environmental Fate:
This material has an experimentally-determined bioconcentration factor (BCF) of greater than 100. This material is expected to significantly bioaccumulate.
Environmental Toxicity:
This material is expected to be toxic to aquatic life. The LC50/96-hour values for fish are less than 1 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: RQ, MERCURY
Hazard Class: 8
UN/NA: UN2809
Packing Group: III
Information reported for product/size: 1LB

International (Water, I.M.O.)

Proper Shipping Name: MERCURY
Hazard Class: 8
UN/NA: UN2809
Packing Group: III
Information reported for product/size: 1LB

International (Air, I.C.A.O.)

Proper Shipping Name: MERCURY
Hazard Class: 8
UN/NA: UN2809
Packing Group: III
Information reported for product/size: 1LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Mercury (7439-97-6)	Yes	Yes	No	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

		--Canada--		
Ingredient	Korea	DSL	NDSL	Phil.
Mercury (7439-97-6)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------------

	-SARA 302-		------SARA 313------	
Ingredient	RQ	TPQ	List	Chemical Catg.
Mercury (7439-97-6)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------------

		-RCRA-	-TSCA-
Ingredient	CERCLA	261.33	8(d)
Mercury (7439-97-6)	1	U151	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Liquid)

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM.

Australian Hazchem Code: 2Z
Poison Schedule: S7
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0**

Label Hazard Warning:

DANGER! CORROSIVE. CAUSES BURNS TO SKIN, EYES, AND RESPIRATORY TRACT. MAY BE FATAL IF SWALLOWED OR INHALED. HARMFUL IF ABSORBED THROUGH SKIN. AFFECTS THE KIDNEYS AND CENTRAL NERVOUS SYSTEM. MAY CAUSE ALLERGIC SKIN REACTION.

Label Precautions:

Do not get in eyes, on skin, or on clothing.
Do not breathe vapor.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.

Label First Aid:

If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 3.

Disclaimer:

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****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

Material Safety Data Sheet

Phenanthrene, 90%

ACC# 59921

Section 1 - Chemical Product and Company Identification

MSDS Name: Phenanthrene, 90%
Catalog Numbers: AC130100000, AC130100010, AC130102500
Synonyms:
Company Identification:

Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410

For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
85-01-8	Phenanthrene	90.0	201-581-5

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: brown solid.

Caution! Powdered material may form explosive dust-air mixtures. May cause allergic skin reaction. May cause eye and skin irritation. May cause respiratory tract irritation. Cancer suspect agent.

Target Organs: None.

Potential Health Effects

Eye: May cause eye irritation.
Skin: May cause skin irritation. May cause photosensitive skin reactions in certain individuals.
Ingestion: May cause irritation of the digestive tract.
Inhalation: Inhalation of dust may cause respiratory tract irritation.
Chronic: No information found.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately.
Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.
Ingestion: If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.

Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Dusts at sufficient concentrations can form explosive mixtures with air. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: Use water spray or dry chemical.
Flash Point: Not available.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 1; Flammability: 1; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Clean up spills immediately, observing precautions in the Protective Equipment section. Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions. Provide ventilation. Do not let this chemical enter the environment.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation.
Storage: Keep container closed when not in use. Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Use adequate ventilation to keep airborne concentrations low.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Phenanthrene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (as benzene soluble fraction) (listed under Coal tar pitches).

OSHA Vacated PELs: Phenanthrene: No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance: brown
Odor: none reported
pH: Not available.
Vapor Pressure: 1 mm Hg @116c
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 340 deg C
Freezing/Melting Point:101 deg C
Decomposition Temperature: Not available.
Solubility: insoluble
Specific Gravity/Density:1.0630g/cm3
Molecular Formula:$C_{14}H_{10}$
Molecular Weight:178.23

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Incompatible materials, dust generation, strong oxidants.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 85-01-8: SF7175000
LD50/LC50:
CAS# 85-01-8:
Oral, mouse: LD50 = 700 mg/kg;
Oral, rat: LD50 = 1.8 gm/kg;
.

Carcinogenicity:
CAS# 85-01-8:

- **ACGIH:** A1 - Confirmed Human Carcinogen (as benzene soluble aerosol) (listed as 'Coal tar pitches').
- **California:** Not listed.
- **NTP:** Known carcinogen (listed as Coal tar pitches).
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

Epidemiology: No data available.
Teratogenicity: No data available.
Reproductive Effects: No data available.
Mutagenicity: No data available.
Neurotoxicity: No data available.
Other Studies:

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	Not regulated as a hazardous material	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 85-01-8 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 85-01-8: 5000 lb final RQ; 2270 kg final RQ

SARA Section 302 Extremely Hazardous Substances

None of the chemicals in this product have a TPQ.

SARA Codes

CAS # 85-01-8: immediate.

Section 313

This material contains Phenanthrene (CAS# 85-01-8, 90.0%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
CAS# 85-01-8 is listed as a Priority Pollutant under the Clean Water Act.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 85-01-8 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, (listed as Coal tar pitches), Massachusetts.

California Prop 65

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

T

Risk Phrases:

R 45 May cause cancer.

Safety Phrases:

S 24/25 Avoid contact with skin and eyes.

WGK (Water Danger/Protection)

CAS# 85-01-8: No information available.

Canada - DSL/NDSL

CAS# 85-01-8 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of D2B.

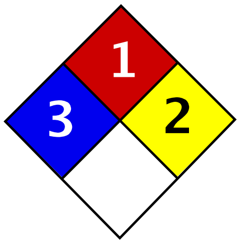
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

CAS# 85-01-8 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 7/14/1998
Revision #3 Date: 10/03/2005



Health	3
Fire	1
Reactivity	2
Personal Protection	E

Material Safety Data Sheet
Arsenic MSDS

Section 1: Chemical Product and Company Identification

Product Name: Arsenic

Catalog Codes: SLA1006

CAS#: 7440-38-2

RTECS: CG0525000

TSCA: TSCA 8(b) inventory: Arsenic

CI#: Not applicable.

Synonym:

Chemical Name: Arsenic

Chemical Formula: As

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

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1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Arsenic	7440-38-2	100

Toxicological Data on Ingredients: Arsenic: ORAL (LD50): Acute: 763 mg/kg [Rat]. 145 mg/kg [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant), of eye contact (irritant).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to kidneys, lungs, the nervous system, mucous membranes.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Flammable in presence of open flames and sparks, of heat, of oxidizing materials.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards:
Material in powder form, capable of creating a dust explosion. When heated to decomposition it emits highly toxic fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Be careful that the product is not

present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, acids, moisture.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.01 from ACGIH (TLV) [United States] [1995]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Lustrous solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 74.92 g/mole

Color: Silvery.

pH (1% soln/water): Not applicable.

Boiling Point: Not available.

Melting Point: Sublimation temperature: 615°C (1139°F)

Critical Temperature: Not available.

Specific Gravity: 5.72 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents, acids, moisture.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 145 mg/kg [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH.
Causes damage to the following organs: kidneys, lungs, the nervous system, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of ingestion, of inhalation.
Slightly hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Arsenic UNNA: UN1558 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Arsenic
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Arsenic
Pennsylvania RTK: Arsenic
Massachusetts RTK: Arsenic
TSCA 8(b) inventory: Arsenic

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R22- Harmful if swallowed.
R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 1

Reactivity: 2

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 1

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Liste des produits purs tératogènes, mutagènes, cancérogènes. Répertoire toxicologique de la Commission de la Santé et de la Sécurité du Travail du Québec.
-Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

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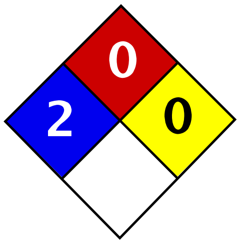

Health	2
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet

Nickel metal MSDS

Section 1: Chemical Product and Company Identification

Product Name: Nickel metal

Catalog Codes: SLN2296, SLN1342, SLN1954

CAS#: 7440-02-0

RTECS: QR5950000

TSCA: TSCA 8(b) inventory: Nickel metal

CI#: Not applicable.

Synonym: Nickel Metal shot; Nickel metal foil.

Chemical Name: Nickel

Chemical Formula: Ni

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Nickel metal	7440-02-0	100

Toxicological Data on Ingredients: Nickel metal LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant, sensitizer), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer), of ingestion, of inhalation (lung sensitizer).
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. Classified 2 (Some evidence.) by NTP.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to skin.
The substance may be toxic to kidneys, lungs, liver, upper respiratory tract.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Material in powder form, capable of creating a dust explosion. This material is flammable in powder form only.

Special Remarks on Explosion Hazards:
Material in powder form, capable of creating a dust explosion.
Mixtures containing Potassium Perchlorate with Nickel & Titanium powders & infusorial earth can explode.
Adding 2 or 3 drops of approximately 90% peroxyformic acid to powdered nickel will result in explosion.
Powdered nickel reacts explosively upon contact with fused ammonium nitrate at temperatures below 200 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Keep away from incompatibles such as oxidizing agents, combustible materials, metals, acids.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 1 (mg/m3) from ACGIH (TLV) [United States] Inhalation Respirable.
TWA: 0.5 (mg/m3) [United Kingdom (UK)]
TWA: 1 (mg/m3) from OSHA (PEL) [United States] InhalationConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid. Lustrous solid.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 58.71 g/mole

Color: Silvery.

pH (1% soln/water): Not applicable.

Boiling Point: 2730°C (4946°F)

Melting Point: 1455°C (2651°F)

Critical Temperature: Not available.

Specific Gravity: Density: 8.908 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Insoluble in cold water, hot water.
Insoluble in Ammonia.
Soluble in dilute Nitric Acid.
Slightly soluble in Hydrochloric Acid, Sulfuric Acid.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, combustible materials, metals, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with strong acids, selenium, sulfur, wood and other combustibles, nickel nitrate, aluminum, aluminum trichloride, ethylene, p-dioxan, hydrogen, methanol, non-metals, oxidants, sulfur compounds, aniline, hydrogen sulfide, flammable solvents, hydrazine, and metal powders (especially zinc, aluminum, and magnesium), ammonium nitrate, nitryl fluoride, bromine pentafluoride, potassium perchlorate + titanium powder + indusorial earth.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. Classified 2 (Some evidence.) by NTP.
Causes damage to the following organs: skin.
May cause damage to the following organs: kidneys, lungs, liver, upper respiratory tract.

Other Toxic Effects on Humans:

Hazardous in case of inhalation.
Slightly hazardous in case of skin contact (irritant, sensitizer), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose/Conc:
LDL [Rat] - Route: Oral; Dose: 5000 mg/kg
LDL [Guinea Pig] - Route: Oral; Dose: 5000 mg/kg

Special Remarks on Chronic Effects on Humans: May cause cancer based on animal test data

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Nickel dust and fume can irritate skin.
Eyes: Nickel dust and fume can irritate eyes.
Inhalation: Inhalation of dust or fume may cause respiratory tract irritation with non-productive cough, hoarseness, sore throat, headache, vertigo, weakness, chest pain, followed by delayed effects, including tachypnea, dyspnea, and ARDS. Death due to ARDS has been reported following inhalation of high concentrations of respirable metallic nickel dust. Later effects may include pulmonary edema and fibrosis.
Ingestion: Metallic nickel is generally considered not to be acutely toxic if ingested. Ingestion may cause nausea, vomiting, abdominal , and diarrhea. Nickel may damage the kidneys(proteinuria), and may affect liver function. It may also affect behavior (somnolence), and cardiovascular system (increased cornary artery resistance, decreased myocardial contractility, myocardial damage, regional or general arteriolar or venus dilation).
Chronic Potential Health Effects:
Skin: May cause skin allergy. Nickel and nickel compounds are among the most common sensitizers inducing allergic contact dermatitis.
Inhalation: Chronic inhalation nickel dust or fume can cause chronic hypertrophic rhinitis, sinusitis, nasal polyps, perforation of the nasal septum, chronic pulmonary irritation, fibrosis, pulmonary edema, pulmonary eosinophilia, Pneumoconiosis, allergies (asthma-like allergy), and cancer of the nasal sinus cavities, lungs, and possibly other organs. Future exposures can cause asthma attacks with shortness of breath, wheezing, cough, and/or chest tightness. Chronic inhalation of nickel dust or fume may also affect the liver (impaired liver function tests), and blood (changes in red blood cell count).
Ingestion: Prolonged or repeated ingestion of nickel can be a source chronic urticaria and other signs of allergy. Chronic ingestion of NIckel may also affect respiration and cause pneumoconiosis or fibrosis.
Note: In the general population, sensitization occurs from exposure to nickel-containing coins, jewelry, watches,

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Nickel metal
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Nickel metal
Connecticut hazardous material survey.: Nickel metal
Illinois toxic substances disclosure to employee act: Nickel metal
Illinois chemical safety act: Nickel metal
New York release reporting list: Nickel metal
Rhode Island RTK hazardous substances: Nickel metal
Pennsylvania RTK: Nickel metal
Michigan critical material: Nickel metal
Massachusetts RTK: Nickel metal
Massachusetts spill list: Nickel metal
New Jersey: Nickel metal
New Jersey spill list: Nickel metal
Louisiana spill reporting: Nickel metal
California Director's List of Hazardous Substances: Nickel metal
TSCA 8(b) inventory: Nickel metal

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects.
R43- May cause sensitization by skin contact.
S22- Do not breathe dust.
S36- Wear suitable protective clothing.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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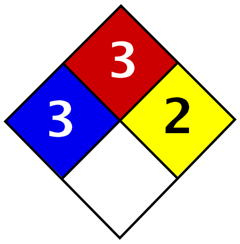

Health	3
Fire	3
Reactivity	2
Personal Protection	J

Material Safety Data Sheet
Calcium MSDS

Section 1: Chemical Product and Company Identification

Product Name: Calcium

Catalog Codes: SLC2782

CAS#: 7440-70-2

RTECS: EV8040000

TSCA: TSCA 8(b) inventory: Calcium

CI#: Not available.

Synonym:

Chemical Formula: Ca

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Calcium	7440-70-2	100

Toxicological Data on Ingredients: Calcium LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Corrosive to eyes and skin. The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastro-intestinal or respiratory tract, characterized by burning, sneezing and coughing. Severe over-exposure can produce lung damage, choking, unconsciousness or death.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to lungs, mucous membranes.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
If the chemical got onto the clothed portion of the body, remove the contaminated clothes as quickly as possible, protecting your own hands and body. Place the victim under a deluge shower. If the chemical got on the victim's exposed skin, such as the hands : Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Corrosive solid. Flammable solid that, in contact with water, emits flammable gases.
Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Cover with dry earth, sand or other non-combustible material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal.

Section 7: Handling and Storage

Precautions:
Keep under inert atmosphere. Keep container dry. Do not breathe dust. Never add water to this product Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes Keep away from incompatibles such as acids, moisture.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. Keep container dry. Keep in a cool place.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor and dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 40.08 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: 1484°C (2703.2°F)

Melting Point: 839°C (1542.2°F)

Critical Temperature: Not available.

Specific Gravity: 1.54 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Not available.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances:
Highly reactive with acids.
Reactive with moisture.
The product reacts violently with water to emit flammable but non toxic gases.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans: The substance is toxic to lungs, mucous membranes.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 4.3: Material that emits flammable gases on contact with water.

Identification: : Calcium : UN1401 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Calcium
Massachusetts RTK: Calcium
TSCA 8(b) inventory: Calcium

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-6: Reactive and very flammable material.
CLASS E: Corrosive solid.

DSCL (EEC): R36/38- Irritating to eyes and skin.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 3

Reactivity: 2

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 3

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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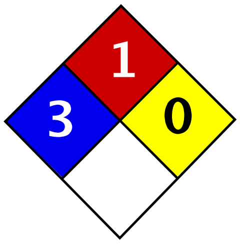

Health	3
Fire	1
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Cadmium MSDS

Section 1: Chemical Product and Company Identification

Product Name: Cadmium

Catalog Codes: SLC3484, SLC5272, SLC2482

CAS#: 7440-43-9

RTECS: EU9800000

TSCA: TSCA 8(b) inventory: Cadmium

CI#: Not applicable.

Synonym:

Chemical Name: Cadmium

Chemical Formula: Cd

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	**CAS #**	**% by Weight**
Cadmium	7440-43-9	100

Toxicological Data on Ingredients: Cadmium: ORAL (LD50): Acute: 2330 mg/kg [Rat.]. 890 mg/kg [Mouse]. DUST (LC50): Acute: 50 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, sensitizer), of eye contact (irritant). Severe over-exposure can result in death.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A2 (Suspected for human.) by ACGIH, 2 (Reasonably anticipated.) by NTP.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to kidneys, lungs, liver.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact: No known effect on eye contact, rinse with water for a few minutes.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 570°C (1058°F)

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances:
Non-flammable in presence of open flames and sparks, of heat, of oxidizing materials, of reducing materials, of combustible materials, of moisture.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards:
Material in powder form, capable of creating a dust explosion. When heated to decomposition it emits toxic fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Keep container tightly closed. Keep in a cool, well-ventilated place. Highly toxic or infectious materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.01 (ppm)
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Lustrous solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 112.4 g/mole

Color: Silvery.

pH (1% soln/water): Not applicable.

Boiling Point: 765°C (1409°F)

Melting Point: 320.9°C (609.6°F)

Critical Temperature: Not available.

Specific Gravity: 8.64 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water, methanol, diethyl ether, n-octanol.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Not considered to be corrosive for metals and glass.

Special Remarks on Reactivity: Reacts violently with potassium.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 890 mg/kg [Mouse].
Acute toxicity of the dust (LC50): 229.9 mg/m3 4 hour(s) [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A2 (Suspected for human.) by ACGIH, 2 (Reasonably anticipated.) by NTP.
The substance is toxic to kidneys, lungs, liver.

Other Toxic Effects on Humans:
Hazardous in case of ingestion, of inhalation.
Slightly hazardous in case of skin contact (irritant, sensitizer).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: An allergen. 0047 Animal: embryotoxic, passes through the placental barrier.

Special Remarks on other Toxic Effects on Humans: May cause allergic reactions, exzema and/or dehydration of the skin.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification:

Identification:

Special Provisions for Transport:

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Cadmium
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Cadmium
Pennsylvania RTK: Cadmium
Massachusetts RTK: Cadmium
TSCA 8(b) inventory: Cadmium
SARA 313 toxic chemical notification and release reporting: Cadmium
CERCLA: Hazardous substances.: Cadmium

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R26- Very toxic by inhalation.
R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 1

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Liste des produits purs tératogènes, mutagènes, cancérogènes. Répertoire toxicologique de la Commission de la Santé et de la Sécurité du Travail du Québec.
-Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

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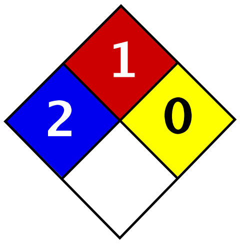

Health	2
Fire	1
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Copper MSDS

Section 1: Chemical Product and Company Identification

Product Name: Copper

Catalog Codes: SLC4939, SLC2152, SLC3943, SLC1150, SLC2941, SLC4729, SLC1936, SLC3727, SLC5515

CAS#: 7440-50-8

RTECS: GL5325000

TSCA: TSCA 8(b) inventory: Copper

CI#: Not available.

Synonym:

Chemical Name: Not available.

Chemical Formula: Cu

Contact Information:

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14025 Smith Rd.
Houston, Texas 77396

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International Sales: **1-281-441-4400**

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1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	**CAS #**	**% by Weight**
Copper	7440-50-8	100

Toxicological Data on Ingredients: Copper LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of ingestion. Hazardous in case of eye contact (irritant), of inhalation. Slightly hazardous in case of skin contact (irritant).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to lungs, mucous membranes.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not breathe dust. Avoid contact with eyes Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If you feel unwell, seek medical attention and show the label when possible.

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Keep container tightly closed. Keep in a cool, well-ventilated place. Combustible materials should be stored away from extreme heat and away from strong oxidizing agents.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 1 (mg/m3) from ACGIH [1990]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 63.54 g/mole

Color: Not available.

pH (1% soln/water): Not applicable.

Boiling Point: 2595°C (4703°F)

Melting Point: 1083°C (1981.4°F)

Critical Temperature: Not available.

Specific Gravity: 8.94 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans: The substance is toxic to lungs, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of ingestion.
Hazardous in case of inhalation.
Slightly hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Human: passes through the placenta, excreted in maternal milk.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Copper
Massachusetts RTK: Copper
TSCA 8(b) inventory: Copper
CERCLA: Hazardous substances.: Copper

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC): R36- Irritating to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an
approved/certified respirator or
equivalent. Wear appropriate respirator

when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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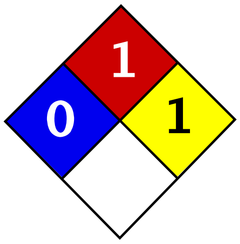

Health	1
Fire	3
Reactivity	2
Personal Protection	E

Material Safety Data Sheet
Magnesium MSDS

Section 1: Chemical Product and Company Identification

Product Name: Magnesium

Catalog Codes: SLM4408, SLM2263, SLM3637

CAS#: 7439-95-4

RTECS: OM2100000

TSCA: TSCA 8(b) inventory: Magnesium

CI#: Not applicable.

Synonym: Magnesium ribbons, turnings or sticks

Chemical Name: Magnesium

Chemical Formula: Mg

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Magnesium	7439-95-4	100

Toxicological Data on Ingredients: Magnesium LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at

least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat.
Flammable in presence of acids, of moisture.
Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.
Explosive in presence of acids, of moisture.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Magnesium turnings, chips or granules, ribbons, are flammable. They can be easily ignited. They may reignite after fire is extinguished. Produces flammable gases on contact with water and acid. May ignite on contact with water or moist air.
Magnesium fires do not flare up violently unless moisture is present.

Special Remarks on Explosion Hazards: Reacts with acids and water to form hydrogen gas with is highly flammable and eplosive

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Flammable solid.
Stop leak if without risk. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not breathe dust. Keep away from incompatibles such as oxidizing agents, acids, moisture.

Storage:
Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Moisture sensitive. Dangerous when wet.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 24.31 g/mole

Color: Silver-white

pH (1% soln/water): Not applicable.

Boiling Point: 1100°C (2012°F)

Melting Point: 651°C (1203.8°F)

Critical Temperature: Not available.

Specific Gravity: 1.74 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Very slightly soluble in hot water.
Insoluble in cold water.
Insoluble in chromium trioxides, and mineral acids, alkalies.
Slightly soluble with decomposition in hot water.
Soluble in concentrated hydrogen fluoride, and ammonium salts.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, incompatible materials, water or moisture, moist air.

Incompatibility with various substances: Reactive with oxidizing agents, acids, moisture.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Violent chemical reaction with oxidizing agents.
Reacts with water to create hydrogen gas and heat. Must be kept dry.
Reacts with acids to form hydrogen gas which is highly flammable and explosive.
Magnesium forms hazardous or explosive mixtures with aluminum and potassium perchlorate; ammonium nitrate; barium nitrate, barium dioxide and zinc; beryllium oxide; boron phosphodiiodide; bromobenzyl trifluoride; cadmium cyanide; cadmium oxide; calcium carbide; carbonates; carbon tetrachloride; chlorine; chlorine trifluoride; chloroform; cobalt cyanide; copper cyanide; copper sulfate(anhydrous), ammonium nitrate, potassium chlorate and water; cupric oxide; cupric sulfate; fluorine; gold cyanide; hydrogen and calcium carbonate; hydrogen iodide; hydrogen peroxide; iodine; lead cyanide; mercuric oxide; mercury cyanide; methyl chloride; molybdenum trioxide; nickel cyanide; nitric acid; nitrogen dioxide; oxygen (liquid); performic acid; phosphates; potassium chlorate; potassium perchlorate; silver nitrate; silver oxide; sodium perchlorate; sodium peroxide; sodium peroxide and carbon dioxide; stannic oxide; sulfates; trichloroethylene; zinc cyanide; zinc oxide.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: May cause skin irritation by mechanical action. May get mechanical injury or embedding of chips/particles in skin. The particles that are embedded in the wounds may retard healing.
Eyes: May cause eye irritation by mechanical action. Mechanical injury may occur. Particles or chips may embed in eye and retard healing.
Inhalation: Low hazard for ususal industrial handling. It may cause respiratory tract irritation. However, it is unlikely due to physical form. When Magnesium metal is heated during welding or smelting process, Metal Fume Fever may result from inhalation of magnesium fumes. Metal Fume Fever is a flu-like condition consisting of fever, chills, sweating, aches, pains, cough, weakness, headache, nausea, vomiting, and breathing difficulty. Other symptoms may include metallic taste, increased white blood cell count. There is no permanent ill-effect.
Ingestion: Low hazard for usual industrial handling. There are no known reports of serious industrial poisonings with Magnesium. Ingeston of large amounts of chips, turnings or ribbons may cause gastrointestinal tract irritation with nausea, vomiting, and diarrhea. Acute ingestion may also result in Hypermagnesia.
Hypermagnesia may cause hypotension, bradycardia, CNS depression, respiratory depression, and impairment of neuromuscular transmission (hyporeflexia, paralysis).

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 4.1: Flammable solid.

Identification: : Magnesium UNNA: 1869 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Magnesium
Rhode Island RTK hazardous substances: Magnesium
Pennsylvania RTK: Magnesium

Massachusetts RTK: Magnesium
Massachusetts spill list: Magnesium
New Jersey: Magnesium
TSCA 8(b) inventory: Magnesium

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-4: Flammable solid.
CLASS B-6: Reactive and very flammable material.

DSCL (EEC):
R11- Highly flammable.
R15- Contact with water liberates extremely flammable gases.
S7/8- Keep container tightly closed and dry.
S43- In case of fire, use dry chemical. Never use water.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 3

Reactivity: 2

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 0

Flammability: 1

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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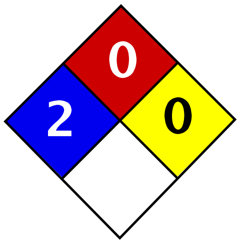
Last Updated: 11/06/2008 12:00 PM



Health	2
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Nickel metal MSDS

Section 1: Chemical Product and Company Identification

Product Name: Nickel metal

Catalog Codes: SLN2296, SLN1342, SLN1954

CAS#: 7440-02-0

RTECS: QR5950000

TSCA: TSCA 8(b) inventory: Nickel metal

CI#: Not applicable.

Synonym: Nickel Metal shot; Nickel metal foil.

Chemical Name: Nickel

Chemical Formula: Ni

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Nickel metal	7440-02-0	100

Toxicological Data on Ingredients: Nickel metal LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant, sensitizer), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer), of ingestion, of inhalation (lung sensitizer).
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. Classified 2 (Some evidence.) by NTP.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to skin.
The substance may be toxic to kidneys, lungs, liver, upper respiratory tract.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Material in powder form, capable of creating a dust explosion. This material is flammable in powder form only.

Special Remarks on Explosion Hazards:
Material in powder form, capable of creating a dust explosion.
Mixtures containing Potassium Perchlorate with Nickel & Titanium powders & infusorial earth can explode.
Adding 2 or 3 drops of approximately 90% peroxyformic acid to powdered nickel will result in explosion.
Powdered nickel reacts explosively upon contact with fused ammonium nitrate at temperatures below 200 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Keep away from incompatibles such as oxidizing agents, combustible materials, metals, acids.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 1 (mg/m3) from ACGIH (TLV) [United States] Inhalation Respirable.
TWA: 0.5 (mg/m3) [United Kingdom (UK)]
TWA: 1 (mg/m3) from OSHA (PEL) [United States] InhalationConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid. Lustrous solid.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 58.71 g/mole

Color: Silvery.

pH (1% soln/water): Not applicable.

Boiling Point: 2730°C (4946°F)

Melting Point: 1455°C (2651°F)

Critical Temperature: Not available.

Specific Gravity: Density: 8.908 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Insoluble in cold water, hot water.
Insoluble in Ammonia.
Soluble in dilute Nitric Acid.
Slightly soluble in Hydrochloric Acid, Sulfuric Acid.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, combustible materials, metals, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with strong acids, selenium, sulfur, wood and other combustibles, nickel nitrate, aluminum, aluminum trichloride, ethylene, p-dioxan, hydrogen, methanol, non-metals, oxidants, sulfur compounds, aniline, hydrogen sulfide, flammable solvents, hydrazine, and metal powders (especially zinc, aluminum, and magnesium), ammonium nitrate, nitryl fluoride, bromine pentafluoride, potassium perchlorate + titanium powder + indusorial earth.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. Classified 2 (Some evidence.) by NTP.
Causes damage to the following organs: skin.
May cause damage to the following organs: kidneys, lungs, liver, upper respiratory tract.

Other Toxic Effects on Humans:

Hazardous in case of inhalation.
Slightly hazardous in case of skin contact (irritant, sensitizer), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose/Conc:
LDL [Rat] - Route: Oral; Dose: 5000 mg/kg
LDL [Guinea Pig] - Route: Oral; Dose: 5000 mg/kg

Special Remarks on Chronic Effects on Humans: May cause cancer based on animal test data

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Nickel dust and fume can irritate skin.
Eyes: Nickel dust and fume can irritate eyes.
Inhalation: Inhalation of dust or fume may cause respiratory tract irritation with non-productive cough, hoarseness, sore throat, headache, vertigo, weakness, chest pain, followed by delayed effects, including tachypnea, dyspnea, and ARDS. Death due to ARDS has been reported following inhalation of high concentrations of respirable metallic nickel dust. Later effects may include pulmonary edema and fibrosis.
Ingestion: Metallic nickel is generally considered not to be acutely toxic if ingested. Ingestion may cause nausea, vomiting, abdominal , and diarrhea. Nickel may damage the kidneys(proteinuria), and may affect liver function. It may also affect behavior (somnolence), and cardiovascular system (increased cornary artery resistance, decreased myocardial contractility, myocardial damage, regional or general arteriolar or venus dilation).
Chronic Potential Health Effects:
Skin: May cause skin allergy. Nickel and nickel compounds are among the most common sensitizers inducing allergic contact dermatitis.
Inhalation: Chronic inhalation nickel dust or fume can cause chronic hypertrophic rhinitis, sinusitis, nasal polyps, perforation of the nasal septum, chronic pulmonary irritation, fibrosis, pulmonary edema, pulmonary eosinophilia, Pneumoconiosis, allergies (asthma-like allergy), and cancer of the nasal sinus cavities, lungs, and possibly other organs. Future exposures can cause asthma attacks with shortness of breath, wheezing, cough, and/or chest tightness. Chronic inhalation of nickel dust or fume may also affect the liver (impaired liver function tests), and blood (changes in red blood cell count).
Ingestion: Prolonged or repeated ingestion of nickel can be a source chronic urticaria and other signs of allergy. Chronic ingestion of NIckel may also affect respiration and cause pneumoconiosis or fibrosis.
Note: In the general population, sensitization occurs from exposure to nickel-containing coins, jewelry, watches,

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Nickel metal
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Nickel metal
Connecticut hazardous material survey.: Nickel metal
Illinois toxic substances disclosure to employee act: Nickel metal
Illinois chemical safety act: Nickel metal
New York release reporting list: Nickel metal
Rhode Island RTK hazardous substances: Nickel metal
Pennsylvania RTK: Nickel metal
Michigan critical material: Nickel metal
Massachusetts RTK: Nickel metal
Massachusetts spill list: Nickel metal
New Jersey: Nickel metal
New Jersey spill list: Nickel metal
Louisiana spill reporting: Nickel metal
California Director's List of Hazardous Substances: Nickel metal
TSCA 8(b) inventory: Nickel metal

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects.
R43- May cause sensitization by skin contact.
S22- Do not breathe dust.
S36- Wear suitable protective clothing.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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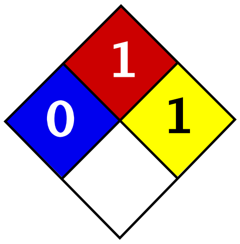

Health	1
Fire	1
Reactivity	1
Personal Protection	E

Material Safety Data Sheet

Zinc Metal MSDS

Section 1: Chemical Product and Company Identification

Product Name: Zinc Metal

Catalog Codes: SLZ1054, SLZ1159, SLZ1267, SLZ1099, SLZ1204

CAS#: 7440-66-6

RTECS: ZG8600000

TSCA: TSCA 8(b) inventory: Zinc Metal

CI#: Not applicable.

Synonym: Zinc Metal Sheets; Zinc Metal Shot; Zinc Metal Strips

Chemical Name: Zinc Metal

Chemical Formula: Zn

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Zinc Metal	7440-66-6	100

Toxicological Data on Ingredients: Zinc Metal LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 480°C (896°F)

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances:
Slightly flammable to flammable in presence of open flames and sparks, of heat, of oxidizing materials, of acids, of alkalis, of moisture.
Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Zinc + NaOH causes ignition.
Oxidation of zinc by potassium proceeds with incandescence.
Residues from zinc dust /acetic acid reduction operations may ignite after long delay if discarded into waste bins with paper.
Incandescent reaction when Zinc and Arsenic or Tellurium, or Selenium are combined.
When hydrazine mononitrate is heated in contact with zinc, a flamming decomposition occurs at temperatures a little above its melting point.
Contact with acids and alkali hydroxides (sodium hydroxide, postasium hydroxide, calcium hydroxide, etc.) results in evolution of hydrogen with sufficient heat of reaction to ignite the hydrogen gas.
Zinc foil ignites if traces of moisture are present.
It is water reactive and produces flammable gases on contact with water. It may ignite on contact with water or

moist air.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Flammable solid that, in contact with water, emits flammable gases.
Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Cover with dry earth, sand or other non-combustible material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not breathe dust. Keep away from incompatibles such as oxidizing agents, acids, alkalis, moisture.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area. Keep from any possible contact with water. Do not allow water to get into container because of violent reaction.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Lustrous solid. Metal solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 65.39 g/mole

Color: Bluish-grey

pH (1% soln/water): Not applicable.

Boiling Point: 907°C (1664.6°F)

Melting Point: 419°C (786.2°F)

Critical Temperature: Not available.

Specific Gravity: Not available.

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water, methanol, diethyl ether, n-octanol, acetone.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, incompatible materials, moisture

Incompatibility with various substances:
Reactive with oxidizing agents, acids, alkalis.
Slightly reactive to reactive with moisture.
The product may react violently with water to emit flammable but non toxic gases.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with acids, halogenated hydrocarbons, NH_4NO_3, barium oxide, $Ba(NO_3)_2$, Cadmium, CS_2, chlorates, Cl_2, CrO_3, F_2, Hydroxylamine, $Pb(N_3)_2$, $MnCl_2$, HNO_3, performic acid, $KClO_3$, KNO_3, N_2O_2, Selenium, $NaClO_3$, Na_2O_2, Sulfur, Te, water, $(NH_4)_2S$, As_2O_3, CS_2, $CaCl_2$, chlorinated rubber, catalytic metals, halocarbons, o-nitroanisole, nitrobenzene, nonmetals, oxidants, paint primer base, pentacarbonoyliron, transition metal halides, seleninyl bromide, HCl, H_2SO_4, (Mg +$Ba(NO_3)_2$ +BaO_2), (ethyl acetoacetate +tribromoneopentyl alcohol.
Contact with Alkali Hydroxides(Sodium Hydroxide, Potassium Hydroxide, Calcium Hydroxide, etc) results in evolution of hydrogen.
Ammonium nitrate + zinc + water causes a violent reaction with evolution of steam and zinc oxide.
May react with water.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:

LD50: Not available.
LC50: Not available.

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: May cause skin irritation. Dermal exposure to zinc may produce leg pains, fatigue, anorexia and weight loss.
Eyes: May cause eye irritation.
Ingestion: May be harmul if swallowed. May cause digestive tract irritation with tightness in throat, nausea, vomiting, diarrhea, loss of appetite, malaise, abdominal pain. fever, and chills. May affect behavior/central nervous system and autonomic nervous system with ataxia, lethargy, staggering gait, mild derrangement in cerebellar function, lightheadness, dizzness, irritability, muscular stiffness, and pain. May also affect blood.
Inhalation: Inhalation of zinc dust or fumes may cause respiratory tract and mucous membrane irritation with cough and chest pain. It can also cause "metal fume fever", a flu-like condition characterized appearance of chills, headached fever, maliase, fatigue, sweating, extreme thirst, aches in the legs and chest, and difficulty in breathing. A sweet taste may also be be present in metal fume fever, as well as a dry throat, aches, nausea, and vomiting, and pale grey cyanosis.
The toxicological properties of this substance have not been fully investisgated.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: Not available.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:

New York release reporting list: Zinc Metal
Rhode Island RTK hazardous substances: Zinc Metal
Pennsylvania RTK: Zinc Metal
Florida: Zinc Metal
Michigan critical material: Zinc Metal
Massachusetts RTK: Zinc Metal
New Jersey: Zinc Metal
California Director's List of Hazardous Substances: Zinc Metal
TSCA 8(b) inventory: Zinc Metal
TSCA 12(b) one time export: Zinc Metal
SARA 313 toxic chemical notification and release reporting: Zinc Metal
CERCLA: Hazardous substances.: Zinc Metal: 1000 lbs. (453.6 kg)

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not Available

DSCL (EEC):
R15- Contact with water liberates
extremely flammable gases.
R17- Spontaneously flammable in air.
S7/8- Keep container tightly closed and dry.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 1

Reactivity: 1

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 0

Flammability: 1

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an
approved/certified respirator or
equivalent.
Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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ATSDR Department of Health and Human Services
Agency for Toxic Substances & Disease Registry

Home > CABS > Lead

ToxFAQs™: Chemical Agent Briefing Sheets (CABS)

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Lead

January 2006

PDF Version

What is lead?

Lead is a heavy, bluish-gray metal that has a low melting point. It occurs naturally in the Earth' s crust, but it is not a particularly abundant element. It is rarely found naturally as a metal, but rather in its divalent (2+) oxidative state in ore deposits widely distributed throughout the world. The most important lead containing ores are galena (PbS), anglesite ($PbSO_4$), and cerussite ($PbCO_3$). Natural lead is a mixture of four stable isotopes: ^{208}Pb (51%–53%), ^{206}Pb (23.5%–27%), ^{207}Pb (20.5%–23%), and ^{204}Pb (1.35%–1.5%).

What are the forms of lead?

- Metallic lead
- Inorganic lead and lead compounds (or lead salts)
- Organic lead (containing carbon)

What are the common uses of lead?

The largest use for lead is in storage batteries in cars and other vehicles. Lead may be used as a pure metal, alloyed with other metals, or as chemical compounds.

Lead used by industry comes from mined ores ("primary") or from recycled scrap metal or batteries ("secondary"). However, most lead today is obtained from recovery of recycled scrap, mostly lead-acid batteries.

Human activities, such as lead mining and smelting operations and manufacturing and use of lead products (*e.g.*, leaded gasoline, lead-based paint), have resulted in the contamination of many industrial and residential areas with lead.

Form	Uses
Metallic lead **Lead and lead compounds (or lead salts), such as** • **lead acetate** • **lead chloride** • **lead nitrate** • **lead oxide** • **lead phosphate** • **lead acetate**	Certain uses of lead, such as leaded gasoline, lead-based paints for domestic use, lead-based solder in food cans and water pipes, lead sinkers, and ammunition, have been reduced or banned to minimize lead's harmful effects on people and animals. • **Cosmetics and hair dye** - Some hair dyes and some non-Western cosmetics, such as kohl and surma, contain lead. • **Fishing equipment** - Most fishing weights and sinkers are made from lead. • **Folk remedies** - Many non-Western folk remedies used to treat diarrhea or other ailments may contain substantial amounts of lead. Examples of these include alarcon, ghasard, alkohl, greta, azarcon,

• **lead sulfate** • **lead sulfide**	liga, bali goli, pay-loo-ah, coral, and rueda. • **Glazing** - Applied to some ceramicware can contain lead. • **Lead based paint** - Although the sale of residential lead-based paint was banned in the United States in 1978, it remains a major source of lead exposure for young children residing in older houses. • **Lead batteries** - Production of lead-acid batteries is the major use of lead. • **Lead-based solder** - Has been banned for use in water distribution systems, but many buildings and homes contain lead pipes or lead-based solder. Lead-based solder also is used for electrical circuitry applications. • **Lead-shot** and **ammunition** - It is the second highest production use of lead. • Other uses of lead include the production of lead alloys, soldering materials, shielding for x-ray machines, and manufacturing of corrosion- and acid-resistant materials used in the building industry.
Organic • **tetraethyl lead** • **tetramethyl lead**	The use of lead in gasoline was phased out in the 1980s, and has been banned since January 1, 1996. The use of lead in gasoline has contributed to its dispersion throughout the environment. During the combustion of gasoline containing these alkyllead compounds, significant amounts of inorganic lead can be released to the surrounding areas. **Current Uses** • Gasoline for off-road vehicles, farm equipment, and airplanes **Past Uses** • Gasoline additives (to increase octane rating)

What are the routes of exposure for lead?

People are most likely to be exposed to lead by consuming contaminated food and drinking water. Exposure can also occur by inadvertently ingesting contaminated soil, dust, or lead-based paint.

Form	Routes of Exposure
Metallic lead **Lead and lead compounds (or lead salts), such as** • **lead acetate** • **lead chloride** • **lead nitrate** • **lead oxide** • **lead phosphate** • **lead subacetate** • **lead sulfate** • **lead sulfide**	• Ingestion is the primary source of exposure to the general population. • Lead paint is a major source of environmental exposure for children who ingest flaking paint, paint chips, and weathered powdered paint (mostly from deteriorated housing units in urban areas). Lead paint can also contribute to soil/dust lead which can be inadvertently ingested via hand-to-mouth activity of young children. • Lead can leach into drinking water from lead-based solder used in water pipes. • Lead can leach into foods or liquids stored in ceramic containers made with lead glazing. • Engaging in hobbies such as casting ammunition, making fishing weights, and stained glass can result in exposure to lead. • Exposure by inhalation can result during activities such as soldering with lead solder or sanding or sandblasting lead-based paint.
Organic • **tetraethyl lead** • **tetramethyl lead**	• Inhalation • Dermal studies in animals have shown that organic lead is well absorbed through the skin

Who are the populations most at risk and how are they usually exposed?

People living near hazardous waste sites, lead smelters or refineries, battery recycling or crushing centers, or other industrial lead sources may be exposed to lead and chemicals that contain lead. Workers in occupations that have sources of lead exposure (*e.g.*, plumbers, miners, mechanics, and lead smelter or refinery workers).

Certain hobbies, folk remedies, home activities, and car repairs (*e.g.*, radiator repair) can contribute to lead exposure. Smoking cigarettes or breathing second-hand smoke increases exposure because tobacco smoke contains small amounts of lead.

Pregnant women, the developing fetuses, and young children are particularly vulnerable to the effects of lead. Young children are more likely to play in dirt and to place their hands and other objects in their mouths, thereby increasing the opportunity for exposure via ingestion of lead-contaminated soil and dust.

What are the possible toxic effects of lead?

The most sensitive targets for lead toxicity are the developing nervous system, the hematological and cardiovascular systems, and the kidney. However, because of lead's many modes of action in biological systems, lead could potentially affect any system or organs in the body. The effects are the same whether it is breathed or swallowed.

Blood Lead Concentrations Corresponding to Adverse Health Effects

Life Stage	Effect	Blood lead (µg/dL)
Children	Depressed ALAD* activity	<5
	Neurodevelopmental effects	<10
	Sexual maturation	<10
	Depressed vitamin D	>15
	Elevated EP**	>15
	Depressed NCV***	>30
	Depressed hemoglobin	>40
	Colic	>60
Adults	Depressed GFR****	<10
	Elevated blood pressure	<10
	Elevated EP (females)	>20
	Enzymuria/proteinuria	>30
	Peripheral neuropathy	>40
	Neurobehavioral effects	>40
	Altered thyroid hormone	>40
	Reduced fertility	>40
	Depressed hemoglobin	>50
Elderly adults	Depressed ALAD*	<5
	Neurobehavioral effects	>4

*aminolevulinic acid dehydratase (ALAD)

**erythrocyte porphyrin (EP)

***nerve conduction velocity (NCV)

****glomerular filtration rate (GFR)

Source: ATSDR Toxicological Profile for Lead (Draft for Public Comment), 2005.

How can I reduce the risk of exposure to lead?

- Do not allow children to chew or mouth surfaces that may have been painted with lead-based paint (homes built before 1978).
- If you have a water lead problem, the U.S. Environmental Protection Agency (EPA) recommends that you flush your cold water pipes if they have not been used in over 6 hours by running water until it is cold (5 seconds to 2 minutes) before drinking or cooking with it.
- Avoid some types of paints and pigments that contain lead and are used as make-up or hair coloring; keep these kinds of products away from children.
- Hire a professional contractor, who is required to follow certain health safety requirements for remediation or renovation involving lead-based paint, (www.epa.gov/lead/pubs/leadinfo.htm#remodeling).
- Wash children's hands and faces often to remove lead dusts and soil, and regularly clean the house of dust and tracked in soil.

What are the safety guidelines for lead exposure?

Air

- National Institute for Occupational Safety and Health (NIOSH)

  Recommended exposure limit (REL) time-weighted average (TWA) - 0.05 mg/m^3
  Immediately dangerous to life or health (IDLH) - 100 mg/m^3

- Occupational Safety and Health Administration (OSHA)

  Air - workplace 50 µg/m^3
  Action level - 40 µg/100 g of whole blood

- The American Conference of Governmental Industrial Hygienists (ACGIH)

Threshold limit values (TLV)/(TWA) - 0.05 mg/m^3
TLV/TWA guideline for lead arsenate - 150 µg/m^3
TLV/TWA guideline for other forms of lead - 50 µg lead/m^3

- U.S. Environmental Protection Agency (EPA)

  National Primary and Secondary Ambient Air Quality Standards - 1.5 µg/m^3

- World Health Organization (WHO)

  Air quality guidelines -- 0.5 µg/m^3

Water

- EPA

  Maximum contaminant level (MCL) - action level 0.015 mg/L
  Action level for public supplies - 15 µg/L

- WHO

  Drinking Water Quality Guidelines - 0.01 mg/L

Blood

- Centers for Disease Control and Prevention (CDC)

  Level of concern for children - 10 µg/dL

- OSHA

  Cause for written notification and medical exam - 40 µg/dL
  Cause for medical removal from exposure - 50 µg/dL

- ACGIH

  Advisory; biological exposure index - 30 µg/dL

Food

- Food and Drug Administration (FDA)

  Bottled drinking water - 0.005 mg/L

Other

- ACGIH

  Biological exposure indices (lead in blood) - 30 µg/100 mL

- Consumer Product Safety Commission

  Paint - 600 ppm

- FDA

  Ceramicware (µg/mL leaching solution) - 0.5-3.0 µg/mL

µg/m^3: micrograms per cubic meter
µg/dL: micrograms per deciliter
µg/L: micrograms per liter
g: gram
mg/L: milligrams per liter
mL: milliliter
ppm: parts per million

What are the most important or common mediating factors?

Factors that determine the severity of the health effects from lead exposure include

- Dose
- Age of the person exposed
  - the developing nervous system is the most sensitive system to the effects of lead
  - the efficiency of lead absorption from the gastrointestinal tract is greater in children than in adults
- Life stages of women (childbirth, lactating, menopause)
- Occupational exposures
- Duration of exposure
- Health and lifestyle of the person exposed
- Nutritional status of the person exposed
  - a diet adequate in calcium and iron may decrease lead absorption

The toxic effects of lead exposure may be worse in individuals with inherited genetic diseases or gene polymorphisms such as thalassemia, individuals with glucose-6-phosphate dehydrogenase (G6PD) deficiency, and carriers of certain gene polymorphic forms (*e.g.*, ALAD and vitamin D receptor). Research continues about this topic.

Is there a test to see if my child or I have been exposed to lead?

Blood	• The screening test of choice is blood lead levels. • Blood tests are commonly used to screen children for lead poisoning. • Analysis of lead in whole blood is the most common and accurate method of assessing lead exposure. • Exposure to lead also can be evaluated by measuring erythrocyte protoporphyrin (EP) in blood samples. EP is a part of red blood cells known to increase when the amount of lead in the blood is high. However, the EP level is not sensitive enough to identify children with elevated blood lead levels below about 25 micrograms per deciliter (µg/dL).
Bone and Teeth	• X-ray fluorescence techniques have been used to determine lead concentration in bones and teeth. It is not widely available and is used mostly in research. • Lead partitions to bone over a lifetime of exposure; therefore, bone lead measurements may be a better indicator of cumulative exposure than blood lead.
Urine	• Measurements of urinary lead levels have been used to assess lead exposure. • The measurement of lead excreted in urine following chelation with calcium disodium EDTA (EDTA provocation) has been used to detect elevated body burden of lead in adults and children.
Hair and Nails	• These are not reliable for testing due to errors external contamination. They are relatively poor predictors of blood lead, particularly at low concentrations.

Future Research Needs

To close current gaps in the scientific database on the health effects of lead, a long–term resear ch program is needed that might include the following:

- Further short-term studies or studies in vitro designed to clarify mechanisms of action for the various toxicities might be useful.
- Studies identifying exposures during different developmental periods can help identify critical periods of vulnerability for immunocompetence, development of sex organs, or neurobehavioral parameters.
- Chronic-duration exposure studies in animals would expand information on the toxicity of lead. Special studies that examine biochemical and morphological effects of lead may provide new information on mechanisms of action of lead, particularly for the effects of greatest concern such as neurobehavioral changes in children.
- Development of new and more sensitive tests of specific neuropsychological functions.
- Further investigation of links between lead and amyotrophic lateral sclerosis, essential tremor, schizophrenia, and Parkinson's disease.
- Epidemiological studies designed in a manner that permits more rigorous assessments of effect modification.
- Studies about the long-term consequences of lead-related neurobehavioral deficits detected in infants and children and the manifestation of chronic neurobehavioral problems in adolescence and adulthood.
- Further characterization of bone lead concentration as a biomarker of exposure for various effect end points (*e.g.*, blood pressure and renal effects).
- Studies of the potential prevalence of elevated bone lead stores in women of reproductive age and the associated risk that this poses to fetal development by mobilization of maternal bone stores during pregnancy.
- Further clarification of the role of some genetic polymorphisms.
- Evaluation of cohorts from prospective studies into adulthood for potential late-appearing effects including cancer.

For more information

- Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for Lead

  http://www.atsdr.cdc.gov/toxprofiles/tp13.html

- ATSDR ToxFAQs™ for Lead

  http://www.atsdr.cdc.gov/tfacts13.html

- ATSDR Case Studies in Environmental Medicine Lead Toxicity

  http://www.atsdr.cdc.gov/csem/lead/

- ATSDR Interaction Profile for Chemical Mixtures for Arsenic, Cadmium, Chromium, and Lead

  http://www.atsdr.cdc.gov/interactionprofiles/ip04.html

- ATSDR Interaction Profile for Chemical Mixtures for Lead, Manganese, Zinc, and Copper

  http://www.atsdr.cdc.gov/interactionprofiles/ip06.html

- ATSDR Interaction Profile for Chemical Mixtures for Chlorpyrifos, Lead, Mercury, and Methylmercury

  http://www.atsdr.cdc.gov/interactionprofiles/ip11.html

- Centers for Disease Control and Prevention Lead Web Page

  http://www.cdc.gov/lead/

- U.S. Environmental Protection Agency Lead Web Page

  http://www.epa.gov/lead/

- U.S. Department of Labor, Occupational Safety & Health Administration

  http://www.osha.gov/SLTC/lead/

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Environmental Medicine
1600 Clifton Road NE, Mailstop F-32
Atlanta, GA 30333
Phone: 1-800-CDC-INFO (800-232-4636)
TTY 888-232-6348

FAX: (770)-488-4178
Email: CDCINFO@cdc.gov

This page was updated on 01/04/2008

Mercury

Mercury is a naturally occurring metal found in air, water, and soil. It exists in several forms, including elemental (or metallic) mercury, inorganic mercury compounds, and organic mercury compounds:

- **Elemental mercury** is liquid at room temperature and is used in thermometers, fluorescent light bulbs, some electrical switches, and some industrial processes.
- **Inorganic mercury** compounds are formed when mercury combines with other elements to form salts, which are usually powders or crystals. Inorganic mercury compounds are found naturally in the environment. Some forms of inorganic mercury have been used in antiseptic creams, ointments, and preservatives.
- **Organic mercury** compounds are formed when mercury combines with carbon. Microscopic organisms can produce organic mercury compounds (methylmercury) in contaminated water and soil, which can accumulate in the food chain. Other special types of organomercurials have been used as medical preservatives and medicines.

How People Are Exposed to Mercury

- Eating fish or shellfish that is contaminated with methylmercury, which is the main source of general human exposures to mercury;
- Breathing air contaminated with elemental mercury vapors (e.g., in workplaces such as dental offices and industries that use mercury or in locations where a mercury spill or release has occurred);
- Having dental fillings that contain mercury; and
- Practicing cultural or religious rituals that use mercury.

How Mercury Affects People’s Health

- Short-term exposure to extremely high levels of elemental mercury vapors can result in lung damage, nausea, diarrhea, increases in blood pressure or heart rate, skin rashes, eye irritation, and injury to the nervous system.
- Prolonged exposure to lower levels of elemental mercury can permanently damage the brain and kidneys.
- The developing brain of a fetus can be injured if the mother is exposed to methylmercury.

Levels of Mercury in U.S. Population

Scientists tested levels of mercury in the blood of 16,780 participants who took part in CDC's national study known as the National Health and Nutrition Examination Survey (NHANES). These findings are based on total blood mercury levels in the U.S. general population for persons aged 1 year and older who participated in NHANES during 2003-2006, as well as trends in the total mercury of children aged 1–5 and females aged 16–49 during 1999–2006.

- In the total population during 2003–2006, the total blood mercury levels for non–Hispanic blacks and non–Hispanic whites were higher than those for Mexican Americans.
- Across the age groups in the total population during 2003-2006, total blood mercury levels increased with age, peaked at the fifth or sixth decade, depending on race/ethnicity, and then declined.
- In the most recent survey period of 2005–2006, the 95th percentile levels for total blood mercury in children aged 1-5 years and females aged 16-49 years were 1.43 µg/L and 4.48 µg/L, respectively. The 95th percentile means that 95 percent of the U.S. population’s exposure is below this estimated level. Conversely, only 5 percent of the population will have values at this level or higher.
- Over the four survey periods from 1999-2006, blood mercury levels increased slightly for non–Hispanic white children and decreased slightly for non–Hispanic black and Mexican American children. Female children had slightly higher blood mercury levels than male children.

For More Information

- Agency for Toxic Substances and Disease Registry
  Detailed information about mercury and public health is available at
  http://www.atsdr.cdc.gov/alerts/970626.html and
  http://www.atsdr.cdc.gov/cabs/mercury/index.html
- CDC Emergency Preparedness and Response
  Case definitions of mercury, toxicology FAQs, and toxicological profile at
  http://emergency.cdc.gov/agent/mercury/

May 2009

ATSDR Department of Health and Human Services
Agency for Toxic Substances & Disease Registry

ATSDR Home › ToxFAQs™ Arsenic

ToxFAQs™

ToxFAQs™
for
Arsenic
(*Arsénico*)
August 2007

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CAS#: 7440-38-2

This fact sheet answers the most frequently asked health questions (FAQs) about arsenic. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

Highlights

Exposure to higher than average levels of arsenic occur mostly in the workplace, near hazardous waste sites, or in areas with high natural levels. At high levels, inorganic arsenic can cause death. Exposure to lower levels for a long time can cause a discoloration of the skin and the appearance of small corns or warts. Arsenic has been found in at least 1,149 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is arsenic?

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds.

Inorganic arsenic compounds are mainly used to preserve wood. Copper chromated arsenate (CCA) is used to make "pressure-treated" lumber. CCA is no longer used in the U.S. for residential uses; it is still used in industrial applications. Organic arsenic compounds are used as pesticides, primarily on cotton fields and orchards.

What happens to arsenic when it enters the environment?

- Arsenic occurs naturally in soil and minerals and may enter the air, water, and land from wind-blown dust and may get into water from runoff and leaching.
- Arsenic cannot be destroyed in the environment. It can only change its form.
- Rain and snow remove arsenic dust particles from the air.
- Many common arsenic compounds can dissolve in water. Most of the arsenic in water will ultimately end up in soil or sediment.
- Fish and shellfish can accumulate arsenic; most of this arsenic is in an organic form called arsenobetaine that is much less harmful.

How might I be exposed to arsenic?

- Ingesting small amounts present in your food and water or breathing air containing arsenic.
- Breathing sawdust or burning smoke from wood treated with arsenic.
- Living in areas with unusually high natural levels of arsenic in rock.
- Working in a job that involves arsenic production or use, such as copper or lead smelting, wood treating, or pesticide application.

How can arsenic affect my health?

Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs.

Ingesting very high levels of arsenic can result in death. Exposure to lower levels can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet.

Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso.

Skin contact with inorganic arsenic may cause redness and swelling.

Almost nothing is known regarding health effects of organic arsenic compounds in humans. Studies in animals show that some simple organic arsenic compounds are less toxic than inorganic forms. Ingestion of methyl and dimethyl compounds can cause diarrhea and damage to the kidneys.

How likely is arsenic to cause cancer?

Several studies have shown that ingestion of inorganic arsenic can increase the risk of skin cancer and cancer in the liver, bladder, and lungs. Inhalation of inorganic arsenic can cause increased risk of lung cancer. The Department of Health and Human Services (DHHS) and the EPA have determined that inorganic arsenic is a known human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic arsenic is carcinogenic to humans.

How does arsenic affect children?

There is some evidence that long-term exposure to arsenic in children may result in lower IQ scores. There is also some evidence that exposure to arsenic in the womb and early childhood may increase mortality in young adults.

There is some evidence that inhaled or ingested arsenic can injure pregnant women or their unborn babies, although the studies are not definitive. Studies in animals show that large doses of arsenic that cause illness in pregnant females, can also cause low birth weight, fetal malformations, and even fetal death. Arsenic can cross the placenta and has been found in fetal tissues. Arsenic is found at low levels in breast milk.

How can families reduce their risk for exposure to arsenic?

- If you use arsenic-treated wood in home projects, you should wear dust masks, gloves, and protective clothing to decrease exposure to sawdust.
- If you live in an area with high levels of arsenic in water or soil, you should use cleaner sources of water and limit contact with soil.
- If you work in a job that may expose you to arsenic, be aware that you may carry arsenic home on your clothing, skin, hair, or tools. Be sure to shower and change clothes before going home.

Is there a medical test to show whether I've been exposed to arsenic?

There are tests available to measure arsenic in your blood, urine, hair, and fingernails. The urine test is the most reliable test for arsenic exposure within the last few days. Tests on hair and fingernails can measure exposure to high levels of arsenic over the past 6-12 months. These tests can determine if you have been exposed to above-average levels of arsenic. They cannot predict whether the arsenic levels in your body will affect your health.

Has the federal government made recommendations to protect human health?

The EPA has set limits on the amount of arsenic that industrial sources can release to the environment and has restricted or cancelled many of the uses of arsenic in pesticides. EPA has set a limit of 0.01 parts per million (ppm) for arsenic in drinking water.

The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit (PEL) of 10 micrograms of arsenic per cubic meter of workplace air (10 $\mu g/m^3$) for 8 hour shifts and 40 hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Arsenic *(Update)*. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Environmental Medicine
1600 Clifton Road NE, Mailstop F-62
Atlanta, GA 30333
Phone: 1-800-CDC-INFO • 888-232-6348 (TTY)
FAX: 770-488-4178
Email: cdcinfo@cdc.gov

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

This page was updated on 10/05/2007

U.S. Environmental Protection Agency

Pesticides: Topical & Chemical Fact Sheets

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EPA Home > Pesticides > About Pesticides > Fact Sheets > Health and Safety > Assessing Health Risks from Pesticides

Health & Safety
Specific Chemicals
Regulatory Actions

Assessing Health Risks from Pesticides

January 1999
735-F-99-002

The Federal Government, in cooperation with the States, carefully regulates pesticides to ensure that they do not pose unreasonable risks to human health or the environment. As part of that effort, the Environmental Protection Agency (EPA) requires extensive test data from pesticide producers that demonstrate pesticide products can be used without posing harm to human health and the environment. EPA scientists and analysts carefully review these data to determine whether to register (license) a pesticide product or a use and whether specific restrictions are necessary. This fact sheet is a brief overview of EPA's process for assessing potential risks to human health when evaluating pesticide products.

Background

There are more than 865 active ingredients registered as pesticides, which are formulated into thousands of pesticide products that are available in the marketplace. About 350 pesticides are used on the foods we eat, and to protect our homes and pets.

EPA plays a critical role in evaluating these chemicals prior to registration, and in reevaluating older pesticides already on the market, to ensure that they can be used with a reasonable certainty of no harm. The process EPA uses for evaluating the health impacts of a pesticide is called risk assessment.

EPA uses the National Research Council's four-step process for human health risk assessment:

- **Step One**: Hazard Identification
- **Step Two**: Dose-Response Assessment
- **Step Three**: Exposure Assessment
- **Step Four**: Risk Characterization

Step One: Hazard Identification (Toxicology)

The first step in the risk assessment process is to identify potential health effects that may occur from different types of pesticide exposure. EPA considers the full spectrum of a pesticide's potential health effects.

Generally, for human health risk assessments, many toxicity studies are conducted on animals by pesticide companies in independent laboratories and evaluated for acceptability by EPA scientists. EPA evaluates pesticides for a wide range of adverse effects, from eye and skin irritation to cancer and birth defects in laboratory animals. EPA may also consult the public literature or other sources of supporting information on any aspect of the chemical.

Step Two: Dose-Response Assessment

Paracelsus, the Swiss physician and alchemist, the “father” of modern toxicology (1493-1541) said,

> "The dose makes the poison."

In other words, **the amount of a substance a person is exposed to** is as important as **how toxic the chemical might be**. For example, small doses of aspirin can be beneficial to people, but at very high doses, this common medicine can be deadly. In some individuals, even at very low doses, aspirin may be deadly.

Dose-response assessment involves considering the dose levels at which adverse effects were observed in test animals, and using these dose levels to calculate an equal dose in humans.

Step Three: Exposure Assessment

People can be exposed to pesticides in three ways:

1. Inhaling pesticides (inhalation exposure),
2. Absorbing pesticides through the skin (dermal exposure), and
3. Getting pesticides in their mouth or digestive tract (oral exposure).

Depending on the situation, pesticides could enter the body by any one or all of these routes. Typical sources of pesticide exposure include:

- **Food**
  Most of the foods we eat have been grown with the use of pesticides. Therefore, pesticide residues may be present inside or on the surfaces of these foods.

- **Home and Personal Use Pesticides**
  You might use pesticides in and around your home to control insects, weeds, mold, mildew, bacteria, lawn and garden pests and to protect your pets from pests such as fleas. Pesticides may also be used as insect repellants which are directly applied to the skin or clothing.

- **Pesticides in Drinking Water**
  Some pesticides that are applied to farmland or other land structures can make their way in small amounts to the ground water or surface water systems that feed drinking water supplies.

- **Worker Exposure to Pesticides**
  Pesticide applicators, vegetable and fruit pickers and others who work around pesticides can be exposed due to the nature of their jobs. To address the unique risks workers face from occupational exposure, EPA evaluates occupational exposure through a separate program. All pesticides registered by EPA have been shown to be safe when used properly.

Step Four: Risk Characterization

Risk characterization is the final step in assessing human health risks from pesticides. It is the process of combining the hazard, dose-response and exposure assessments to describe the overall risk from a pesticide. It explains the assumptions used in assessing exposure as well as the uncertainties that are built into the dose-response assessment. The strength of the overall database is considered, and broad conclusions are made. EPA's role is to evaluate both toxicity and exposure and to determine the risk associated with use of the pesticide.

Simply put,

RISK = TOXICITY x EXPOSURE.

This means that the risk to human health from pesticide exposure depends on both the toxicity of the pesticide and the likelihood of people coming into contact with it. At least *some* exposure and *some* toxicity are required to result in a risk. For example, if the pesticide is very poisonous, but no people are exposed, there is no risk. Likewise, if there is ample exposure but the chemical is non-toxic, there is no risk. However, usually when pesticides are used, there is some toxicity and exposure, which results in a potential risk.

EPA recognizes that effects vary between animals of different species and from person to person. To account for this variability, *uncertainty factors* are built into the risk assessment. These uncertainty factors create an additional margin of safety for protecting people who may be exposed to the pesticides. FQPA requires EPA to use an extra 10-fold safety factor, if necessary, to protect infants and children from effects of the pesticide.

Types of Toxicity Tests EPA Requires for Human Health Risk Assessments

EPA evaluates studies conducted over different periods of time and that measure specific types of effects. These tests are evaluated to screen for potential health effects in infants, children and adults.

Acute Testing: Short-term exposure; a single exposure (dose).

- Oral, dermal (skin), and inhalation exposure
- Eye irritation
- Skin irritation
- Skin sensitization
- Neurotoxicity

Sub-chronic Testing: Intermediate exposure; repeated exposure over a longer period of time (i.e., 30-90 days).

- Oral, dermal (skin), and inhalation
- Neurotoxicity (nerve system damage)

Chronic Toxicity Testing: Long-term exposure; repeated exposure lasting for most of the test animal's life span. Intended to determine the effects of a pesticide after prolonged and repeated exposures.

- Chronic effects (non-cancer)
- Carcinogenicity (cancer)

Developmental and Reproductive Testing: Identify effects in the fetus of an exposed pregnant female (birth defects) and how pesticide exposure affects the ability of a test animal to successfully reproduce.

Mutagenicity Testing: Assess a pesticide's potential to affect the cell's genetic components.

Hormone Disruption: Measure effects for their potential to disrupt the endocrine system. The endocrine system consists of a set of glands and the hormones they produce that help guide the development, growth, reproduction, and behavior of animals including humans.

Risk Management

Once EPA completes the risk assessment process for a pesticide, we use this information to determine if (when used according to label directions), there is a reasonable certainty that the pesticide will not harm a person's health.

Using the conclusions of a risk assessment, EPA can then make a more informed decision regarding whether to approve a pesticide chemical or use, as proposed, or whether additional protective measures are necessary to limit occupational or non-occupational exposure to a pesticide. For example, EPA may prohibit a pesticide from being used on certain crops because consuming too much food treated with the pesticide may result in an unacceptable risk to consumers. Another example of protective measures is requiring workers to wear personal protective equipment (PPE) such as a respirator or chemical resistant gloves, or not allowing workers to enter treated crop fields until a specific period of time has passed.

If, after considering all appropriate risk reduction measures, the pesticide still does not meet EPA's safety standard, the Agency will not allow the proposed chemical or use. Regardless of the specific measures enforced, EPA's primary goal is to ensure that legal uses of the pesticide are protective of human health, especially the health of children, and the environment.

Human Health Risk Assessment and the Law

Federal law requires detailed evaluation of pesticides to protect human health and the environment. In 1996, Congress made significant changes to strengthen pesticide laws through the Food Quality Protection Act (FQPA). Many of these changes are key elements of the current risk assessment process. FQPA required that EPA consider:

- **A New Safety Standard**: FQPA strengthened the safety standard that pesticides must meet before being approved for use. EPA must ensure with a reasonable certainty that no harm will result from the legal uses of the pesticide.
- **Exposure from All Sources**: In evaluating a pesticide, EPA must estimate the combined risk from that pesticide from all non-occupational sources, such as:
  - Food Sources
  - Drinking Water Sources
  - Residential Sources
- **Cumulative Risk**: EPA is required to evaluate pesticides in light of similar toxic effects that different pesticides may share, or "a common mechanism of toxicity." At this time, EPA is developing a methodology for this type of assessment.
- **Special Sensitivity of Children to Pesticides**: EPA must ascertain whether there is an increased susceptibility from exposure to the pesticide to infants and children. EPA must build an additional 10-fold safety factor into risk assessments to ensure the protection of infants and children, unless it is determined that a lesser margin of safety will be safe for infants and children.

For More Information

If you would like more information about EPA's pesticide programs, contact the Communication Service Branch at (703) 305-5017 or visit the Pesticides Web site.

For more information on specific pesticides, or to inquire about the symptoms of pesticide poisoning, call the National Pesticide Information Center (NPIC), a toll-free hotline information at: 1-800-858-7378, or visit their Web site EXIT Disclaimer .

Publications | Glossary | A-Z Index | Jobs

EPA Home | Privacy and Security Notice | Contact Us

Last updated on Tuesday, May 2nd, 2006
URL: http://www.epa.gov/pesticides/factsheets/riskassess.htm

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

CONTENTS

February 2001

ToxFAQs™
for
Polychlorinated Biphenyls (PCBs)

(Bifenilos Policlorados (BPCs))

This fact sheet answers the most frequently asked health questions about polychlorinated biphenyls (PCBs). For more information, you may call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Polychlorinated biphenyls (PCBs) are a mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment. Health effects that have been associated with exposure to PCBs include acne-like skin conditions in adults and neurobehavioral and immunological changes in children. PCBs are known to cause cancer in animals. PCBs have been found in at least 500 of the 1,598 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polychlorinated biphenyls (PCBs)?

Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. PCBs have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils.

back to top

What happens to polychlorinated biphenyls (PCBs) when they enter the environment?

- PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.
- PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.
- PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs can travel long distances in the air and be deposited in areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also bind strongly to soil.
- PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

back to top

How might I be exposed to polychlorinated biphenyls (PCBs)?

- Using old fluorescent lighting fixtures and electrical devices and appliances, such as television sets and refrigerators, that were made 30 or more years ago. These items may leak small amounts of PCBs into the air when they get hot during operation, and could be a source of skin exposure.
- Eating contaminated food. The main dietary sources of PCBs are fish (especially sportfish caught in contaminated lakes or rivers), meat, and dairy products.
- Breathing air near hazardous waste sites and drinking contaminated well water.
- In the workplace during repair and maintenance of PCB transformers; accidents, fires or spills involving transformers, fluorescent lights, and other old electrical devices; and disposal of PCB materials.

back to top

How can polychlorinated biphenyls (PCBs) affect my health?

Contact Information

RELATED RESOURCES

ToxFAQ™ 35k

ToxFAQ™ en Español 32k

Public Health Statement 125k

Public Health Statement en Español 321k

Toxicological Profile 13.6MB

A-Z INDEX

A B C
D E
F G H I
J K
L M N O P
Q R S
T U
V W X Y Z

ATSDR RESOURCES

ToxFAQs™

ToxFAQs™ en Español

Public Health Statements

Toxicological Profiles

Minimum Risk Levels

MMGs

MHMIs

Interaction Profiles

Priority List of Hazardous Substances

Division of Toxicology

The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects. Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs.

Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

back to top

How likely are polychlorinated biphenyls (PCBs) to cause cancer?

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. The EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans.

back to top

How do polychlorinated biphenyls (PCBs) affect children?

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs or of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. Transplacental transfers of PCBs were also reported In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

back to top

How can families reduce the risk of exposure to polychlorinated biphenyls (PCBs)?

- You and your children may be exposed to PCBs by eating fish or wildlife caught from contaminated locations. Certain states, Native American tribes, and U.S. territories have issued advisories to warn people about PCB-contaminated fish and fish-eating wildlife. You can reduce your family's exposure to PCBs by obeying these advisories.
- Children should be told not play with old appliances, electrical equipment, or transformers, since they may contain PCBs.
- Children should be discouraged from playing in the dirt near hazardous waste sites and in areas where there was a transformer fire. Children should also be discouraged from eating dirt and putting dirty hands, toys or other objects in their mouths, and should wash hands frequently.
- If you are exposed to PCBs in the workplace it is possible to carry them home on your clothes, body, or tools. If this is the case, you should shower and change clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

back to top

Is there a medical test to show whether I've been exposed to polychlorinated biphenyls (PCBs)?

Tests exist to measure levels of PCBs in your blood, body fat, and breast milk, but these are not routinely conducted. Most people normally have low levels of PCBs in their body because nearly everyone has been environmentally exposed to PCBs. The tests can show if your PCB levels are elevated, which would indicate past exposure to above-normal levels of PCBs, but cannot determine when or how long you were exposed or whether you will develop health effects.

back to top

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.0005 milligrams of PCBs per liter of drinking water (0.0005 mg/L). Discharges, spills or accidental releases of 1 pound or more of PCBs into the environment must be reported to the EPA. The Food and Drug Administration (FDA) requires that infant foods, eggs, milk and other dairy products, fish and shellfish, poultry and red meat contain no more than 0.2-3 parts of PCBs per million parts (0.2-3 ppm) of food. Many states have established fish and wildlife consumption advisories for PCBs.

back to top

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for polychlorinated biphenyls (PCBs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

back to top

Where can I get more information?

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop F-32
Atlanta, GA 30333
Phone: 1-888-42-ATSDR (1-888-422-8737)
FAX: (770)-488-4178
Email: ATSDRIC@cdc.gov

back to top

ATSDR Department of Health and Human Services
Agency for Toxic Substances & Disease Registry

Home › CERCLA 2007 CERCLA Substance List

2007 CERCLA Priority List of Hazardous Substances

2007 RANK	SUBSTANCE NAME	TOTAL POINTS	2005 RANK	CAS #
1	ARSENIC	1672.58	1	007440-38-2
2	LEAD	1534.07	2	007439-92-1
3	MERCURY	1504.69	3	007439-97-6
4	VINYL CHLORIDE	1387.75	4	000075-01-4
5	POLYCHLORINATED BIPHENYLS	1365.78	5	001336-36-3
6	BENZENE	1355.96	6	000071-43-2
7	CADMIUM	1324.22	8	007440-43-9
8	POLYCYCLIC AROMATIC HYDROCARBONS	1316.98	7	130498-29-2
9	BENZO(A)PYRENE	1312.45	9	000050-32-8
10	BENZO(B)FLUORANTHENE	1266.55	10	000205-99-2
11	CHLOROFORM	1223.03	11	000067-66-3
12	DDT, P,P'-	1193.36	12	000050-29-3
13	AROCLOR 1254	1182.63	13	011097-69-1
14	AROCLOR 1260	1177.77	14	011096-82-5
15	DIBENZO(A,H)ANTHRACENE	1165.88	15	000053-70-3
16	TRICHLOROETHYLENE	1154.73	16	000079-01-6
17	DIELDRIN	1150.91	17	000060-57-1
18	CHROMIUM, HEXAVALENT	1149.98	18	018540-29-9
19	PHOSPHORUS, WHITE	1144.77	19	007723-14-0
20	CHLORDANE	1133.21	21	000057-74-9
21	DDE, P,P'-	1132.49	20	000072-55-9
22	HEXACHLOROBUTADIENE	1129.63	22	000087-68-3
23	COAL TAR CREOSOTE	1124.32	23	008001-58-9
24	ALDRIN	1117.22	25	000309-00-2
25	DDD, P,P'-	1114.83	24	000072-54-8
26	BENZIDINE	1114.24	26	000092-87-5
27	AROCLOR 1248	1112.20	27	012672-29-6
28	CYANIDE	1099.48	28	000057-12-5
29	AROCLOR 1242	1093.14	29	053469-21-9
30	AROCLOR	1091.52	62	012767-79-2
31	TOXAPHENE	1086.65	30	008001-35-2
32	HEXACHLOROCYCLOHEXANE, GAMMA-	1081.63	32	000058-89-9
33	TETRACHLOROETHYLENE	1080.43	31	000127-18-4
34	HEPTACHLOR	1072.67	33	000076-44-8
35	1,2-DIBROMOETHANE	1064.06	34	000106-93-4
36	HEXACHLOROCYCLOHEXANE, BETA-	1060.22	37	000319-85-7
37	ACROLEIN	1059.07	36	000107-02-8
38	DISULFOTON	1058.85	35	000298-04-4
39	BENZO(A)ANTHRACENE	1057.96	38	000056-55-3
40	3,3'-DICHLOROBENZIDINE	1051.61	39	000091-94-1

41	ENDRIN	1048.57	41	000072-20-8
42	BERYLLIUM	1046.12	40	007440-41-7
43	HEXACHLOROCYCLOHEXANE, DELTA-	1038.27	42	000319-86-8
44	1,2-DIBROMO-3-CHLOROPROPANE	1035.55	43	000096-12-8
45	PENTACHLOROPHENOL	1028.01	45	000087-86-5
46	HEPTACHLOR EPOXIDE	1027.12	44	001024-57-3
47	CARBON TETRACHLORIDE	1023.32	46	000056-23-5
48	AROCLOR 1221	1018.41	47	011104-28-2
49	COBALT	1015.57	50	007440-48-4
50	DDT, O,P'-	1014.71	49	000789-02-6
51	AROCLOR 1016	1014.33	48	012674-11-2
52	DI-N-BUTYL PHTHALATE	1007.49	52	000084-74-2
53	NICKEL	1005.40	55	007440-02-0
54	ENDOSULFAN	1004.65	54	000115-29-7
55	ENDOSULFAN SULFATE	1003.56	53	001031-07-8
56	DIAZINON	1002.08	57	000333-41-5
57	ENDOSULFAN, ALPHA	1001.30	58	000959-98-8
58	XYLENES, TOTAL	996.07	59	001330-20-7
59	CIS-CHLORDANE	995.08	51	005103-71-9
60	DIBROMOCHLOROPROPANE	994.87	60	067708-83-2
61	METHOXYCHLOR	994.47	61	000072-43-5
62	BENZO(K)FLUORANTHENE	981.26	63	000207-08-9
63	ENDRIN KETONE	978.99	64	053494-70-5
64	TRANS-CHLORDANE	973.99	56	005103-74-2
65	CHROMIUM(VI) OXIDE	969.58	66	001333-82-0
66	METHANE	959.78	67	000074-82-8
67	ENDOSULFAN, BETA	959.19	65	033213-65-9
68	AROCLOR 1232	955.64	68	011141-16-5
69	ENDRIN ALDEHYDE	954.86	69	007421-93-4
70	BENZOFLUORANTHENE	951.48	70	056832-73-6
71	TOLUENE	947.50	71	000108-88-3
72	2-HEXANONE	942.02	72	000591-78-6
73	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	938.11	73	001746-01-6
74	ZINC	932.89	74	007440-66-6
75	DIMETHYLARSINIC ACID	922.06	75	000075-60-5
76	DI(2-ETHYLHEXYL)PHTHALATE	919.02	76	000117-81-7
77	CHROMIUM	908.52	77	007440-47-3
78	NAPHTHALENE	896.67	78	000091-20-3
79	1,1-DICHLOROETHENE	891.19	79	000075-35-4
80	METHYLENE CHLORIDE	888.96	81	000075-09-2
81	AROCLOR 1240	888.11	80	071328-89-7
82	2,4,6-TRINITROTOLUENE	883.59	82	000118-96-7
83	BROMODICHLOROETHANE	870.00	83	000683-53-4
84	HYDRAZINE	864.41	85	000302-01-2
85	1,2-DICHLOROETHANE	863.99	84	000107-06-2
86	2,4,6-TRICHLOROPHENOL	863.71	86	000088-06-2
87	2,4-DINITROPHENOL	860.45	87	000051-28-5
88	BIS(2-CHLOROETHYL) ETHER	859.88	88	000111-44-4
89	THIOCYANATE	849.21	89	000302-04-5
90	ASBESTOS	841.54	90	001332-21-4
91	CHLORINE	840.37	92	007782-50-5
92	CYCLOTRIMETHYLENETRINITRAMINE (RDX)	840.28	91	000121-82-4
93	HEXACHLOROBENZENE	838.34	93	000118-74-1

94	2,4-DINITROTOLUENE	837.88	96	000121-14-2
95	RADIUM-226	835.93	94	013982-63-3
96	ETHION	834.03	97	000563-12-2
97	1,1,1-TRICHLOROETHANE	833.81	95	000071-55-6
98	URANIUM	833.41	98	007440-61-1
99	ETHYLBENZENE	832.13	99	000100-41-4
100	RADIUM	828.07	100	007440-14-4
101	THORIUM	825.17	101	007440-29-1
102	4,6-DINITRO-O-CRESOL	822.78	102	000534-52-1
103	1,3,5-TRINITROBENZENE	820.17	103	000099-35-4
104	CHLOROBENZENE	819.69	105	000108-90-7
105	RADON	817.89	104	010043-92-2
106	RADIUM-228	816.76	106	015262-20-1
107	THORIUM-230	814.72	107	014269-63-7
107	URANIUM-235	814.72	107	015117-96-1
109	BARIUM	813.46	109	007440-39-3
110	FLUORANTHENE	812.40	113	000206-44-0
111	URANIUM-234	812.11	110	013966-29-5
112	N-NITROSODI-N-PROPYLAMINE	811.05	111	000621-64-7
113	THORIUM-228	810.36	112	014274-82-9
114	RADON-222	809.78	114	014859-67-7
115	HEXACHLOROCYCLOHEXANE, ALPHA-	809.56	116	000319-84-6
116	1,2,3-TRICHLOROBENZENE	808.41	143	000087-61-6
117	MANGANESE	807.90	115	007439-96-5
118	COAL TARS	807.07	117	008007-45-2
119	CHRYSOTILE ASBESTOS	806.68	119	012001-29-5
119	STRONTIUM-90	806.68	119	010098-97-2
121	PLUTONIUM-239	806.67	118	015117-48-3
122	POLONIUM-210	806.39	122	013981-52-7
123	METHYLMERCURY	806.39	121	022967-92-6
124	PLUTONIUM-238	806.01	123	013981-16-3
125	LEAD-210	805.90	124	014255-04-0
126	PLUTONIUM	805.23	125	007440-07-5
127	CHLORPYRIFOS	804.93	125	002921-88-2
128	COPPER	804.86	133	007440-50-8
129	AMERICIUM-241	804.55	128	086954-36-1
130	RADON-220	804.54	127	022481-48-7
131	AMOSITE ASBESTOS	804.07	129	012172-73-5
132	IODINE-131	803.48	130	010043-66-0
133	HYDROGEN CYANIDE	803.08	132	000074-90-8
134	TRIBUTYLTIN	802.61	131	000688-73-3
135	GUTHION	802.32	134	000086-50-0
136	NEPTUNIUM-237	802.13	135	013994-20-2
137	CHRYSENE	802.10	139	000218-01-9
138	CHLORDECONE	801.64	136	000143-50-0
138	IODINE-129	801.64	136	015046-84-1
138	PLUTONIUM-240	801.64	136	014119-33-6
141	S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	797.88	140	000078-48-8
142	BROMINE	789.15	142	007726-95-6
143	POLYBROMINATED BIPHENYLS	789.11	141	067774-32-7
144	DICOFOL	787.56	144	000115-32-2
145	PARATHION	784.14	145	000056-38-2
146	1,1,2,2-TETRACHLOROETHANE	782.15	146	000079-34-5

147	SELENIUM	778.98	147	007782-49-2	
	148	HEXACHLOROCYCLOHEXANE, TECHNICAL GRADE	774.91	148	000608-73-1
149	TRICHLOROFLUOROETHANE	770.74	149	027154-33-2	
150	TRIFLURALIN	770.12	150	001582-09-8	
151	DDD, O,P'-	768.73	151	000053-19-0	
152	4,4'-METHYLENEBIS(2-CHLOROANILINE)	766.66	152	000101-14-4	
153	HEXACHLORODIBENZO-P-DIOXIN	760.42	153	034465-46-8	
154	HEPTACHLORODIBENZO-P-DIOXIN	754.47	154	037871-00-4	
155	PENTACHLOROBENZENE	753.58	155	000608-93-5	
156	1,3-BUTADIENE	747.31	201	000106-99-0	
157	AMMONIA	745.55	156	007664-41-7	
158	2-METHYLNAPHTHALENE	743.24	157	000091-57-6	
159	1,4-DICHLOROBENZENE	737.32	159	000106-46-7	
160	1,1-DICHLOROETHANE	736.23	158	000075-34-3	
161	ACENAPHTHENE	731.25	160	000083-32-9	
162	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	726.14	161	039001-02-0	
163	1,1,2-TRICHLOROETHANE	724.96	162	000079-00-5	
164	TRICHLOROETHANE	723.32	163	025323-89-1	
165	HEXACHLOROCYCLOPENTADIENE	719.01	164	000077-47-4	
166	HEPTACHLORODIBENZOFURAN	718.58	165	038998-75-3	
167	1,2-DIPHENYLHYDRAZINE	713.90	166	000122-66-7	
168	2,3,4,7,8-PENTACHLORODIBENZOFURAN	710.71	167	057117-31-4	
169	TETRACHLOROBIPHENYL	709.21	168	026914-33-0	
170	CRESOL, PARA-	707.83	169	000106-44-5	
171	OXYCHLORDANE	706.32	170	027304-13-8	
172	1,2-DICHLOROBENZENE	704.91	171	000095-50-1	
173	1,2-DICHLOROETHENE, TRANS-	704.04	178	000156-60-5	
174	INDENO(1,2,3-CD)PYRENE	703.30	180	000193-39-5	
175	GAMMA-CHLORDENE	702.59	172	056641-38-4	
176	CARBON DISULFIDE	702.55	174	000075-15-0	
177	TETRACHLOROPHENOL	702.54	173	025167-83-3	
178	AMERICIUM	701.62	175	007440-35-9	
178	URANIUM-233	701.62	175	013968-55-3	
180	PALLADIUM	700.66	177	007440-05-3	
181	HEXACHLORODIBENZOFURAN	700.56	179	055684-94-1	
182	PHENOL	696.96	183	000108-95-2	
183	CHLOROETHANE	693.90	182	000075-00-3	
184	ACETONE	693.31	181	000067-64-1	
185	P-XYLENE	690.20	185	000106-42-3	
186	DIBENZOFURAN	689.19	187	000132-64-9	
187	ALUMINUM	688.13	186	007429-90-5	
188	2,4-DIMETHYLPHENOL	685.76	189	000105-67-9	
189	CARBON MONOXIDE	684.49	188	000630-08-0	
190	TETRACHLOROETHANE	677.97	190	025322-20-7	
191	HYDROGEN SULFIDE	676.51	193	007783-06-4	
192	PENTACHLORODIBENZOFURAN	673.21	192	030402-15-4	
193	CHLOROMETHANE	670.19	191	000074-87-3	
194	BIS(2-METHOXYETHYL) PHTHALATE	666.08	194	034006-76-3	
195	BUTYL BENZYL PHTHALATE	659.38	195	000085-68-7	
196	CRESOL, ORTHO-	658.66	196	000095-48-7	
197	HEXACHLOROETHANE	653.10	199	000067-72-1	
198	VANADIUM	651.70	198	007440-62-2	

199	N-NITROSODIMETHYLAMINE	650.71	200	000062-75-9
200	1,2,4-TRICHLOROBENZENE	647.30	203	000120-82-1
201	BROMOFORM	643.53	202	000075-25-2
202	TETRACHLORODIBENZO-P-DIOXIN	635.74	204	041903-57-5
203	1,3-DICHLOROBENZENE	631.41	205	000541-73-1
204	PENTACHLORODIBENZO-P-DIOXIN	625.12	207	036088-22-9
205	N-NITROSODIPHENYLAMINE	624.79	208	000086-30-6
206	1,2-DICHLOROETHYLENE	622.49	206	000540-59-0
207	2,3,7,8-TETRACHLORODIBENZOFURAN	622.15	210	051207-31-9
208	2-BUTANONE	620.01	209	000078-93-3
209	2,4-DICHLOROPHENOL	616.45	212	000120-83-2
210	1,4-DIOXANE	616.29	215	000123-91-1
211	FLUORINE	613.28	214	007782-41-4
212	NITRITE	612.64	216	014797-65-0
213	CESIUM-137	612.50	217	010045-97-3
214	SILVER	612.19	213	007440-22-4
215	CHROMIUM TRIOXIDE	610.85	218	007738-94-5
216	NITRATE	610.66	219	014797-55-8
217	POTASSIUM-40	608.91	220	013966-00-2
218	DINITROTOLUENE	607.65	221	025321-14-6
219	ANTIMONY	605.37	222	007440-36-0
220	COAL TAR PITCH	605.33	224	065996-93-2
221	THORIUM-227	605.32	223	015623-47-9
222	2,4,5-TRICHLOROPHENOL	604.83	225	000095-95-4
223	ARSENIC ACID	604.45	226	007778-39-4
224	ARSENIC TRIOXIDE	604.36	227	001327-53-3
225	PHORATE	603.10	228	000298-02-2
226	BENZOPYRENE	603.00	230	073467-76-2
227	CRESOLS	602.74	229	001319-77-3
228	CHLORDANE, TECHNICAL	602.62	231	012789-03-6
229	DIMETHOATE	602.61	232	000060-51-5
230	ACTINIUM-227	602.57	233	014952-40-0
230	STROBANE	602.57	233	008001-50-1
232	4-AMINOBIPHENYL	602.51	235	000092-67-1
232	PYRETHRUM	602.51	235	008003-34-7
234	ARSINE	602.42	237	007784-42-1
235	NALED	602.32	238	000300-76-5
236	DIBENZOFURANS, CHLORINATED	602.13	239	042934-53-2
236	ETHOPROP	602.13	239	013194-48-4
238	ALPHA-CHLORDENE	601.94	241	056534-02-2
238	CARBOPHENOTHION	601.94	241	000786-19-6
240	DICHLORVOS	601.64	243	000062-73-7
241	CALCIUM ARSENATE	601.45	244	007778-44-1
241	MERCURIC CHLORIDE	601.45	244	007487-94-7
241	SODIUM ARSENITE	601.45	244	007784-46-5
244	FORMALDEHYDE	599.64	247	000050-00-0
245	2-CHLOROPHENOL	599.62	248	000095-57-8
246	PHENANTHRENE	597.68	249	000085-01-8
247	HYDROGEN FLUORIDE	588.03	250	007664-39-3
248	2,4-D ACID	584.47	251	000094-75-7
249	DIBROMOCHLOROMETHANE	580.59	252	000124-48-1
250	DIURON	579.16	253	000330-54-1
251	BUTYLATE	578.43	254	002008-41-5

252	DIMETHYL FORMAMIDE	578.23	255	000068-12-2
253	PYRENE	577.95	256	000129-00-0
254	DICHLOROBENZENE	577.70	211	025321-22-6
255	ETHYL ETHER	572.47	257	000060-29-7
256	DICHLOROETHANE	570.46	258	001300-21-6
257	4-NITROPHENOL	567.79	259	000100-02-7
258	1,3-DICHLOROPROPENE, CIS-	561.82	184	010061-01-5
259	PHOSPHINE	559.74	260	007803-51-2
260	TRICHLOROBENZENE	557.96	261	012002-48-1
261	2,6-DINITROTOLUENE	555.20	262	000606-20-2
262	FLUORIDE ION	549.64	263	016984-48-8
263	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	547.90	264	035822-46-9
264	METHYL PARATHION	545.83	265	000298-00-0
265	PENTAERYTHRITOL TETRANITRATE	545.59	266	000078-11-5
266	1,3-DICHLOROPROPENE, TRANS-	543.37	267	010061-02-6
267	BIS(2-ETHYLHEXYL)ADIPATE	540.20	268	000103-23-1
268	CARBAZOLE	534.52	269	000086-74-8
269	METHYL ISOBUTYL KETONE	533.24	271	000108-10-1
270	1,2-DICHLOROETHENE, CIS-	533.15	270	000156-59-2
271	STYRENE	532.70	272	000100-42-5
272	CARBARYL	530.98	273	000063-25-2
273	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	529.45	274	067562-39-4
274	ACRYLONITRILE	528.28	275	000107-13-1
275	1-METHYLNAPHTHALENE	526.51	NEW	

Substances were assigned the same rank when two (or more) substances received equivalent total point scores.

CAS #= Chemical Abstracts Service Registry Number

This page was updated on 01/10/2008

ARIEL CZEMERINSKI, P.E.
191 Parkway Drive
Roslyn Heights, NY 11577
mobile (516) 987-1662
fax (516) 706-3214
Email: info@C2env.com

SUMMARY:

New York State Professional Engineer. Results-oriented Chemical and Environmental Engineer, with 21 years of experience in the chemical and environmental areas. Areas of expertise include inspections and sign off on Large Scale Vapor Barrier Installations at Various NYC schools, Design and inspections of Sub Slab Depressurization Systems, wastewater treatment systems, process control and automation, process optimization, productivity improvement, quality systems, environmental compliance, Phase I Environmental Site Assessments, Phase II Environmental Investigations, Phase III: Remedial Activities, process and plant safety, and management of a production facility. Special Inspector with New York City Department of Buildings. Registered PE in NY.

WORK EXPERIENCE:

2012-present C Squared Environmental Corp. Jericho, NY (Incorporated in 2012).
President

- Provide environmental and geotechnical services.
- Obtain soil and water samples.
- Conduct environmental monitoring activities.

1997-present AMC Engineering, PLLC. Jericho, NY (Organized in 2000).
Principal. Clients range from small car wash and Laundromat operators to large chemical process companies.

- Engineering Consulting Services.
- Design and Inspection of SubSlab Depressurization Systems
- Design of Subsurface Drainage Systems.
- SPDES and SWPPP Inspections
- Environmental Compliance.
- Phase I ESA, Phase II ESI. Remedial Investigations, Remediation of contaminated sites.
- Wastewater Treatment systems.
- Design of cleaning compounds for the Transportation industry.
- Zoning regulations. Expediting Services. NYFD, NYC Buildings, NYSDEC, Suffolk County
- Permitting: NYSDoB, NYCDEP, NYFD, NYSDEC
- NYCDOB Special Inspector: for heating system, chimneys and fire stops, and mechanical systems
- Safety and environmental training.
- Soil and Water characterization and sampling
- Inspections and sign off on Large Scale Vapor Barrier Installations at Various NYC schools

1994-2001 Axel Plastics Research Laboratories, Woodside, NY
Plant Manager

- Responsible for all day-to-day operations.
- Designed and installed a powders blending facility, including materials handling, dust collection systems, mixers, and other processing equipment.

- Implemented a safety program, based on OSHA standards.
- Implemented a Company-wide Quality Management system (ISO 9000).
- Successfully addressed all environmental-related issues with local authorities.
- Wrote all operating procedures and instructions. Designed and implemented an Intranet system with all information pertaining to day-to-day operations, for Company wide use.
- Planned production for the two plants and more than 140 lines of products.
- Managed all shipping/receiving operations. Managed all equipment and process maintenance.

1992-1994 Millennium Chemicals (SCM, Colors & Silica), Baltimore, MD.
Process Engineer and Project Manager.

- Process engineering, design, manufacturing and environmental control for the Silica Gel plant.
- Responsible for ISO 9000 certification. Wrote all procedures and instructions for the plant and maintenance.
- Conducted capital asset planning.
- Responsible for Health, Safety and Environmental compliance.

1990-1992 CROMPTON (WITCO) CORPORATION, POLYMER ADDITIVES, Taft, LA.
Process Development Engineer.

- Routine responsibilities were to develop new processes and optimize existing ones.
- Successfully designed and installed a distributed control system to remotely control an organic peroxides facility (Marshall, TX).
- Designed, erected and operated a Pilot Plant. It successfully brought to the market a pesticide, patented by Dupont and commercialized by Witco (Seenox).
- Conducted process simulation to identify process and product optimization.
- Designed process equipment (reactors, heat exchangers, pumps)

1987-1988 VINISA S.A.I.C. - PVC COMPOUNDING, Buenos Aires, Argentina.
Production and Project Manager.
Coordinated production in VINISA's 3 compounding plants. Routine responsibilities included: Technical assistance to PVC compounders, Production organization, planning and control, production management.

EDUCATION:

1988-1990 COLUMBIA UNIVERSITY, New York, NY
M.S. Chemical Engineering, Feb. 1990.
Awarded Fellowship as a Teaching Assistant. Thesis: Optimal Periodic Control.

1981-1987 UNIVERSITY OF BUENOS AIRES, Buenos Aires, Argentina.
Chemical Engineer (six year program).
Teaching Assistant Inorganic Chemistry.

Continuing Education Courses attended: (partial list)

- Building Inspections Course
- Environmental Regulation
- Design of Subsurface Drainage Systems
- Process Hazard Analysis
- Hazardous Materials Regulations

- Supervisors Training
- OSHA regulations
- ISO 9000
- Lead auditor training
- Wastewater Treatment System

ADDITIONAL INFORMATION

Speaker at Water Conferences: Long Island Water, wastewater and aquifers. Director, Metro New York Section, AIChE

Mark E. Robbins, C.P.G., C.E.I.
Vice President, Senior Geologist

Mr. Robbins has over nine (9) years experience in geology and hydrogeology, involving such activities as Phase I Environmental Site Assessments, Phase II Environmental Site Assessments, Subsurface Investigations, Remedial Actions, data acquisition, evaluation and contouring, and geotechnical investigations. Mr. Robbins has performed over 400 Phase I Assessments involving residential through heavy industrial properties and over 200 Subsurface Investigations throughout the United States. Mr. Robbins has also designed and implemented over 20 remediation systems for both public and private sectors.

Representative Occupational Experience

- *Environmental Site Assessments*
  Conducted Phase I and II Environmental Site Assessments, analysis of site investigation reports, identifying contamination locations and sources. Soil, soil-vapor and water sampling, analyzing laboratory results for QA/QC, magnetometer and Ground-Penetrating Radar surveys for locating buried drums and underground storage tanks (USTs), estimating UST and other subsurface leaks, monitoring well logging, Project Management, liability assessments and estimating costs to attain compliance.

- *Remedial Investigation and Feasibility Studies*
  Oversight/planning of site investigations; data analysis, including statistical analysis and geostatistical contouring utilizing SURFER; performance of feasibility studies, including technology evaluations, alternatives development and evaluation and cost estimations.

- *Due- Diligence Programs*
  Designed and implemented due-diligence programs (ranging from Phase I Assessment to Comprehensive Hydrogeologic Investigations) to assess environmental liabilities for numerous land development clientele.

- *Delineation of Chlorinated Organic Plumes*
  Supervised the delineation of a dissolved chlorinated organic plume from underground tank loss. Developed a remedial action program in accordance with New York State regulatory guidelines to abate soil and groundwater contamination.

- *Remedial Action*
  Prepared numerous Remedial Action Plans. Designed and implemented hydrocarbon and chlorinated solvent remediation systems for soil and groundwater.

- *Pump Test Aquifer Analysis*
  Conducted several pump tests and pump test analysis and field coordination in relation to dewatering permit requirements for Keyspan Energy and the private sector.

Employment

2001 - Present Vice President, Senior Geologist
Hydro Tech Environmental Corp., Commack, New York

2000 – 2001	Assistant Director, Professional Services Fenley & Nicol Environmental, Inc., Deer Park, New York
1999 – 2000	Senior Geologist Fenley & Nicol Environmental, Inc. Deer Park, New York
1995 – 1999	Operations Director Advanced Cleanup Technologies, Inc., Farmingdale, New York
1992 – 1995	Project Geologist Advanced Cleanup Technologies, Inc., Roslyn Heights, New York

Education

B.S. Geology, State University of New York at Oneonta, 1991

Affiliations and Certifications

- American Institute of Professional Geologists
- American Association of Petroleum Geologists
- Long Island Geologist Organization
- Geological Society of America
- American Standards in Testing Materials – E50 Committee Member
- Environmental Assessment Association
- OSHA 40-Hour & 8-Hour, Supervisor

Registrations and Certifications

- Certified Professional Geologist (C.P.G. # 10527)
- Certified Environmental Inspector (C.E.I. # 73383)
- GPR Operator's Course, Geophysical Survey Systems, Inc., 1993.

Publications/Presentations

- *A Case Study of the Impact of MTBE on the Investigation and Remediation of a Fuel Oil Release,* National Groundwater Focus Conference MTBE in Groundwater: Assessment, Remediation Technologies & Public Policy, Baltimore, MD June 4-5, 2001.
- *Is MTBE in Fuel Oil? Why MTBE Plays a Major Concern on Long Island,* Long Island Business News, February 2001.

Paul I. Matli (Ph.D.)

EXPERIENCES

Senior Project Manager
Hydro Tech Environmental Corp. - USA
Apr. 2005 - Nov. 2005 & July 2006 - Present
Completed Environmental Assessment Statements, Phase I Environmental Site Assessments, Phase II Investigations Work Plans, environmental monitoring programs of groundwater and indoor air quality, field sampling of soil, water, air, soil gas, mold and solid wastes, data evaluation through Quality Assurance and Quality Control programs and reports writing. Prepared and engineered Phase III Remedial Action Work Plans for regulated developments, superfund sites and hazardous waste facilities by implementing in-situ bio-chemical remedial technologies, ex-situ disposal of impacted media and on-site mitigation methods of soil vapor intrusion. Supervised and coordinated the closure and removal of petroleum storage tanks. Fulfilled the task of Health and Safety Officer and the duties of a Geologist at a New York State Brownfield Cleanup Program site and multiple New York City Brownfield Cleanup Program sites.

Vocational Lecturer of the Course "Ecology and Environment"
Saint Joseph University – Lebanon
Nov. 2003 - Feb. 2004
Introduced undergraduate students in the School of Agriculture Engineering and the Nursing School to advanced knowledge in the fields of ecology, environment, ecosystem management, earth science and multivariate statistical analytical methods.

Agriculture Engineer in the Italian Rural Development Project in the Upper Bekaa Valley, Baalbek-Hermel Region
Lebanese Agricultural Research Institute - Lebanon
May 2003 - Jan. 2004
Contributed to boosting agricultural production in rural communities in a semi-arid region by identifying deficient production and marketing elements in their farming system and promoting sustainbale agriculture by introducing drought tolerant crops and the construction and management of engineered water reservoirs.

Teaching Assistant
Tokyo University of Agriculture and Technology - Japan
Apr.1999-Sept. 2002
Played a key role in the completion of research thesis of graduate research students by instructing and assisting them in their experimental designs and the application of statistical analytical methods.

Environmental Manager of Ammiq Private Wetlands in the Bekaa Valley - Lebanon
Oct.1997 - Sept. 1998
Successfully managed the exploitation of natural resources of privately owned wetlands by local stakeholders and implemented the United Nations strategies to suppress hunting of endangered bird species and waterfawls in coordination with government and international non-government organizations.

EDUCATION

Ph.D. in Environmental Sciences (a)
Tokyo University of Agriculture and Technology- Japan
Apr. 1999 - Sept. 2002
Research Theme: Conducted field research of crop physiological responses to micro-climatic conditions and developed empirical and multivariate statistical models predicting the impact of future global warming on crop production.

M.Sc. in Environmental Sciences ^(b)^

International Center for Advanced Mediterranean Agronomic Studies - Greece

Sept. 1995 - Sept. 1997

Research Theme: Performed field surveys and laboratory analytical studies of the physico-chemical properties of forest and plant species in promoting wildland fires and developed empirical statistical models predicting their inputs into forest fire behavior prediction systems.

D.S.P.G.S. in Management and Conservation of Mediterranean Ecosystems

International Center for Advanced Mediterranean Agronomic Studies - Greece

Nov. 1994 - Aug. 1995

Top second among 15% of students successfully passing a one-year postgraduate program of intensive multidisciplinary courses for the major of management and conservation of natural renewable resources with a GPA of 4.0.

Diploma of Agricultural Engineer (c)

University of Saint Joseph - Lebanon

Sept. 1989 - July 1994

Successfully passed a five-year engineering program in agronomy and ranked first in the 1994 class graduation with a GPA of 3.69.

Research Theme: Collected and established a socio-economic database of the impact of trout fish farms on the bio-chemical property and microbial quality of fresh watercourses.

PEER-REVIEWED PUBLICATIONS

Matli P.I., Aoki M., Ozawa Y., Hideshima Y., Nakayama H., and Maruya S. 2002. Characterization of canopy photosynthetic CO_2 flux and leaf stomatal conductance responses of potato crop to changing field meteorological conditions in Hokkaido (in English). Journal of Agricultural Meteorology, **58**(3)115-122.

Dimitrakopoulos A.P., and **Matli P.** 2001. Bulk density and physical properties of *Sarcopoterium spinosum* (L.) Spach as fuel characteristics (in English). Journal of Mediterranean Ecology, **2**:75-82.

Elzein G., **Matli P.**, and Darwish S. 1997. The Study of physico-chemical and biological parameters of fresh water in fisheries in the Bekaa Valley (in French). Lebanese Scientific Bulletin, **10**(1):3-20.

Matli P. 1998. Measures and strategies to prevent and manage forest fires in Lebanon (in Arabic). Al Nahar Newspaper; Nahar El Shabab, Sept. 22, pp.2-3.

Matli P. 1997. A preliminary planning of managerial strategies for the conservation and management of Ammiq private wetlands (in English). Technical report submitted to the owners committee of Ammiq Estates-Lebanon, 10p.

EXTRACURRICULAR TRAININGS AND SKILLS

40 Hours OSHA training Course in Health & Safety Methods in Handling Hazardous Materials, USA, Feb. 2010.

10 Hours OSHA Training Course in Construction Safety & Health, Feb. 2013.

Turbo Training in pursuing environmental remedial activities at hazardous sites in compliance with the New York City Mayor's Office of Environmental Remediation, Feb. 2015.

(a), (b), (c) Accredited US Educational Equivalence, *Globe Language Services, Inc*.

Appendix 10 Permits Required

Appendix 9

Permits Required

DOB

New Building
Builders Pavement Plan
SD1 & SD2
Electrical
Plumbing
Sprinkler
Sheeting and Shoring
Temp Electric

DOT

Street Crossing
Container
Lane Closure

Appendix 11 Estimated Remedial Costs

Track 2 – Estimated Remedial Cost

Task	Budget Cost/Range
- Waste Characterization Sampling and Analysis	$7,500
- Tank Removal and Closure	$9,000
- Air Monitoring/Geologist on-site	$8,250
- Supervision of excavation	$12,000
- Treatment of GW impact	35,000
- Post-excavation end point soil samples/DUSR	$12,000
- Implementation of a GW monitoring and sampling program	$60,000
- Supervision of installation of vapor barrier and active SSDS	$2,800
- Operation and Maintenance Plan for active SSDS	$5,500
- Disposal of 500 tons of soil/fill	$21,000
Total	173,000

Appendix 12   ISCO Injection Design Plan

11-28 31st Drive
QUEENS, NEW YORK
Block 502 Lot 22

IN SITU CHEMICAL OXIDANT DESIGN DOCUMENT

Prepared for:
Mr. George Man
11-28 31st Drive,
Queens, NY 11106

Prepared By:

AMC Engineering PLLC
38-20 32nd Street
Long Island City, NY 11101
Phone: (516) 417-8588

August 2016

CERTIFICATIONS

I, Ariel Czemerinski, certify that I am currently a NYS registered professional engineer and that this IN SITU CHEMICAL OXIDANT Design Document was prepared in accordance accepted engineering practices.

ARIEL CZEMERINSKI
076508

076508
NYS Professional Engineer #

9/2/216
Date

Signature

TABLE OF CONTENTS
IN SITU CHEMICAL OXIDANT DESIGN DOCUMENT
11-28 31st Drive, Queens

LIST OF FIGURES

ATTACHMENTS

1.0 SITE BACKGROUND

AMC Engineering, PLLC (AMC) has been retained by Mr. George Mann to conduct environmental remediation activities for a commercial property located 11-28 31st Drive in the Long Island City section of Queens (**Figure 1**). Site has formally entered into to the New York State Department of Environmental Conservation (NYSDEC) Brownfields Cleanup Program (BCP) and given Site Number C241159. The applicant has applied to this program as a Volunteer. The proposed future use of the Site will consist of residential use. The Site will be developed into 6-story building with slab on grade, plus stair/elevator and bulkhead.

The Site is 2,416.40-square feet and is bounded by 31st Drive to the north-northeast, a vacant land and a 1-story manufacturing building to the south-southwest, a 1-story cabinet manufacturing facility to the east-southeast and a vacant 1-story warehouse to the west-northwest. Currently, the Site is vacant and contains a 1-story building that was until most recently occupied by a manufacturing facility of wood cabinets

The Remedial Investigation (RI) conducted by Hydro Tech Environmental (HYDRO TECH) in July 2013 and subsequent monitoring activities on and offsite has revealed elevated levels of chlorinated volatile organic compounds (CVOCs), including tetrachloroethene (PCE) and trichloroethene (TCE), in soil gas above mitigation levels established within the State DOH soil vapor guidance matrix. TCE concentrations in soil gas ranged from 9.3 $\mu g/m^3$ to a high of 15 $\mu g/m^3$ onsite and 130 $\mu g/m^3$ offsite. PCE concentrations ranged from 140 $\mu g/m^3$ to 1600 $\mu g/m^3$ onsite and 1600 $\mu g/m^3$ offsite (see figure 4)

PCE, TCE and cis-1,2 Dichloroethylene (1,2 DCE) were also detected in groundwater samples obtained from one indoor and three outdoor monitoring wells. As depicted in Figure 4, MW3 resulted in 83 ug/L of PCE (2013) and 20.83 ug/L (2015); MW4 yielded 3799.83 ug/L of PCE, 17ug/L of TCE and 20 ug/L of 1,2 DCE; MW6 resulted in 85.83 ug/L of PCE, 8.9ug/L of TCE and 40 ug/L of 1,2 DCE. No other VOCs were detected.

Groundwater flow direction could not be thoroughly estimated, therefore there are injections wells located of both sides of the assumed source to account for uncertainty in the groundwater flow direction. NYSDEC has determined that an existing onsite UST in the NE area of the site is the source of groundwater contamination.

An IN SITU CHEMICAL OXIDANT (ISCO) system has been proposed as part of the remedy outlined in the approved Remedial Action Work Plan (RAWP), to reduce the potential risk of vapor intrusion. The ISCO system will be installed beneath the slab. The chemical oxidant will be injected into the subsurface to destroy the contaminants in the NE portion of the site, where the UST is located.

2.0 SITE DESCRIPTION AND HISTORY

1. Elevation of the property is approximately 11 feet.

2. Depth to groundwater ranges from 8.47 to 10.03 feet at the Site.

3. Depth to bedrock is in excess of 40 feet at the Site.

4. The stratigraphy of the site, from the surface down, consists of historic fill (sand with traces of pebbles, silt, and ash) at variable depths ranging in thickness from zero to 5 feet. The fill layer is underlain by clayey sand to variable depths ranging from 2 to 10 feet. This layer is underlain by granular soils to 40 feet.

5. Soil samples collected during the RI indicated that Pesticides and PCBs were not detected in any of the soil samples. Trace concentrations VOCs including acetone, methylene chloride and PCE (3.9 ppb) was detected in 1 of 3 shallow soil samples at the Site. No other VOCs were detected in any soil samples. Trace levels of several SVOC's were detected in shallow soil samples (maximum total SVOCs of 6.33 ppm). No SVOC compounds exceeded Unrestricted Use SCOs. Metals including copper (maximum of 54.6 mg/kg), lead (maximum of 191 mg/kg), zinc (maximum of 111 mg/kg), chromium trivalent (maximum of 37.2 mg/kg) and chromium Hexavalent (maximum of 1.47 mg/kg) were detected in shallow soil samples at concentrations that exceeded the Track 1 Unrestricted SCOs. No metals exceeded Restricted Residential SCOs. Metal concentrations in deeper soils were all below Track 1 Unrestricted Use SCOs. Data collected during the RI is sufficient to delineate the vertical and horizontal distribution of contaminants in soil/fill at the Site.

6. Groundwater samples collected during the RI showed two chlorinated VOC, including PCE (maximum of 83 ug/l) and chloroform (maximum of 4.7 ug/l), acetone (4 ug/l) and methylene chloride (4 ug/l) in 1 of 3 monitoring wells installed at the Site. Only PCE concentrations exceeded 6NYCRR Part 703.5 Class GA Groundwater Quality Standards (GQS). One SVOC, Di-n-butyl phthalate, which is a common laboratory contaminant, was detected in one sample at a concentration (11.2 ppb), below its GQS. No pesticides or PCBs were detected in groundwater samples. Two dissolved metals, Sodium and magnesium were detected in groundwater above their GQS..

7. Soil vapor samples collected during the RI showed a wide range of compounds throughout the property including BTEX and associated derivative compounds and chlorinated hydrocarbons. BTEX were found in all soil vapor samples and included a wide number of compounds. These

compounds were not identified in soil or groundwater on the property. PCE was detected in all vapor samples at concentrations of 140 ug/m3, 1,400 ug/m3 and 1,600 ug/m3. TCE was detected in 2 of 3 vapor samples at a concentration of 9.5 ug/m3 and 15 ug/m3. TCA and carbon tetrachloride was not detected in any sample. Other chlorinated hydrocarbon compounds included chloroform (18 ug/m3), methylene chloride (maximum 29 ug/m3) and acetone (maximum 900 ug/m3). PCE (NYSDOH AGV of 100 µg/m3) and TCE (AGV of 5 µg/m3) concentrations detected in soil vapor at the site are above the NYSDOH guidance matrix.

Based upon the review of the Fire Insurance Maps and Regulatory Agency documents from the Phase I Environmental Site Assessment (ESA) Report prepared by Hydro Tech in March 2013, the Site was utilized as an auto repair shop between 1934 and 1936, a machine shop between 1945 and 1970 and commercial facility between 1977 and 2006. Until most recently, the site was utilized as a manufacturing facility of wood cabinets and then became vacant during the last quarter of 2012.

3.0 IN SITU CHEMICAL OXIDANT SYSTEM DESCRIPTION

Remediation of chlorinated solvents present in groundwater will be accomplished through a chemical oxidant injection program. The proposed area of injection surrounds the UST in every direction given the uncertainty of groundwater flow. Injections at these locations will deliver oxidant to the subsurface allowing it to flow with groundwater, treating both residual contaminants in soil and the groundwater.

3.1 Chemical Oxidant Treatment of Soil Excavation Area

Dry sodium persulfate may be utilized to treat residual VOCs in soil which may remain following the excavation procedure and tank removal. Sodium persulfate and a chelated iron activator will be delivered to the site as a dry powder and applied directly to the open excavation at a ratio of 9 lbs of FeEDTA powder to each 55 lb bag of sodium persulfate. The amount of oxidant to be applied will be dependent on the size of the excavation and the degree of residual contamination remaining. It is anticipated that approximately 5-6 bags of persulfate will be applied in this situation. If application is on dry soil, it will then be wetted with water prior to backfilling. Wetting is not required if the material is applied on wet soil or at or below the water table.

Activated sodium persulfate will be broadcast directly into the open excavation or trench (as a dry powder) prior to backfilling. The activated sodium persulfate power will be thoroughly mixed into subsurface soil utilizing a mini excavator bucket.

3.2 Injections: Probe injection or Well Installation

Six injection wells have been proposed; they will be located in the proximity of the UST. Their location is depicted in figure 3, attached.

Injections will be done either via injection probe or through the installation of 1” PVC injection wells. Chemical oxidant will be applied from 8 ft below the water table to 2 ft above the water table. If injections are conducted through PVC wells, then No. 1 Morie gravel pack will be placed around the screen to a depth of approximately 1 ft above the screen followed by a 1 ft hydrated bentonite pellet seal. The injection wells will be finished at the surface with a 5-inch bold down manhole cover. In this case, and since remediation injection points for chemical oxidation are considered Class V UIC wells and are regulated through the USEPA UIC program, EPA will be notified of the construction of the injection well by filing form OMB No. 2040-0042 with the Region 1 USEPA office 30 days prior to performing any oxidant injection into oxidant injection wells.

If injections are done through an injection probe, then a small Geoprobe will be mobilized to the site and drive the injection point to 6 ft below water. An injection pump will inject the Klozur solution while slowly lifting the injection probe a total of 8 ft.

3.3 Oxidant Injection Events

The oxidant selected for this project is FeEDTA-activated sodium persulfate. Sodium persulfate is a robust oxidant which has a long residence time (anion lifetime) in the subsurface. Persulfate activation through iron provides fast contaminant reaction kinetics capable of destroying a wide range of organics including the petroleum VOCs present at the Site.

Sodium persulfate will be delivered to the site as a dry powder; it will be mixed with water on-site to provide a 9.3lb/gal solution. FeEDTA will be delivered to the site in 55 lb bags. The manufacturer’s instructions for using FeEDTA-activated Klozur are attached.

The initial injection will consist of approximately 34 gallons of activated persulfate solution per injection point. The need for subsequent injections and the number/ location of injection points to be utilized for subsequent injections will be determined following the collection and analysis of performance monitoring samples.

MW3 is located in the immediate vicinity of the UST. It is not anticipated that MW3 will be damaged during the UST removal process. There will be additional inspections of MW3 during and after tank removal to assess its usability. If MW3 is rendered unusable, a new monitoring well will be installed nearby the original location of MW3 in consultation with the DEC and remedial engineer.

3.4 Basis of Calculation

Stoichiometric relation for full oxidation of PCE is 3 pounds of persulfate per pound of PCE. Variable field conditions and presence of other parameters increases this amount. Attachment B contains the calculations and characteristics of the injected material. In designing the injection, we assume the impacted GW to contain 3.8 mg/L and the soil concentration 10.5 mg/Kg of PCE. It is assumed that the treatment zone is 500 $ft^2$and the thickness is 7 ft. Including an assumed 1 g Klozur per kg of soil, the calculated persulfate demand is 1,886 lb.

For activation, Peroxychem recommends a 200 ppm of Fe in groundwater. Based on the GW volume, 117 lbs of FeEDTA will be required. Attachment A contains additional information.

3.5 Pre- and post- injection control

Prior to commencement of injection activities, a round of sampling of groundwater will be conducted to establish background levels and be able to adjust the injected quantities based on these results. Samples will be obtained from MW1, MW2, MW3, MW4, MW5, and MW6.

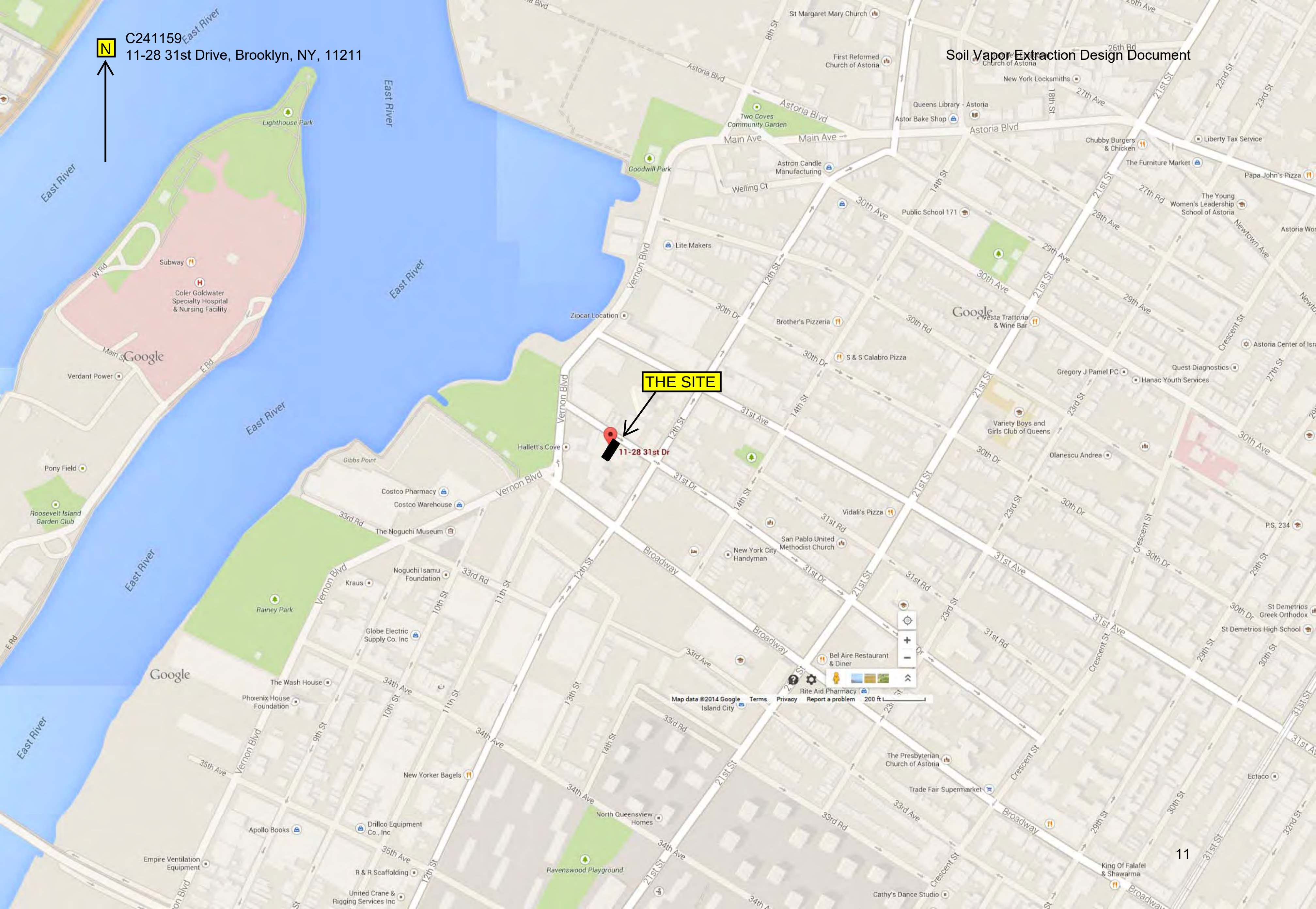
Another round of sampling will be conducted six and twelve weeks after the initial injection event; this will assess the effectiveness of remedial action. If these results show presence of PCE in exceedance of 5 ug/L, another round of injections will be conducted and the QC protocol as described herein repeated.

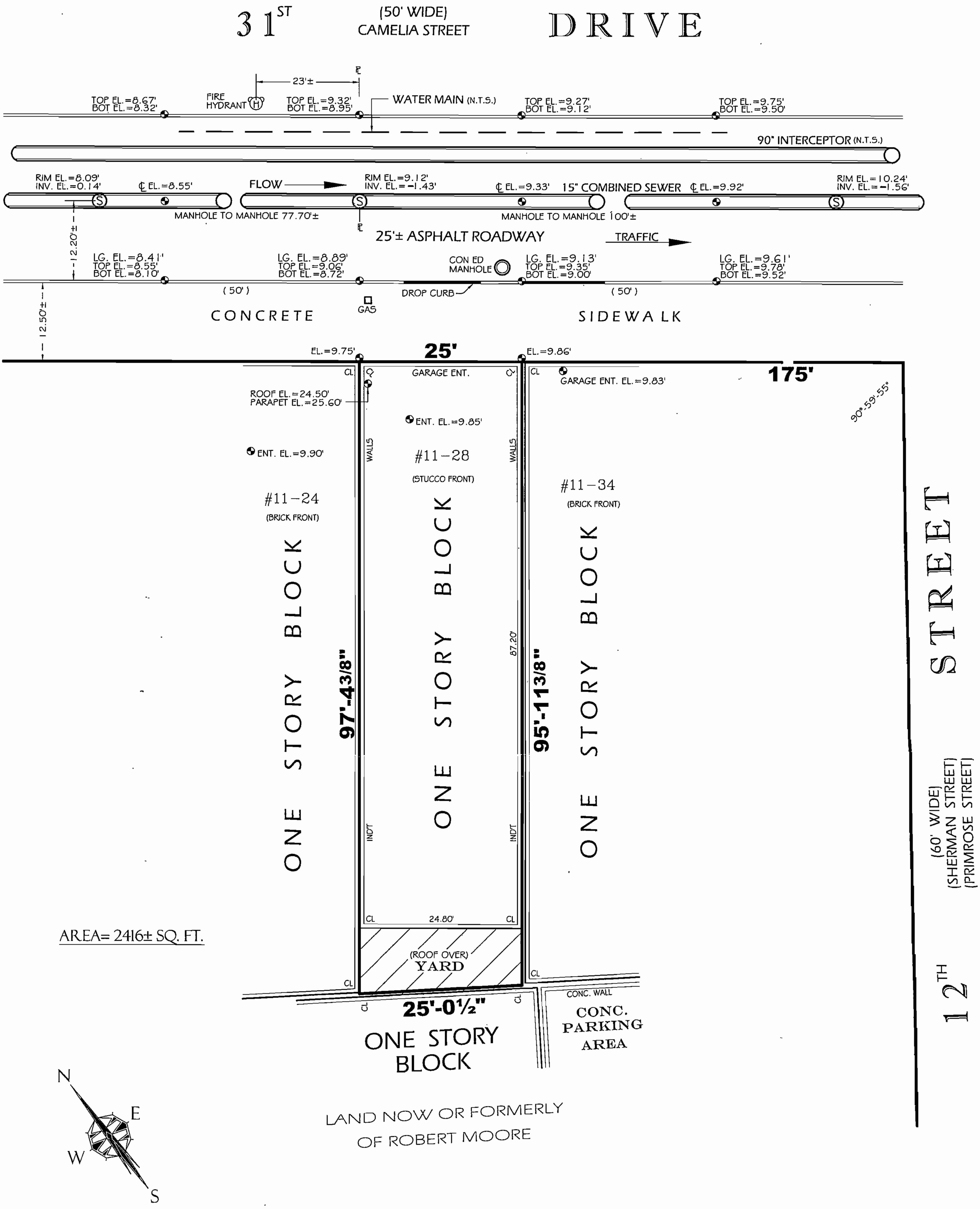
During sampling events subsequent to chemical injections, the groundwater will be analyzed to determine the amount of oxidant remaining. The manufacturer Peroxychem sells Klozur Persulfate Field Test Kits; the instruments rely on iron reactions with the persulfate oxidant. The test kit is considered a reliable measure of persulfate in the groundwater. The specifications are included in Appendix A.

Location of injection locations will be modified if, as a result of the sampling, it is established that the PCE concentrations are different than anticipated.

FIGURES

C241159
11-28 31st Drive, Brooklyn, NY, 11211





ARCHITECTURAL SURVEY

(NOT FOR TITLE PURPOSES)
(NOT TO BE USED FOR THE STAKEOUT OF STRUCTURES.)

CAUTION: BEFORE PERFORMING ANY DIGGING OR DRILLING ON THIS SITE, IT IS REQUIRED THAT SUBSURFACE SERVICES, INCLUDING THE UNDERGROUND MAINS BE MARKED AND IDENTIFIED BY THE UTILITY INVOLVED IN COMPLIANCE WITH INDUSTRIAL CODE 53 OF NEW YORK STATE.

1)ALL ELEVATIONS REFER TO QUEENS TOPOGRAPHICAL DATUM WHICH IS 2.725 FEET ABOVE U.S. COASTAL & GEODETIC SURVEY DATUM AT SANDY HOOK NEW JERSEY.

2)UNDERGROUND UTILITY INFORMATION SHOWN WAS OBTAINED FROM VARIOUS COMPANIES AND CITY AGENCIES AND IS NOT GUARANTEED FOR ACCURACY OR COMPLETENESS. CONSULT CONSOLIDATED EDISON COMPANY AND KEYSPAN FOR DETAILED INFORMATION ON THEIR RESPECTIVE SERVICES.

3)THIS IS TO CERTIFY THAT THERE ARE NO APPARENT STREAMS NOR NATURAL WATER COURSES IN THE PROPERTY AS SHOWN ON THIS SURVEY.

SCALE: 1"=15"

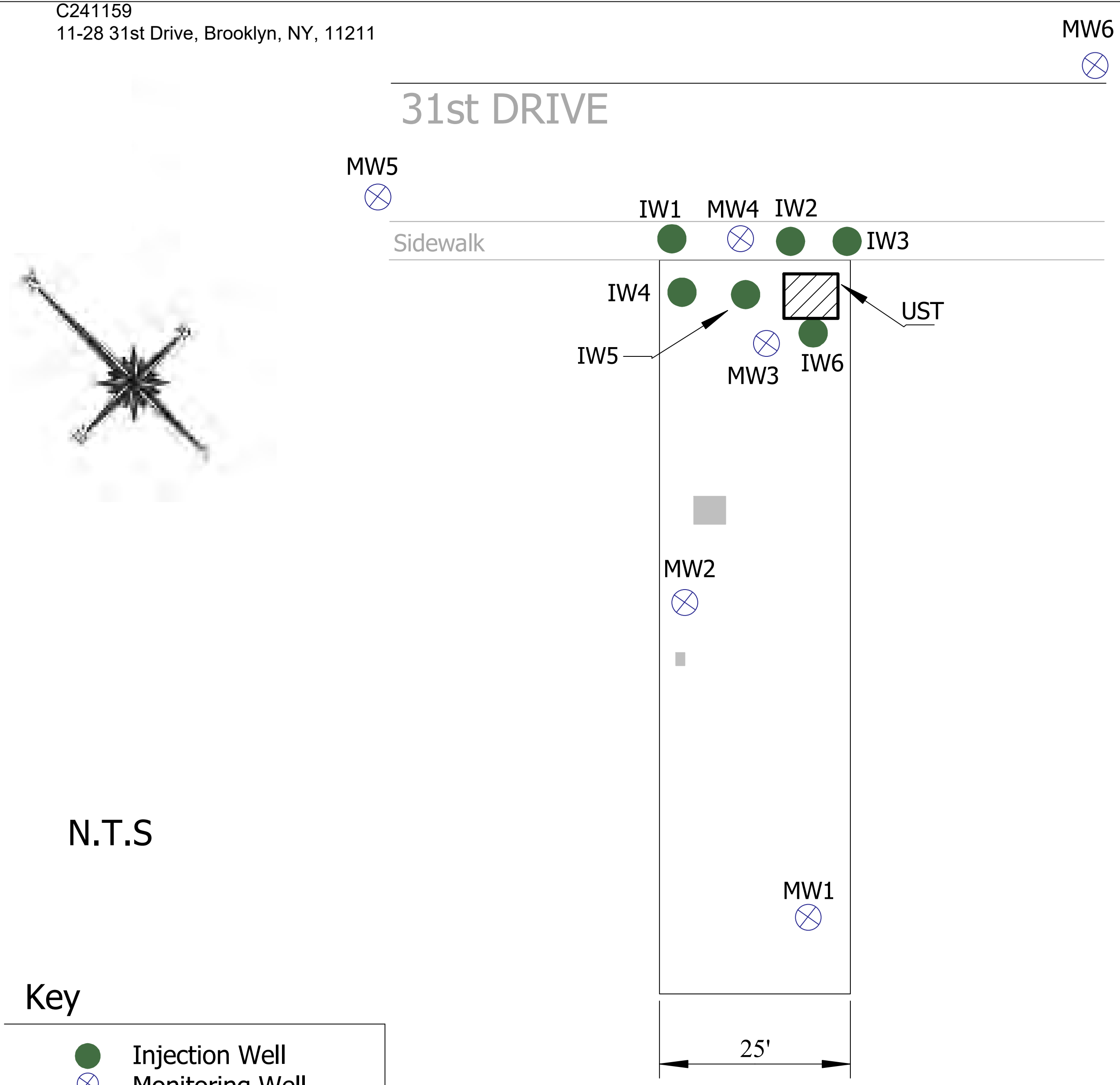
UNAUTHORIZED ALTERATIONS OR ADDITIONS TO THIS SURVEY IS A VIOLATION OF SECTION 7209 OF THE NEW YORK STATE EDUCATION LAW. COPIES OF THIS SURVEY MAP NOT BEARING THE LAND SURVEYOR'S INKED SEAL OR EMBOSSED SEAL SHALL NOT BE CONSIDERED TO BE A VALID TRUE COPY. GUARANTEES OR CERTIFICATIONS INDICATED HEREON SHALL RUN ONLY TO THE PERSON FOR WHOM THE SURVEY IS PREPARED, AND ON HIS BEHALF TO THE TITLE COMPANY, GOVERNMENTAL AGENCY AND LENDING INSTITUTION LISTED HEREON, AND TO THE ASSIGNEES OF THE LENDING INSTITUTION. GUARANTEES OR CERTIFICATION ARE NOT TRANSFERABLE TO ADDITIONAL INSTITUTIONS OR SUBSEQUENT OWNERS.

BLOCK: 502
LOT: 22
SECTION: 4
COUNTY: *QUEENS*
DWG BY: P.S.
CHK'D BY:

SURVEYED
NOVEMBER 9, 2012

VINCENT J. DICCE L.S.,Pres.

BORO LAND SURVEYING, P.C.
353 COURT STREET
BROOKLYN, N.Y. 11231
TEL. (718) 624-BORO (2676)



N.T.S

Key

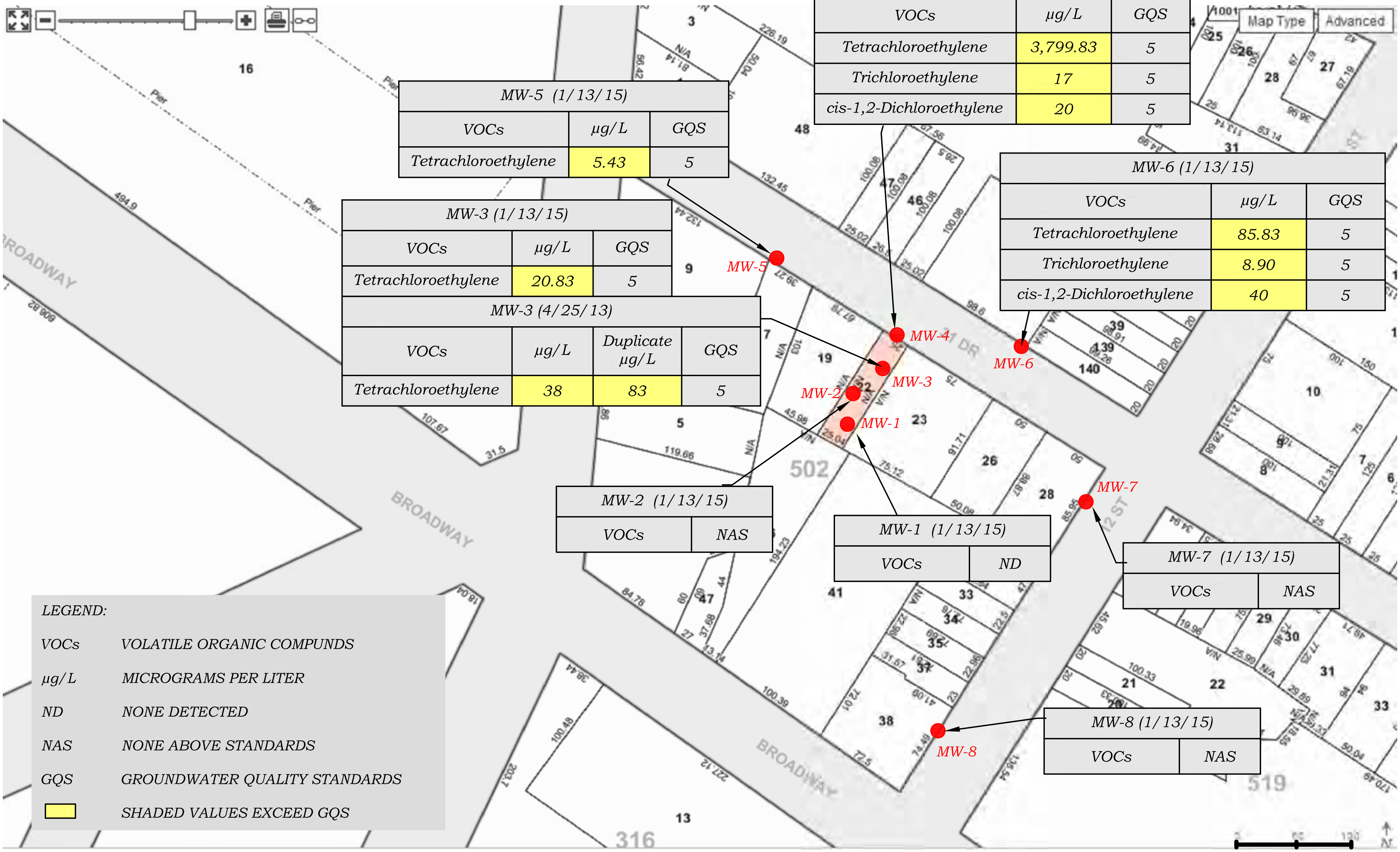
● Injection Well
⊗ Monitoring Well
▨ UST
■ Other Obstructions

AMC ENGINEERING PLLC
38-20 32nd Street, Unit 102
Long Island City, NY 11101
Office: 516-417-8588

PROJECT
39-40 30th Street
Long Island City, NY 11101

DATE: AUG 31, 2016
DRAWING BY: AC

Fig 3: Well Locations



MW-4 (1/13/15)

VOCs	µg/L	GQS
Tetrachloroethylene	3,799.83	5
Trichloroethylene	17	5
cis-1,2-Dichloroethylene	20	5

MW-5 (1/13/15)

VOCs	µg/L	GQS
Tetrachloroethylene	5.43	5

MW-3 (1/13/15)

VOCs	µg/L	GQS
Tetrachloroethylene	20.83	5

MW-3 (4/25/13)

VOCs	µg/L	Duplicate µg/L	GQS
Tetrachloroethylene	38	83	5

MW-6 (1/13/15)

VOCs	µg/L	GQS
Tetrachloroethylene	85.83	5
Trichloroethylene	8.90	5
cis-1,2-Dichloroethylene	40	5

MW-2 (1/13/15)

VOCs	NAS

MW-1 (1/13/15)

VOCs	ND

MW-7 (1/13/15)

VOCs	NAS

MW-8 (1/13/15)

VOCs	NAS

LEGEND:

VOCs	VOLATILE ORGANIC COMPUNDS
µg/L	MICROGRAMS PER LITER
ND	NONE DETECTED
NAS	NONE ABOVE STANDARDS
GQS	GROUNDWATER QUALITY STANDARDS
🟨	SHADED VALUES EXCEED GQS

HYDRO TECH ENVIRONMENTAL CORP.

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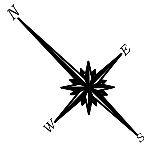
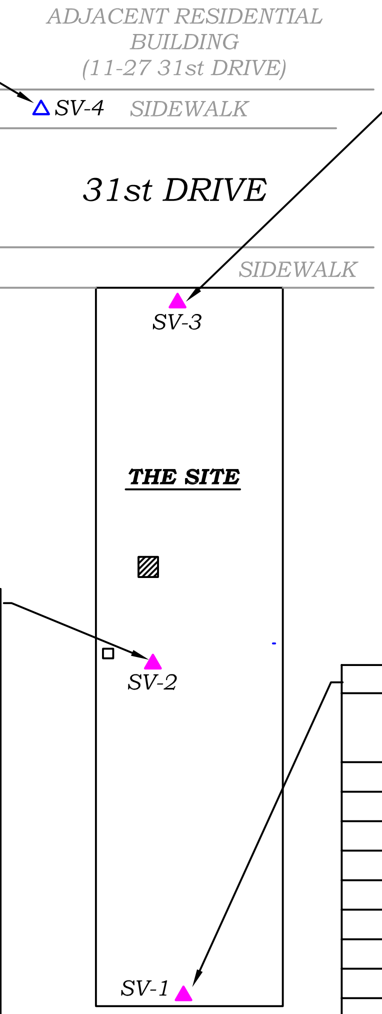
11-28 31st Drive
Long Island City, NY
HTE Job# 120029

Drawn By: C.Q.
Reviewed By: M.R
Approved By: M.R
Date: 07/09/14
Scale: AS NOTED

TITLE:

FIGURE 4 SPIDER MAP OF PCE AND ITS DERIVATIVES IN EXCEEDANCES IN GROUNDWATER





SV-4

VOCs	µg/m³
1,2,4-Trimethylbenzene	18
Ethyl Benzene	10
Benzene	14
n-Heptane	8.1
n-Hexane	30
o-Xylene	13
p- & m- Xylenes	45
Toluene	46
Isopropanol	20
2-Butanone	17
Carbon disulfide	41
Acetone	91
Methylene chloride	23
Tetrachloroethylene	1,600
Trichloroethylene	130

SV-3

VOCs	µg/m³
1,2,4-Trimethylbenzene	29
Toluene	22
Ethyl Benzene	9.8
n-Heptane	32
o-Xylene	12
p- & m- Xylenes	41
Cyclohexane	44
Carbon disulfide	7.0
Isopropanol	79
Tetrahydrofuran	20
Acetone	82
Chloroform	18
Methylene chloride	9.4
Tetrachloroethylene	1,400
Trichloroethylene	15

SV-2

VOCs	µg/m³
1,2,4-Trimethylbenzene	35
Toluene	33
Ethyl Benzene	12
n-Heptane	55
o-Xylene	15
p- & m- Xylenes	50
2-Butanone	15
Carbon disulfide	8.4
Isopropanol	210
Tetrahydrofuran	25
Acetone	520
Methylene chloride	29
Tetrachloroethylene	1,600
Trichloroethylene	9.3

SV-1

VOCs	µg/m³
Toluene	48
Ethyl Benzene	10
n-Heptane	820
n-Hexane	9.0
o-Xylene	14
p- & m- Xylenes	43
2-Butanone	40
Ethyl acetate	230
Isopropanol	2,200
Tetrahydrofuran	23
Acetone	90
Methylene chloride	17
Tetrachloroethylene	140

LEGEND:

▲	SOIL VAPOR SAMPLE (SV) - COLLECTED ON APRIL 25, 2013
△	SOIL VAPOR SAMPLE (SV) - COLLECTED ON JULY 8, 2013
µg/m³	MICROGRAMS PER CUBIC METER
VOC	VOLATILE ORGANIC COMPOUNDS

0' 20' 40'
SCALE IN FEET (FT.)

HYDRO TECH ENVIRONMENTAL CORP.

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11-28 31st Drive
Long Island City, NY
HTE Job# 120029

Drawn By: C.O.
Reviewed By: M.R
Approved By: M.R
Date: 08/14/13
Scale: AS NOTED

TITLE:

FIGURE 5 SPIDER MAP OF SOIL VAPOR DATA

ATTACHMENT A
ISCO Specifications

Environmental
Solutions

KLOZUR® PERSULFATE
In Situ Chemical Oxidation

Product Sheet

The Field Proven and Versatile ISCO Solution to Address Soil & Groundwater Contamination

Klozur® persulfate is the oxidant of choice for *in situ* chemical oxidation (ISCO), because of its ability to treat a wide range of contaminants including chlorinated solvents, petroleum and PAHs. Klozur persulfate is ideal for contaminated source zones and hot spots that require rapid treatment. When properly activated, Klozur persulfate provides an unmatched combination of oxidative power, versatility, and control that can be delivered both safely and cost effectively.

Successful field applications of Klozur activated persulfate have been performed globally. These applications demonstrate the ability of Klozur activated persulfate to treat diverse organic contaminants of concern including: chlorinated ethenes (TCE, PCE, DCE and vinyl chloride), chlorinated ethanes (TCA and DCA), chlorinated methanes (carbon tetrachloride and methylene chloride), BTEX, MTBE, polyaromatic hydrocarbons (PAHs), petroleum hydrocarbons (TPHs, GRO, DRO), 1,4-dioxane and pesticides.

The benefits of Klozur Persulfate

When used with PeroxyChem's proprietary activation methods, Klozur persulfate provides a powerful multi-radical attack for the rapid destruction of recalcitrant compounds.

$$S_2O_8^{-2} + \text{Activator} \rightarrow SO_4\bullet^{-},\ OH\bullet^{-}$$

Multiple activation options and methods of delivery provide for a flexible and custom solution based on site conditions. With a solubility limit of up to 40 wt%, Klozur can be applied as a fully soluble solution. Klozur persulfate is a remarkable stable oxidant given its high oxidation potential, with a typical active lifetime in the subsurface of 3-6 months, providing an extended radius of influence. Klozur persulfate is safe to handle with PeroxyChem's recommended use guidelines; does not generate heat or gas.

Examples of Contaminants of Concern
CHLORINATED SOLVENTS PCE, TCE, DCE, VC, TCA, DCA, Methylene Chloride, Carbon Tetrachloride, Chlorobenzene
PETROLEUM TPH, BTEX, DRO, GRO
PAHs Creosote, MGP residuals 1,4-dioxane, MTBE, TBA, energetics, Chlorinated pesticides

The sound science of Klozur Activated Persuflate

Klozur activated persulfate has a long history of documented success. Site and laborortory data prove successful treatment of some of the most recalcitrant compounds, such as chlorinated ethanes, and emerging contaminants, such as 1,4-dioxane and PFOS/PFOA.

Application methods

- Direct push injection
- Fixed well injection
- Soil blending

PeroxyChem

Document 02-01-ESD-14

Measurement of Persulfate in Solution

The determination of persulfate concentration in groundwater post *in situ* application is critical in determining parameters such as the persulfate radius of influence (ROI) achieved and the residence time of the persulfate in the contaminated zone. In general, measurement of persulfate concentration in the field is problematic. Metals, either native to the soil or added for persulfate activation, may interfere with various persulfate analytical methods, yielding variable, inaccurate or misleading results. In addition, some methods, which may be suitable for the laboratory, may not be suitable for field application due to the need of sensitive or expensive detection equipment. In this edition of *Peroxygen Talk*, the measurement of persulfate in ground water is explored. A more detailed review, including comparisons between various persulfate analytical methods, can be found in Reference 1.

Analytical Methods Involving Persulfate – Iron Reactions

Persulfate anion will oxidize divalent iron [Fe(II)] to form trivalent iron [Fe(III)] in the reaction:

$S_2O_8^{-2} + 2\ Fe^{+2} \rightarrow 2\ Fe^{+3} + 2\ SO_4^{-2}$ Equation 1

Quantitative determination of persulfate concentration can be achieved by first adding in excess a known amount of Fe (II) to the persulfate solution. A portion of the Fe(II) is then converted to Fe(III) via Equation 1. The remaining Fe (II) is then titrated with either a known concentration of potassium permanganate [$KMnO_4$]to a pink end-point or ceric sulfate [$Ce(SO_4)_2$] to a Ferroin indicator end-point (a color change from orange to clear or light blue). As an example, for permanganate:

$MnO_4^- + 5\ Fe^{+2} + 8\ H^+ \rightarrow Mn^{+2} + 5\ Fe^{+3} + 4\ H_2O$ Equation 2

Using the volume of permanganate or ceric sulfate needed to reach the endpoint (which occurs when all of the remaining Fe (II) is oxidized), allows for the determination of how much persulfate was originally present :

Fe (II) reacted with persulfate = Fe (II) total – Fe (II) reacted with permanganate Equation 3

then:

Moles of persulfate = moles of Fe (II) reacted with persulfate / 2 Equation 4

As this method is dependent upon a known quantity of Fe (II) in the test solution, naturally occurring iron and other reduced metals and residual contaminant that may react with the permanganate or cerric sulfate, in the groundwater can significantly impact the quantification of the persulfate concentration. Also, additives such as chelates, as when using chelated metal activation for persulfate, may cause interference with the titration. For example, Fe(III)-EDTA will interfere with the permanganate titration, but not so with the ceric sulfate titration. Addition of other oxidants, such as hydrogen peroxide likewise will impact the accuracy of the method, as additional oxidant will also oxidize the Fe(II), making it difficult to determine the persulfate contribution. For hydrogen peroxide – persulfate combinations, it is possible to react the peroxide with ceric sulfate first, to a Ferroin end-point, as the ceric sulfate will preferentially react with hydrogen peroxide over persulfate. When the end-point is reached, the hydrogen peroxide will have been consumed (which will also give a quantifiable measurement of the peroxide in solution). Then the permanganate or ceric sulfate back-titration of Fe (II) can be utilized to quantify the remaining persulfate. The above titration method can provide a very accurate measurement of persulfate in solution. But typically it is only applicable in a laboratory, due to the instrumentation and chemicals required.

Application in the field

We have developed an easy-to-use, onsite titration kit for the measurement of persulfate in groundwater that addresses the limitations mentioned above, the new Klozur® Persulfate Field Test Kits. Two kits are currently available, one for use when activating Klozur persulfate with either high pH or with iron sulfate, and a second kit for use when activating Klozur persulfate with chelated iron. If hydrogen peroxide is being used as the activator, please contact us for additional support.

Iodiometric Methods

Persulfate anion will react with potassium iodide as:

$S_2O_8^{-2} + 2\ I^- \rightarrow 2\ SO_4^{-2} + I_2$ Equation 5

I_2 forms a brown color. In the laboratory, this method can be made quantitative by titrating the resulting solution with thiosulfate, reducing the I_2 back to I^-, the end-point identified by the disappearance of the brown color. This can be enhanced by the addition of starch, which will form an intense blue complex with I_2 in the presence of I^-. Disappearance of the blue color indicates the end-point when I^- has been consumed. This method will have less interference from native metals as compared to the persulfate - iron method described above. However, accuracy will be affected by the instability of I_2 and the sensitivity of the reaction to the timing of the addition of the starch indicator.

Application in the field

The presence of persulfate can be qualitatively assessed by looking for a color change when starch is added to a solution of the groundwater and potassium iodide. If persulfate is present, a blue color will appear. However, instability of thiosulfate solutions, oxidation of I^- by air and sunlight and the sensitivity of the end-point on the addition timing of the starch limit the use of this method as a *quantitative* assessment tool in the field for persulfate concentration.

Spectroscopic Methods

Huang, et al[2] developed a laboratory spectroscopic method for the quantification of persulfate. The method is based on the oxidation of Fe(II) by persulfate to Fe(III). The Fe (III) is then complexed with thiocyanate (SCN^-), which forms an intense red color. A spectrophotometer is then used to determine the concentration of the iron - thiocyanate complex as a function of absorbance at a wavelength of 450 nm. As this method is dependent upon Equation 1, it is subject to the same interferences from background iron concentrations and chelating agents as described for the persulfate – iron methods.

Several other spectroscopic methods have been developed for persulfate as well. These have been reported in reference 1 and by Williams[3]. In general, spectroscopic methods can obtain a high degree of quantification in a laboratory setting. However, the applicability to use in the field is somewhat limited due to the need of spectrophotometers. These methods may be suitable to mobile field labs equipped with the appropriate devices.

Novel Techniques for Future Development

Gillian[1], in work supported by Arcadis, developed a couple of new spectroscopic methods for the analytical determination of persulfate concentration. One of these includes the use of indole as a reactant with persulfate, forming a distinctive blue-colored compound. A second method utilizes the reaction of persulfate with promethazine-HCL, which forms a red-colored compound. Gillian[1] reports that in particular, the promethazine-HCL procedure has potential to be developed into a field test method, provided that iron concentrations in the groundwater are not high. Rossabi[4] et al described a novel approach to using ion chromatography to measure aqueous persulfate concentrations, and reported a measurement range of 0 – 500 mg persulfate / liter.

Other Field Measurement Methods

There are commercially available persulfate test kits on the market. These are predominately based on the permanganate back-titration of Fe (II), Equation 1, which relies on matching a shade of purple to a subsequent persulfate concentration. Such kits can have significant interference from native groundwater iron or residual contaminant. In addition, these kits can be too sensitive in that they may indicate the presence of persulfate into the mg / L range, far below the effective persulfate dosing for most contaminated sites.

Secondary parameters, such as conductivity and sulfate concentration can be used to monitor the effective movement of persulfate in the subsurface. Persulfate injection will significantly increase the conductance of groundwater due to the increase in ion concentrations. Down-well conductivity probes and direct-push rod probes have been used successfully to determine the presence of persulfate in groundwater. Commercially available sulfate concentration kits have also been used to determine the presence of persulfate in down-gradient monitoring wells, as persulfate is consumed through reaction, it generates sulfate. Dissolved oxygen, ORP and pH measurement can also be used to track persulfate in the subsurface through its impact on groundwater parameters.

1. Lai, Gillian. “Development of Analytical Methods for Estimation of Oxidants Concentrations”. Master’s thesis, Imperial College, London, September, 2007.

2. Huang, K.C., Couttenye, R.A. and Hoag, G.E. “Kinetics of heat-assisted persulfate oxidation of methyl terty-butyl ether (MTEBE)”. **Chemosphere** 49, p 413-420, 2002.

3. Williams, W. J. **Handbook of Anion Determination**. 1979, London, Butterworths.

4. Rossabi, J. and B. Fassolt. “Ion Chromotography for Persulfate and Total Oxidant Demand Analysis”. 1st Annual Southeastern *In Situ* Soil and Groundwater Remediation Conference, Raleigh, NC 2007.

The content in this document was originally published in Peroxygen Talk dated August 2010.

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.

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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)

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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.

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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

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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.

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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

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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.

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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.

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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.

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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_2O=1)
VAPOR DENSITY:	Not applicable (Air = 1)
VAPOR PRESSURE:	Not applicable

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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 LD_{50}: > 10 g/kg [FMC Study Number: ICG/T-79.029]

ORAL LD_{50}: 895 mg/kg (rat) [FMC Study Number: ICG/T-79.029]

INHALATION LC_{50}: 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

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12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION:

Bluegill sunfish, 96-hour LC_{50} = 771 mg/L [FMC Study I92-1250]
Rainbow trout, 96-hour LC_{50} = 163 mg/L [FMC Study I92-1251]
Daphnia, 48-hour LC_{50} = 133 mg/L [FMC Study I92-1252]
Grass shrimp, 96-hour LC_{50} = 519 mg/L [FMC Study I92-1253]

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

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13. DISPOSAL CONSIDERATIONS

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

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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.

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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)

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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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Type or print all information. See reverse for instructions.

OMB No. 2040-0042 Approval Expires 12/31/2011

INVENTORY OF INJECTION WELLS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF GROUND WATER AND DRINKING WATER

(This information is collected under the authority of the Safe Drinking Water Act)

1. DATE PREPARED *(Year, Month, Day)*

2. FACILITY ID NUMBER

PAPERWORK REDUCTION ACT NOTICE

The public reporting burden for this collection of information is estimated at about 0.5 hour per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, Director, Collection Strategies Division (2822), U.S. Environmental Protection Agency, 1200 Pennsylvania Avenue, NW, Washington, DC 20460, and to the Office of Management and Budget, Paperwork Reduction Project, Washington, DC 20503.

3. TRANSACTION TYPE *(Please mark one of the following)*

☐ Deletion ☐ First Time Entry
☐ Entry Change ☐ Replacement

4. FACILITY NAME AND LOCATION

A. NAME *(last, first, and middle initial)*

B. STREET ADDRESS/ROUTE NUMBER

C. LATITUDE

DEG	MIN	SEC
		.

D. LONGITUDE

DEG	MIN	SEC
		.

E. TOWNSHIP/RANGE

TOWNSHIP	RANGE	SECT	1/4 SECT

F. CITY/TOWN

G. STATE

H. ZIP CODE

I. NUMERIC COUNTY CODE

J. INDIAN LAND *(mark "x")* ☐ Yes ☐ No

5. LEGAL CONTACT:

A. TYPE *(mark "x")*

☐ Owner ☐ Operator

B. NAME *(last, first, and middle initial)*

C. PHONE *(area code and number)*

D. ORGANIZATION

E. STREET/P.O. BOX

F. CITY/TOWN

G. STATE

H. ZIP CODE

I. OWNERSHIP *(mark "x")*

☐ PRIVATE ☐ PUBLIC ☐ SPECIFY OTHER
☐ STATE ☐ FEDERAL

6. WELL INFORMATION:

A. CLASS AND TYPE		B. NUMBER OF WELLS		C. TOTAL NUMBER OF WELLS	D. WELL OPERATION STATUS				
		COMM	NON-COMM		UC	AC	TA	PA	AN
				0					
				0					
				0					
				0					
				0					
				0					
				0					

COMMENTS *(Optional):*

KEY:

DEG = Degree
MIN = Minute
SEC = Second

SECT = Section
1/4 SECT = Quarter Section

COMM = Commercial
NON-COMM = Non-Commercial

AC = Active
UC = Under Construction
TA = Temporarily Abandoned
PA = Permanently Abandoned and Approved by State
AN = Permanently Abandoned and not Approved by State

EPA Form 7520-16 (Rev. 12-08)

SECTION 1. DATE PREPARED: Enter date in order of year, month, and day.

SECTION 2. FACILITY ID NUMBER: In the first two spaces, insert the appropriate U.S. Postal Service State Code. In the third space, insert one of the following one letter alphabetic identifiers:

D - DUNS Number,
G - GSA Number, or
S - State Facility Number.

In the remaining spaces, insert the appropriate nine digit DUNS, GSA, or State Facility Number. For example, A Federal facility (GSA - 123456789) located in Virginia would be entered as : VAG123456789.

SECTION 3. TRANSACTION TYPE: Place an "x" in the applicable box. See below for further instructions.

Deletion. Fill in the Facility ID Number.
First Time Entry. Fill in all the appropriate information.
Entry Change. Fill in the Facility ID Number and the information that has changed.
Replacement.

SECTION 4. FACILITY NAME AND LOCATION:

A. **Name.** Fill in the facility's official or legal name.
B. **Street Address.** Self Explanatory.
C. **Latitude.** Enter the facility's latitude (all latitudes assume North Except for American Samoa).
D. **Longitude.** Enter the facility's longitude (all longitudes assume West except Guam).
E. **Township/Range.** Fill in the complete township and range. The first 3 spaces are numerical and the fourth is a letter (N,S,E,W) specifying a compass direction. A township is North or South of the baseline, and a range is East or West of the principal meridian (e.g., 132N, 343W).
F. **City/Town.** Self Explanatory.
G. **State.** Insert the U.S. Postal Service State abbreviation.
H. **Zip Code.** Insert the five digit zip code plus any extension.

SECTION 4. FACILITY NAME & LOCATION (CONT'D.):

I. **Numeric County Code.** Insert the numeric county code from the Federal Information Processing Standards Publication (FIPS Pub 6-1) June 15, 1970, U.S. Department of Commerce, National Bureau of Standards. For Alaska, use the Census Division Code developed by the U.S. Census Bureau.
J. **Indian Land.** Mark an "x" in the appropriate box (Yes or No) to indicate if the facility is located on Indian land.

SECTION 5. LEGAL CONTACT:

A. **Type.** Mark an "x" in the appropriate box to indicate the type of legal contact (Owner or Operator). For wells operated by lease, the operator is the legal contact.
B. **Name.** Self Explanatory.
C. **Phone.** Self Explanatory.
D. **Organization.** If the legal contact is an individual, give the name of the business organization to expedite mail distribution.
E. **Street/P.O. Box.** Self Explanatory.
F. **City/Town.** Self Explanatory.
G. **State.** Insert the U.S. Postal Service State abbreviation.
H. **Zip Code.** Insert the five digit zip code plus any extension.
I. **Ownership.** Place an "x" in the appropriate box to indicate ownership status.

SECTION 6. WELL INFORMATION:

A. **Class and Type.** Fill in the Class and Type of injection wells located at the listed facility. Use the most pertinent code (specified below) to accurately describe each type of injection well. For example, 2R for a Class II Enhanced Recovery Well, or 3M for a Class III Solution Mining Well, etc.
B. **Number of Commercial and Non-Commercial Wells.** Enter the total number of commercial and non-commercial wells for each Class/Type, as applicable.
C. **Total Number of Wells.** Enter the total number of injection wells for each specified Class/Type.
D. **Well Operation Status.** Enter the number of wells for each Class/Type under each operation status (see key on other side).

CLASS I Industrial, Municipal, and Radioactive Waste Disposal Wells used to inject waste below the lowermost Underground Source of Drinking Water (USDW).

TYPE	**1I**	Non-Hazardous Industrial Disposal Well.
	1M	Non-Hazardous Municipal Disposal Well.
	1H	Hazardous Waste Disposal Well injecting below the lowermost USDW.
	1R	Radioactive Waste Disposal Well.
	1X	Other Class I Wells.

CLASS II Oil and Gas Production and Storage Related Injection Wells.

TYPE	**2A**	Annular Disposal Well.
	2D	Produced Fluid Disposal Well.
	2H	Hydrocarbon Storage Well.
	2R	Enhanced Recovery Well.
	2X	Other Class II Wells.

CLASS III Special Process Injection Wells.

TYPE	**3G**	*In Situ* Gasification Well
	3M	Solution Mining Well.

CLASS III (CONT'D.)

TYPE	**3S**	Sulfur Mining Well by Frasch Process.
	3T	Geothermal Well.
	3U	Uranium Mining Well.
	3X	Other Class III Wells.

CLASS IV Wells that inject hazardous waste into/above USDWs.

TYPE	**4H**	Hazardous Facility Injection Well.
	4R	Remediation Well at RCRA or CERCLA site.

CLASS V Any Underground Injection Well not included in Classes I through IV.

TYPE	**5A**	Industrial Well.
	5B	Beneficial Use Well.
	5C	Fluid Return Well.
	5D	Sewage Treatment Effluent Well.
	5E	Cesspools (non-domestic).
	5F	Septic Systems.
	5G	Experimental Technology Well.
	5H	Drainage Well.
	5I	Mine Backfill Well.
	5J	Waste Discharge Well.

PAPERWORK REDUCTION ACT The public reporting and record keeping burden for this collection of information is estimated to average 0.5 hours per response. Burden means the total time, effort, or financial resource expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal Agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to the collection of information; search data sources; complete and review the collection of information; and, transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments on the Agency’s need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including the use of automated collection techniques to Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822), 1200 Pennsylvania Ave., NW., Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed forms to this address.

Activating Klozur® Persulfate with Iron-EDTA

BACKGROUND

Klozur® Persulfate can be activated with iron–EDTA (FeEDTA), a chelated iron, for the oxidative destruction of organic contaminants of concern, including PCE, TCE, DCE, vinyl chloride, BTEX, low molecular weight aromatic hydrocarbons, methyl-tert-butyl ether (MTBE), 1,4-dioxane, and others.

For the FeEDTA activation of Klozur Persulfate, the iron concentration in the groundwater needs to be maintained between 150 mg / L (ppm) and 600 mg / L (ppm). Iron concentrations below 150 ppm will result in kinetics that may not be favorable for the oxidation of various contaminants, and concentrations in excess of 600 ppm may lead to increased persulfate decomposition. FeEDTA is 13% iron by weight, thus requiring between 1,154 ppm and 4,615 ppm FeEDTA to maintain the desired groundwater iron concentrations.

PeroxyChem recommends the addition of FeEDTA as an activator when iron activation is selected, even if there is iron already present in the subsurface. Measured iron concentrations present in soils may not be available for persulfate activation or the iron may not be distributed evenly enough through the treatment zone to insure adequate activation of the persulfate.

SAFETY AND HANDLING

FeEDTA is a yellowish-green powder with slight health hazards. Appropriate Personal Protective Equipment (PPE), including chemical goggles and a respirator for dust is required when handling this product.

Review the Safety Data Sheets (SDS) with all workers prior to use and follow guidance within the SDS when handling FeEDTA.

PeroxyChem does not recommend combining FeEDTA with persulfate in the same batching tank, as persulfate decomposition may occur with subsequent generation of heat and oxidant loss.

PeroxyChem recommends the use of separate batch tanks to make up the persulfate solution and the FeEDTA solution. The solutions may then be mixed inline prior to the well-head and co-injected or injected separately in a serial fashion.

DETERMINING THE AMOUNT OF ACTIVATOR NEEDED

1. Determine the volume of groundwater to be treated with FeEDTA activated persulfate.
2. The minimum amount of FeEDTA needed to achieve 150 ppm of Fe in the groundwater can be determined by:

$$\boxed{\text{Lbs FeEDTA} = \text{\# gallons of groundwater} * 150 * 6.38 \times 10^{-5}}$$

At room temperature (20 C), FeEDTA is soluble up to a concentration of 90 g/L (0.75 lb/gallon).

Attachment B
Injection Calculations

Klozur® Activated Persulfate Demand Calculations

25-Apr-2016

Customer:	**AMC Engineering**	**Prepared by:**
Contact:	**Ariel Czemerinski**	**Ravi Srirangam PhD**
Site Location:	**Queens, NY**	**1-312-480-5250**
Proposal Number:	**PeroxyChem Proposal-19279**	**Ravi.Srirangam@peroxychem.com**

PRODUCT OVERVIEW

Klozur® Activated Persulfate has been delivered safely and cost effectively to treat a wide variety of common contaminants of concern with an unmatched combination of power and control. With proper activation, Klozur activated persulfate can generate oxidative, reductive and nucleophilic pathways, giving Klozur Persulfate the power to destroy the most recalcitrant of contaminants.

For more information on Klozur Activated Persulfate, please contact your PeroxyChem representative or www.klozur.com.

SITE INFORMATION

	Value	Unit	Note
Area of Treatment	500	ft2	customer supplied
Treatment Zone Thickness	7	ft	customer supplied
Treatment Volume	3,500	ft3	calculated value
Porosity	35	%	default value
Ground Water Volume	9,162	USG	calculated value
Soil Density	110	lbs/ft3	default value
Soil Mass	385,000	lb	calculated value
Fraction Soil Mass Contacted*	100	%	default value
Base Buffering Capacity (Alkaline Activation only)	3	g 25 percent NaOH / kg soil	estimated value, it is recommend that this be analytically determined
Soil Oxidant Demand	1	g Klozur / kg soil	estimated value, it is recommend that this be analytically determined

* Fraction soil mass contacted may be less for sites with contact limitations such as fractured bedrock or those with low permeable materials.

CONTAMINANTS OF CONCERN* (COCs)

Concentrations:

The following are estimates of the contaminant concentration in soil and groundwater within the target area. The total COC mass was calculated including estimated COC mass in groundwater, soil and NAPL, if present, within the targeted area.

Constituent	GW (mg/L)	Soil (mg/kg)	NAPL (lbs)	Total COC Mass** (lb)
PCE	3.8	10.5	0.0	4.3

Remedial Goals and Target Mass Reductions:

The target demand is determined by also accounting for remedial goals for each contaminant and represents the estimated mass reductions targeted for each constituent.

Constituent	GW (mg/L)	Soil (mg/kg)	NAPL (lbs)	Total COC Mass Targeted*** (lbs)
PCE	0	0	0	4.3

*Unless provided, sorbed concentrations were roughly estimated based on expected groundwater concentrations, foc and Koc values. For a more refined estimate, it is recommended that actual values be verified via direct sampling of the targeted treatment interval.

** Includes estimated contaminant mass in soil, groundwater, and NAPL (if provided) at the site.

*** Includes estimated contaminant mass in soil, groundwater, and NAPL (if provided) at the site with the remedial goals subtracted from the total mass onsite.

KLOZUR PERSULFATE DEMAND

The estimated mass of Klozur accounts for target demand with the COCs, non-target demand associated with the soils (SOD) and a safety factor applied to each. The safety factor is intended to account for potential variability in the COC and SOD estimates and any other uncertainties associated with the application or site.

The demand from COCs was estimated using: **Degradation Ratio**

The degradation ratio should be determined/verified in a bench or field test

	Persulfate Demand	Safety Factor	Persulfate Demand with Factor	
Demand from COCs	87	4.0	346	lb
Demand from SOD	385	4.0	1,540	lb

Total Klozur Persulfate Demand: **1,886** **lb**

KLOZUR PERSULFATE PACKAGING OPTIONS AND PRICING

Klozur Persulfate can be delivered to your site in a variety of packages including in bags, or two sizes of super sacks for your handling convenience.

Available Packaging Types	# of packages / pallet	lb Klozur® / pallet	# of packages needed
55.1 # bags	42	2,314	35
1,102 # super sacks	2	2,204	2
2,204 # super sacks	1	2,204	1

Available Packaging Types	Unit Rate ($ / lb)	Total Mass (lbs)	Cost in USD (FOB Tonawanda, NY)
55.1 # bags	1.59	1,929	$3,066
1,102 # super sacks	1.48	2,204	$3,262
2,204 # super sacks	1.46	2,204	$3,218

1) Number of packages needed is rounded up to nearest whole unit.

2) Price valid for 90 days from date at top of document. Terms: net 30 days.

3) Any applicable taxes not included. Please provide a copy of your tax exempt certificate or resale tax number when placing your order. In accordance with the law, applicable state and local taxes will be applied at the time of invoicing if PeroxyChem has not been presented with your fully executed tax exemption documentation.

4) Shipping not included. Freight rates from Tonawanda NY available upon request. Standard delivery time can vary from 1-3 weeks from time of order, depending upon volume. Expedited transport can be arranged at extra cost.

5) Return Policy: Within 90 days after sale, following approval by PeroxyChem, products in their unopened containers, which by analysis meet the original specifications under which they were shipped, will be accepted for return at invoiced price, less 25% handling charge and return freight, excluding original freight paid by buyer. Products made to order or custom blended are non-returnable.

6) All sales are per PeroxyChem's Terms and Conditions.

Disclaimer:

The estimated dosage and recommended application methodology described in this document are based on the site information provided to PeroxyChem, but are not meant to constitute a guaranty of performance or a predictor of the speed at which a given site is remediated. Klozur® persulfate and activator demand calculations do not take into account the kinetics, speed of the reaction, or ability to establish contact between the reagents and contamination in the subsurface. These calculations represent the minimum anticipated amount needed to treat the constituents of concern (COCs). As a result, these calculations should be used as a general approximation for purposes of an initial economic assessment. PeroxyChem recommends that oxidant demand and treatability testing be performed to verify the quantities of oxidant needed.

KLOZUR ACTIVATION CHEMISTRIES

Klozur Persulfate activation chemistries are used to convert Klozur Persulfate into the highly reactive radicals. Choosing the right activator chemistry for your contaminants of concern is important in obtaining a successful site remediation. The choice of activator will be dependent upon the target contaminants, site lithology and hydrogeology, and other site conditions. While activator demand quantities for all methods are given, not all activation methods are recommended for your given contaminant or site conditions. Please consult with an PeroxyChem Environmental Solutions technologist for proper selection of activation chemistry.

Note: Only <u>one</u> type of activator is typically needed.

Recommended methods to activate Klozur Persulfate:	**FeEDTA**	**high pH**	**hydrogen peroxide**

***PeroxyChem LLC is the owner or licensee under various patent applications relating to the use of activation chemistries**

<u>Calculation for FeEDTA demand:</u>

Recommended concentration of Fe available in the groundwater	200	ppm
Calculated FeEDTA demand based on gw volume	117	lb
# of bags of FeEDTA needed (55.1 lb / 25 kg bags)	3	bags
Pricing	$4.10	$ / lb
Cost in USD (FOB Tonawanda, NY)	$677.73	

<u>Calculation for NaOH (high pH) demand:</u>

NaOH demand = NaOH to neutralize generate HSO4 from persulfate decomposition + amount needed to raise ground water / soil to a pH > 10.5

NaOH demand for HSO4 neutralization	634	lb @ 100% basis
Soil buffering amount	289	lb @ 100% basis
Total NaOH demand	923	lb @ 100% basis

PeroxyChem recommends using a 25 wt% or less NaOH concentration **

Amount of	25	wt% solution needed	348	gal
			3,690	lb

<u>25% NaOH Solution is available from PeroxyChem directly for convenience or from a third party:</u>

Estimated Pricing from Third Party^:

25% NaOH Solution Price Estimate	0.255	$/lb	in drums
(^Please contact PeroxyChem for updated estimate at time of order)	0.235	$/lb	in totes
	0.145	$/lb	in tankers

Klozur Caustic provided directly from PeroxyChem:

Klozur Caustic Pricing (25% NaOH solution)	0.390	$/lb	in 560 # drums
FOB, Tonawanda, NY. Freight quote upon request	0.520	$/lb	in 2800 # totes

** note: the addition of concentrated NaOH to water is very exothermic. Add NaOH slowly to water, and allow for excess heat to dissipate.

Attachment C
Methodology to calculate residual Persulfate in Groundwater

Klozur® Field Test Kits

Technical Data Sheet

Introduction

Klozur® Field Test kits provide an accurate quantitative measurement of remaining persulfate in the groundwater at a remediation site. There are two test kits available, depending on which activation method is used.

	Klozur Persulfate Activator Chemistries	Activator Examples	Primary Titration Chemistry
Kit "K"	High pH	Klozur® Caustic, sodium hydroxide, lime, Klozur® CR, Percarbonate	Permanganate back-titration of ferrous ammonium sulfate
	Iron	Iron Sulfate, $FeSO_4$	
	Heat	Steam, hot water	
Kit "C"	Chelated iron	Dissolvine® E-FE-13, iron EDTA, FeEDTA, iron citrate	Cerric sulfate titration to a Ferroin end-point
	Hydrogen peroxide*	Hydrogen peroxide*	

*Please contact PeroxyChem for more information

Kit Contents

Each kit contains materials for measuring ten (10) aqueous measurements of persulfate concentration.

Item	Kit "K"	Kit "C"
15 mL plastic vials	10	10
filters	11	11
Plastic syringes	11	11
Plastic pipettes	35	35
Centrifuge tubes containing Ferrous ammonium sulfate	10	10
Sulfuric acid (6N) 2 ml vials	10	10
Potassium Permangnate (0.1 N) 20 mL bottle	5	Not applicable
Ceric Sulfate solution (0.1N) 20 mL bottle	Not applicable	5
Ferroin Indicator 2 mL vial	Not applicable	1

Specifications

Measurement Range:	1 g / L to 100 g / L
Accuracy:	Range 1 – 50 g / L +/- 1 g / L Range 50 – 100 g / L +/- 2 g / L
Shelf Life:	one year
Storage:	cool, dry conditions
Operating Ranges:	Water temperature: 5 – 50 °C pH ≤ 12 Fe(II): 0-500 mg/L

Prior to working with Klozur Field Test Kit consult the Safety Data Sheet and to understand proper safety, handling, storage and disposal procedures.

Klozur® Persulfate Test C-Kit

Each kit contains enough supplies for 10 tests:

11 each	Syringes
11 each	Filters
10 vials	6.0 N H_2SO_4
5 vials	0.1 N Ceric Sulfate
35 each	Pipettes
1 vial	Ferroin Indicator
10 each	10mL clear vials
10 each	Centrifuge tubes with Ferrous Ammonium Sulfate

Instructions

Procedure for Klozur quantification 0-25 g/L & 25-50 g/L, Pages 2 – 6

Procedure for Klozur quantification 50-75 g/L & 75-100 g/L, Pages 7 – 11

Safety Data Sheet Package

1) Sulfuric Acid, 6.0 N
2) Ferrous Ammonium Sulfate
3) Ceric Sulfate, 0.1 N
4) Ferroin Indicator

Klozur® Persulfate Test C-Kit

Procedure for Quantification of Klozur Persulfate in Groundwater
Quantification Range: **0 – 25 g/L and 25 – 50 g/L**

Suitable for use with the following Klozur Persulfate activation methods:

- Heat
- High pH (alkaline activation)
- Iron Sulfate
- Iron-EDTA

NOT suitable for use with the following Klozur Persulfate activation methods

- Hydrogen Peroxide

SAFETY: Personal protective equipment must be worn, including acid-resistant gloves and safety goggles for eye protection. Review the SDS's prior to use.

Procedure:

1) Step 1 must be performed first. Transfer enough Sulfuric Acid with provided pipette into the purple-topped graduated tube to bring the level to the 2mL mark.

Klozur® Persulfate Test C-Kit

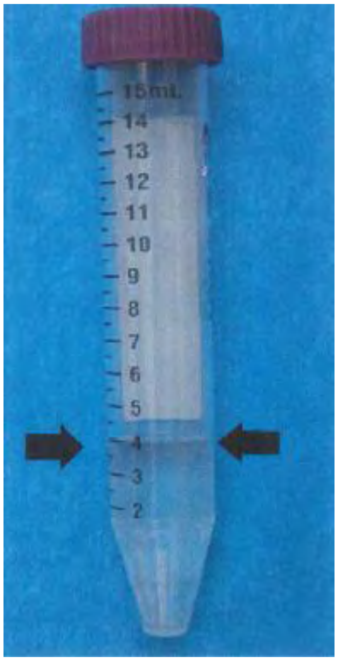
2) Fill a syringe with site groundwater* containing Klozur Persulfate.

*Important: If the groundwater is muddy, let it stand for approximately five minutes to allow the dirt to settle. Use the top water to fill the syringe.

Klozur® Persulfate Test C-Kit

3) Screw on a filter disk to the end of the syringe and push the plunger slowly to collect about 5mL of filtered groundwater in a provided 10mL clear vial equipped with a Teflon-lined cap.

4) Carefully transfer **2mL** of filtered groundwater from Step 3, **using a new pipette**, to the graduated tube from Step 1 until the total volume reaches the **4mL** mark. Cap the graduated tube and shake until the solids are completely dissolved.



Klozur® Persulfate Test C-Kit

5) Add 2 drops of Ferroin indicator to the solution, cap the graduated tub, and shake well. The should should be orange.

Note: If the solution remains blue / light blue for more than 1 minute after shaking, the concentration of Klozur Persulfate in the groundwater is greater than 50 g/L. Follow the procedure for quantification of Klozur Persulfate, quantification range 50 – 75 g/L and 75 – 100 g/L.

6) Drop wise add the Ceric Sulfate, **using a new pipette**. Shake the graduated tube during the addition of Ceric Sulfate.

7) When the orange color disappears and light blue color shows up upon shaking, stop adding Ceric Sulfate and note the final volume.

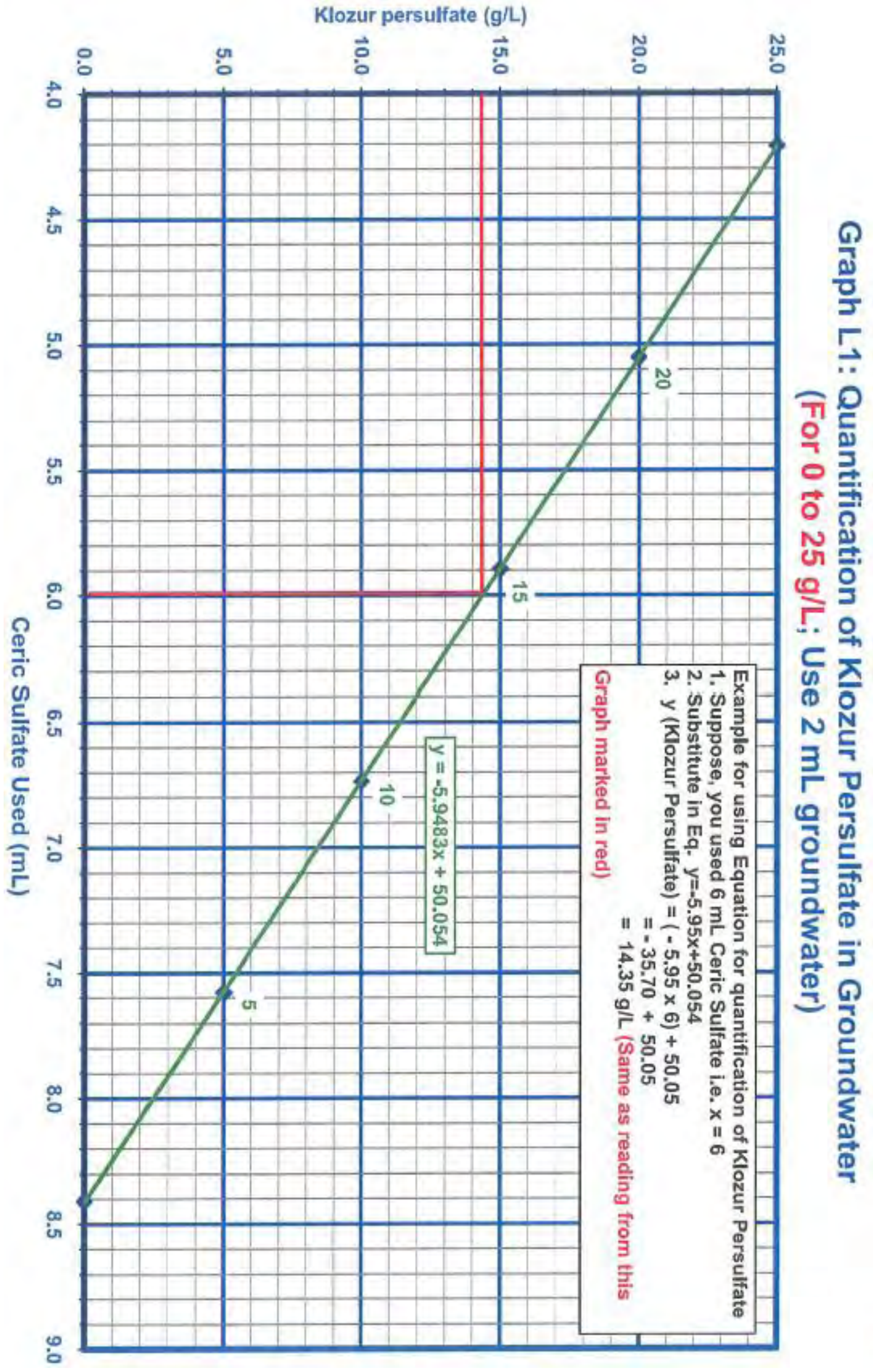
8) Calculate the volume of Ceric Sulfate used:

Ceric Sulfate used (mL) = Final Volume – 4

9) Use this volume with the provided graphs (L1 or L2) to find the concentration of Klozur Persulfate in the groundwater sample.

DISPOSAL OF UNUSED REAGENTS: Remaining unused reagents should be disposed per local, state, and federal regulations. Please review SDS's for disposal information.

Klozur® Persulfate Test C-Kit

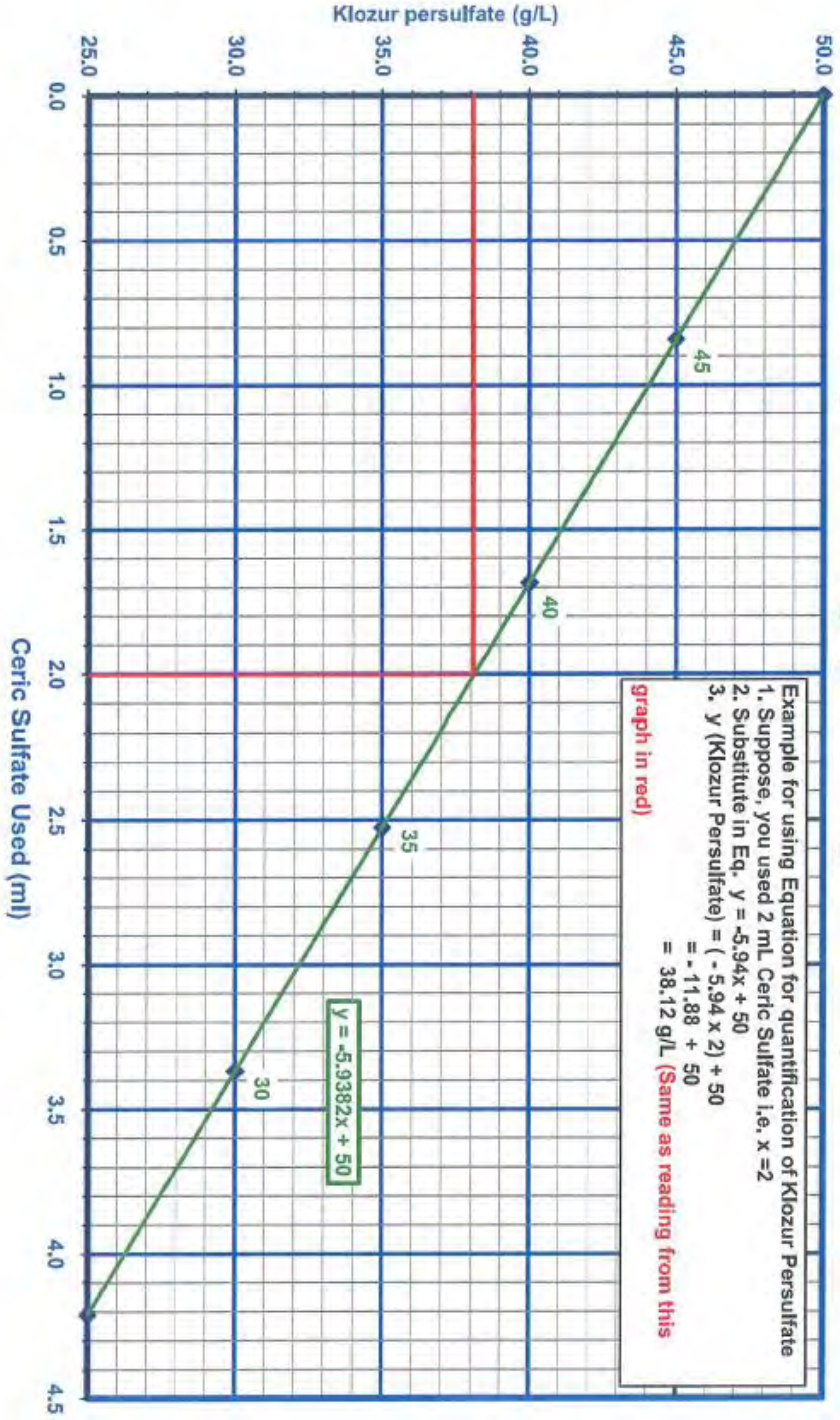


Graph L1: Quantification of Klozur Persulfate in Groundwater
(For 0 to 25 g/L; Use 2 mL groundwater)

Example for using Equation for quantification of Klozur Persulfate
1. Suppose, you used 6 mL Ceric Sulfate i.e. x = 6
2. Substitute in Eq. y=-5.95x+50.054
3. y (Klozur Persulfate) = (- 5.95 x 6) + 50.05
= - 35.70 + 50.05
= 14.35 g/L (Same as reading from this Graph marked in red)

Klozur® Persulfate Test C-Kit

Graph L2: Quantification of Klozur Persulfate in Groundwater (For 25 to 50 g/L; Use 2 mL groundwater)



Example for using Equation for quantification of Klozur Persulfate
1. Suppose, you used 2 mL Ceric Sulfate i.e. x =2
2. Substitute in Eq. y = -5.94x + 50
3. y (Klozur Persulfate) = (- 5.94 x 2) + 50
= - 11.88 + 50
= 38.12 g/L (Same as reading from this graph in red)

Klozur® Persulfate Test C-Kit

Procedure for Quantification of Klozur Persulfate in Groundwater
Quantification Range: **50 – 75 g/L and 75 – 100 g/L**

Suitable for use with the following Klozur Persulfate activation methods:

- Heat
- High pH (alkaline activation)
- Iron Sulfate
- Iron-EDTA

NOT suitable for use with the following Klozur Persulfate activation methods

- Hydrogen Peroxide

SAFETY: Personal protective equipment must be worn, including acid-resistant gloves and safety goggles for eye protection. Review the SDS's prior to use.

Procedure:

1) Step 1 must be performed first. Transfer enough Sulfuric Acid with provided pipette into the purple-topped graduated tube to bring the level to the 2mL mark.

Klozur® Persulfate Test C-Kit

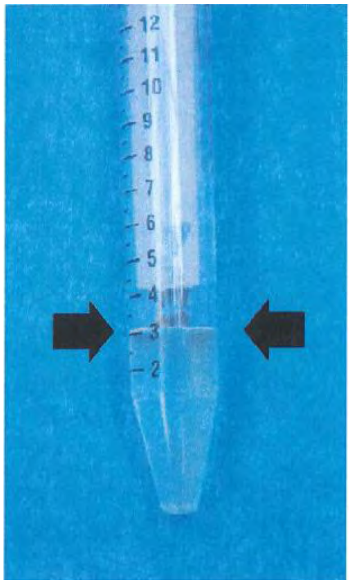
2) Fill a syringe with site groundwater* containing Klozur Persulfate.

*Important: If the groundwater is muddy, let it stand for approximately five minutes to allow the dirt to settle. Use the top water to fill the syringe.

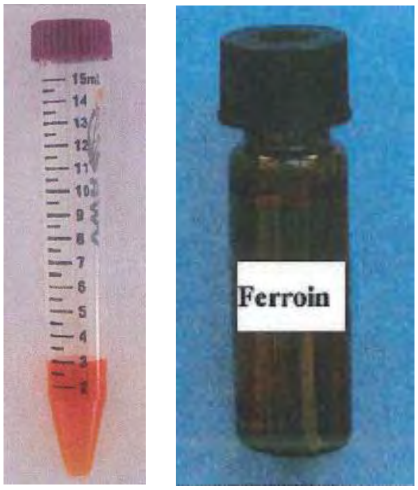
Klozur® Persulfate Test C-Kit

3) Screw on a filter disk to the end of the syringe and push the plunger slowly to collect about 5mL of filtered groundwater in a provided 10mL clear vial equipped with a Teflon-lined cap.

4) Carefully transfer **1mL** of filtered groundwater from Step 3, **using a new pipette**, to the graduated tube from Step 1 until the total volume reaches the **3mL** mark. Cap the graduated tube and shake until the solids are completely dissolved.



Klozur® Persulfate Test C-Kit



5) Add 2 drops of Ferroin indicator to the solution, cap the graduated tub, and shake well. The should should be orange.

6) Drop wise add the Ceric Sulfate, **using a new pipette**. Shake the graduated tube during the addition of Ceric Sulfate.

7) When the orange color disappears and light blue color shows up upon shaking, stop adding Ceric Sulfate and note the final volume.

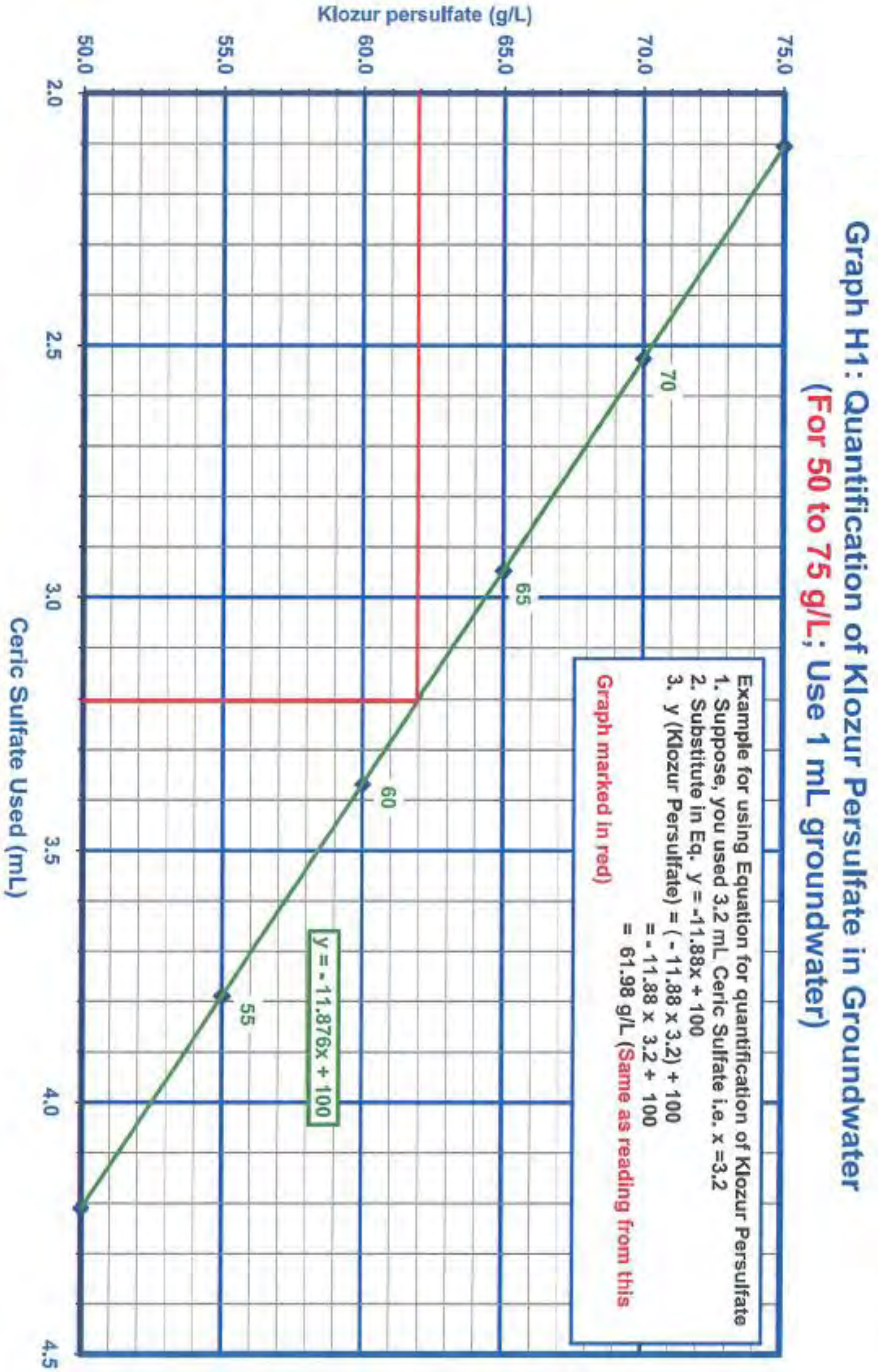
8) Calculate the volume of Ceric Sulfate used:

Ceric Sulfate used (mL) = Final Volume – 3

9) Use this volume with the provided graphs (H1 or H2) to find the concentration of Klozur Persulfate in the groundwater sample.

DISPOSAL OF UNUSED REAGENTS: Remaining unused reagents should be disposed per local, state, and federal regulations. Please review SDS's for disposal information.

Klozur® Persulfate Test C-Kit



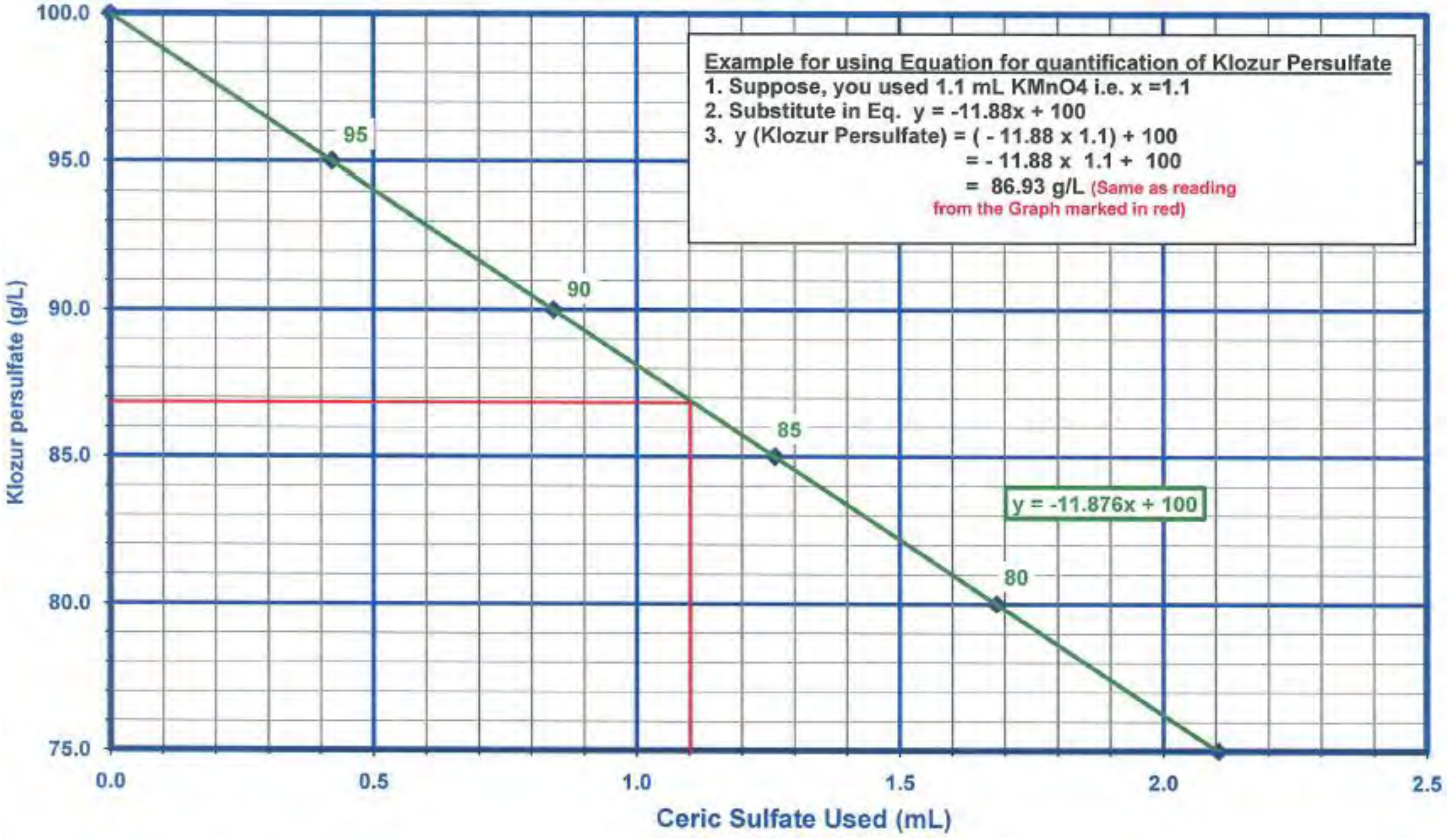
Graph H1: Quantification of Klozur Persulfate in Groundwater
(For 50 to 75 g/L; Use 1 mL groundwater)

Example for using Equation for quantification of Klozur Persulfate
1. Suppose, you used 3.2 mL Ceric Sulfate i.e. x =3.2
2. Substitute in Eq. y = -11.88x + 100
3. y (Klozur Persulfate) = (- 11.88 x 3.2) + 100
= - 11.88 x 3.2 + 100
= 61.98 g/L (Same as reading from this

Graph marked in red)

Klozur® Persulfate Test C-Kit

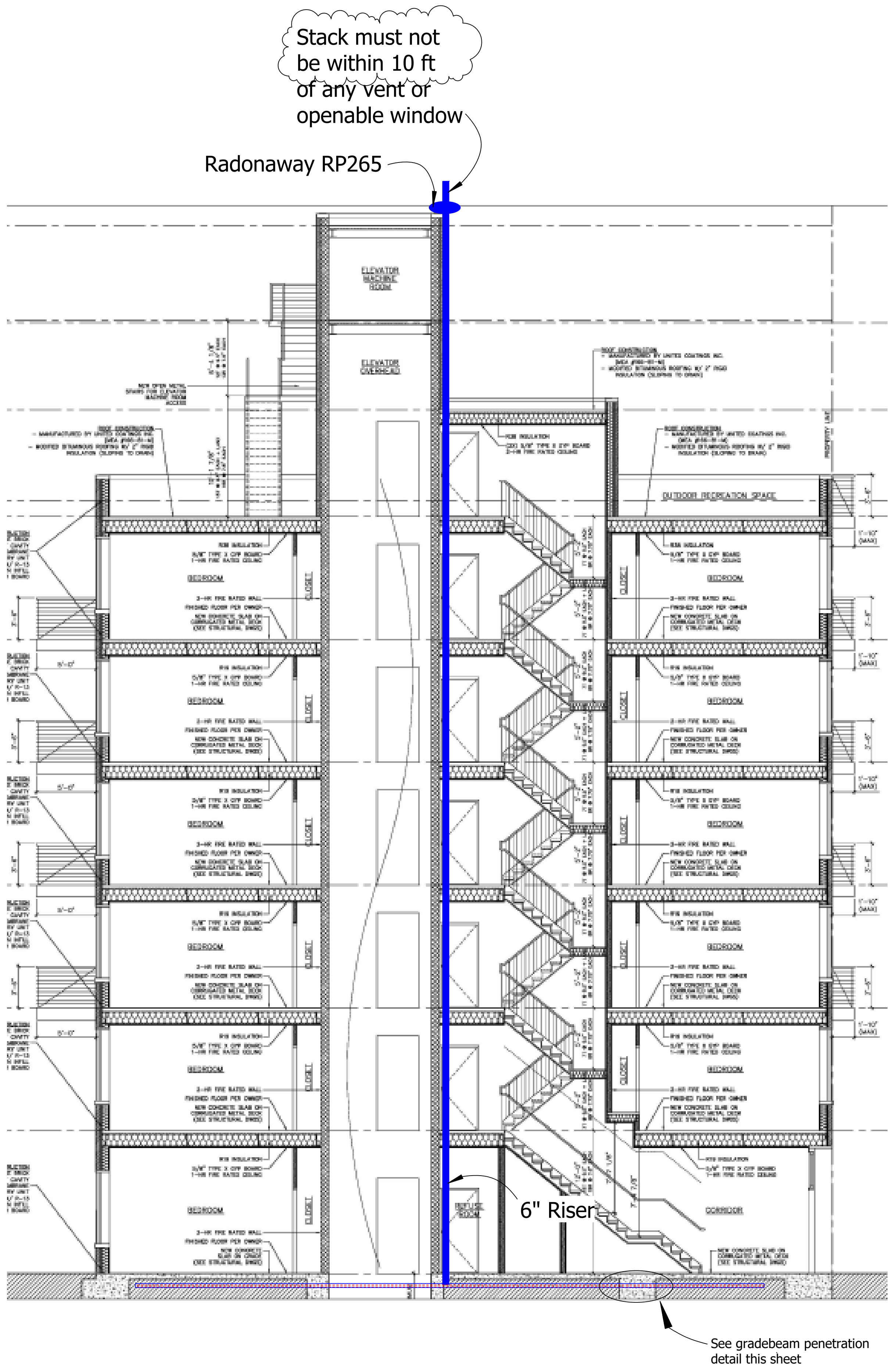
Graph H2: Quantification of Klozur Persulfate in Groundwater
(For 75 to 100 g/L; Use 1 mL groundwater)



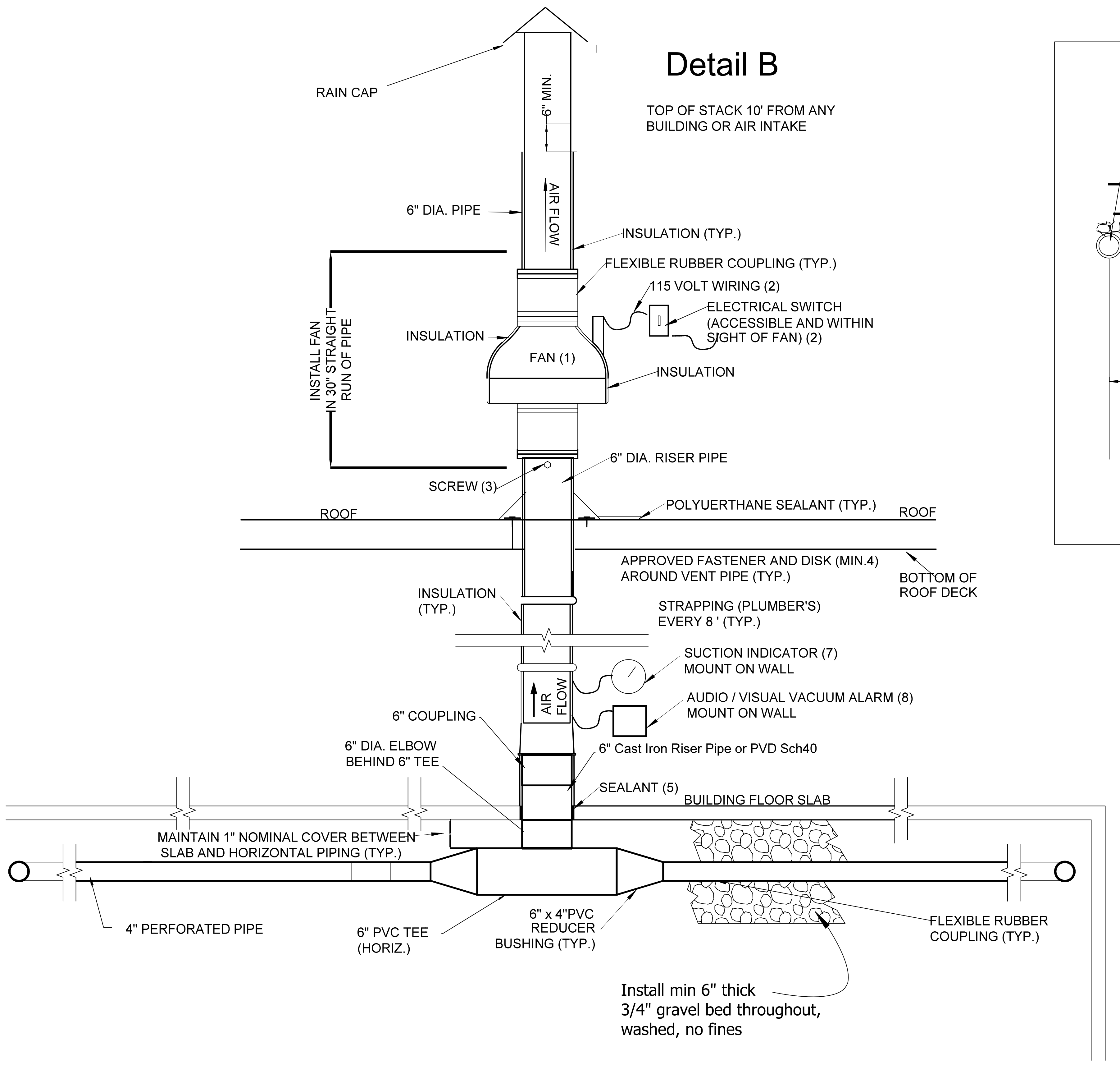
Example for using Equation for quantification of Klozur Persulfate

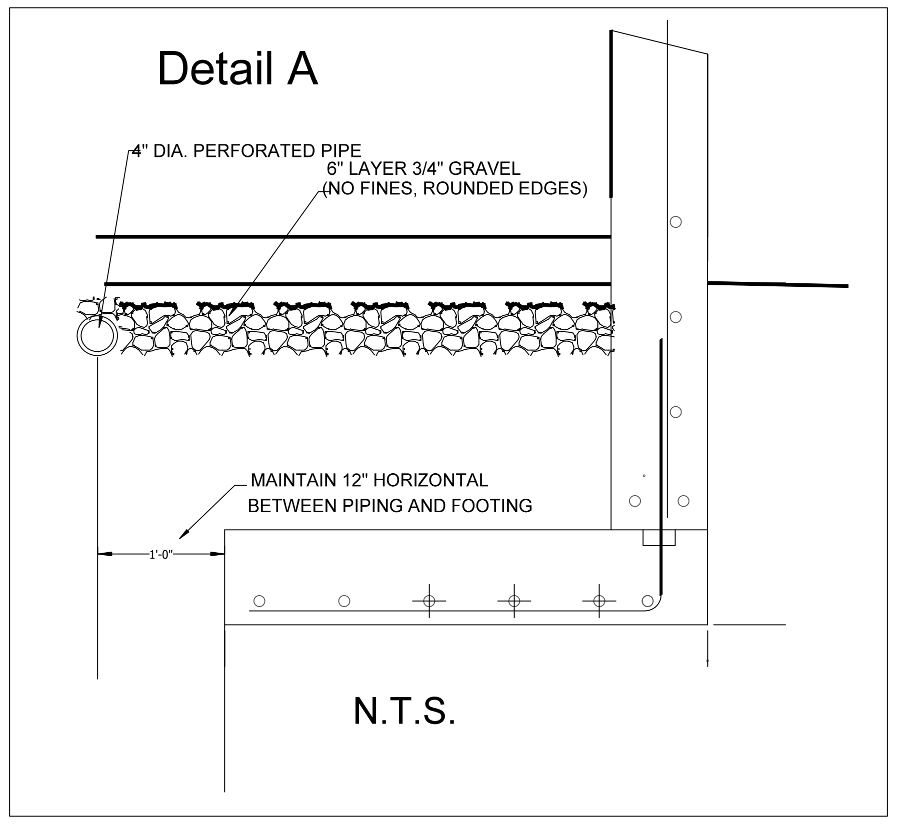
1. Suppose, you used 1.1 mL KMnO4 i.e. x =1.1
2. Substitute in Eq. y = -11.88x + 100
3. y (Klozur Persulfate) = (- 11.88 x 1.1) + 100
   = - 11.88 x 1.1 + 100
   = 86.93 g/L (Same as reading from the Graph marked in red)

Appendix 13 SSD Systems design and Specifications



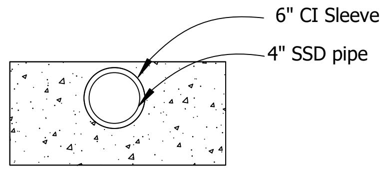
SECTION VIEW - SSDS RISER



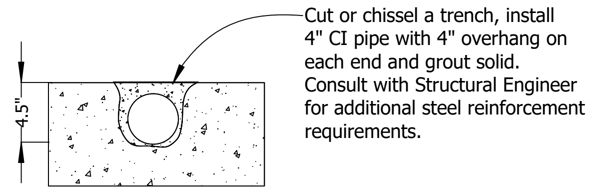


LEGEND

- ━━━ 6" Solid PVC Sch 40
- – – – 4" Slotted 0.020" PVC Sch 40 or equal
- ○ 6" Solid PVC Sch 40 riser

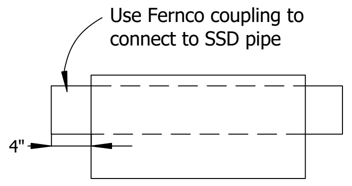


Gradebeam Penetration for new pour

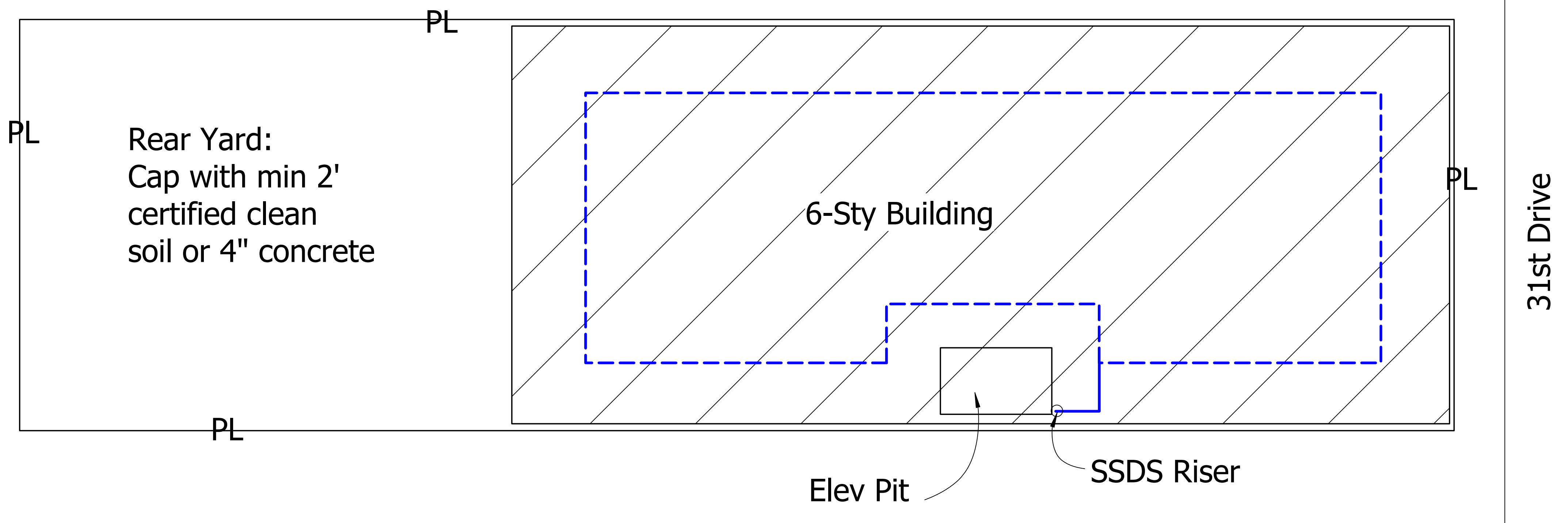


Cut or chissel a trench, install 4" CI pipe with 4" overhang on each end and grout solid. Consult with Structural Engineer for additional steel reinforcement requirements.

Gradebeam Penetration on existing beam



Use Fernco coupling to connect to SSD pipe



NOTES:

1. REFER TO ARCHITECTURAL PLANS FOR WATERPROOFING REQUIREMENTS.
2. FAN TO BE RADONAWAY HIGH FLOW INLINE FAN, MODEL RP-265 OR APPROVED EQUAL.
3. FAN AND ON/OFF SWITCH TO BE HARD-WIRED TOGETHER TO 115 VOLT CIRCUIT.
4. SECURE RUBBER COUPLING WITH SCREW TO PREVENT FAN ASSEMBLY FROM SLIPPING DOWN VERTICAL PIPE.
5. DWYER MAGNAHELIC DIAL TYPE VACUUM GAUGE MODEL 2002-M OR APPROVED EQUAL.
6. ALARM: Checkpoint IIA Mitigation System Alarm Item # 28001-2
7. ABOVE SLAB RISER MUST BE CAST IRON OR PVC SCH 40. IF PVC, THEN ENCLOSE PIPE WITH ENCLOSURE OF THE SAME FIRE RATING AS THE SPACE OCCUPANCY.
8. USE N12-ADS PERFORATED PIPE OR PVC SCREEN PIPE SCH40 OR SIMILAR.
9. PROGRESS INSPECTIONS:
   - A. SUBSLAB PIPE INSTALLATION
   - B. GAS PERMEABLE AGGREGATE
   - C. PIPE CONNECTIONS
   - D. RISER LABELING
   - E. STARTUP AND VACUUM TEST
   - F. ABOVE-SLAB PIPE AND SYSTEM INSTALLATION, INCLUDING FANS, ALARM, GAUGE.

AMC ENGINEERING PLLC
38-20 32nd Street
Unit 102
LIC, NY 11101
(516) 417-8588

PROJECT

11-28 31st Drive
LIC, NY

TITLE:

SSDS: SUB SLAB DEPRESSURIZATION SYSTEM RISER DETAILS AND NOTES

SEAL & SIGNATURE:

STATE OF NEW YORK · LICENSED PROFESSIONAL ENGINEER · ARIEL CZEMERINSKI · 076508

DATE:	9/2/2016
PROJECT No:	
DRAWING BY:	AC
CHK BY:	
DWG No:	SSDS.03
CADO FILE No:	1 OF 1

RP265 Radon Fan

Item # 23033-1

Description - The popular RadonAway RS265 radon fan has a 6" duct and is chosen most often by radon professionals when there is a need for quiet efficiency coupled with more power and higher air flow.

Quantity Price Discounts apply at 4, 8 and 20. Pricing will update when added to Shopping Cart.

RadonAway is a B2B business only. You must be an approved RadonAway customer to purchase products through this website. If you are an existing RadonAway customer and need a website login, click here. If you are a professional and would like to become a RadonAway customer, click here.

Technical Specifications:

Radon Fan Features:

- Five-year limited warranty
- Quiet and attractive
- Thermally protected
- Water-hardened motorized impeller
- **RP140 and RP260 Energy Star® Qualified**
- ETL Listed - for indoor or outdoor use
- Meets all electrical code requirements
- Rated for commercial and residential use

Additional Radon Fan Information:

- Downloadable Fan Specifications/Sales Sheet (PDF format)
- Downloadable Fan Installation Instructions (PDF format)
- Calculate your estimated annual electrical cost.

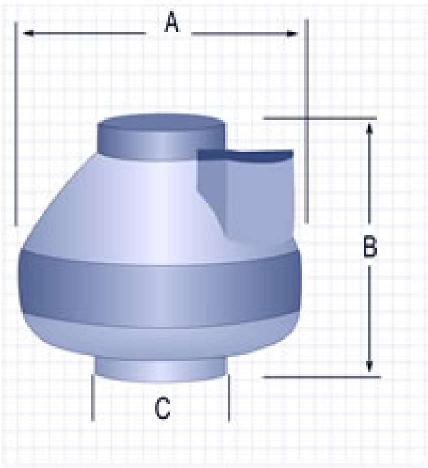
Typical CFM vs. Static Pressure WC

Model	P/N	Energy Star® Rated	Fan Duct Diameter	Watts	Max Pressure "WC						RRNC Type[1]
						0"	.5"	1.0"	1.5"	2.0"	
RP140	23029-1	Yes	4"	15-21	0.8	135	70	-	-	-	RF1
RP145	23030-1	-	4"	41-72	2.1	166	126	82	41	3	RF1, RF2
RP260	23032-1	Yes	6"	50-75	1.6	272	176	89	13	-	RF2
RP265	23033-1	-	6"	91-129	2.3	334	247	176	116	52	-
RP380	28208	-	8"	95-152	2.3	497	353	220	130	38	-

[1] *Suitable as designated by the new Reducing Radon in New Construction Standard, RRNC 2.0. Click here for details.*

Dimensions

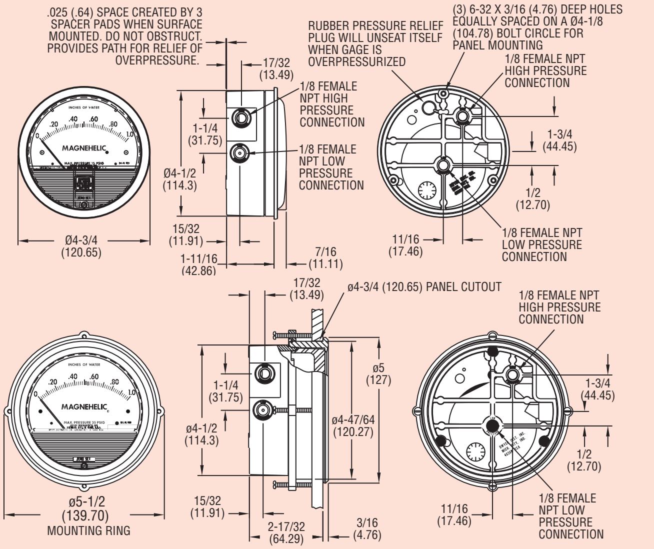
Model	A	B	C
RP140	9.7"	8.5"	4.5"
RP145	9.7"	8.5"	4.5"
RP260	11.75"	8.6"	6"
RP265	11.75"	8.6"	6"
RP380	13.41"	10.53"	8"



Series
2000

Magnehelic® Differential Pressure Gages

Indicate Positive, Negative or Differential, Accurate within 2%

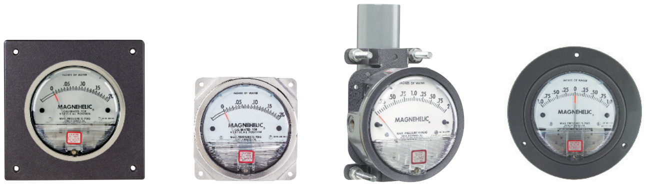


Select the Dwyer® Magnehelic® gage for high accuracy – guaranteed within 2% of full-scale – and for the wide choice of 81 models available to suit your needs precisely. Using Dwyer's simple, frictionless Magnehelic® gage movement, it quickly indicates low air or non-corrosive gas pressures – either positive, negative (vacuum) or differential. The design resists shock, vibration and over-pressures. No manometer fluid to evaporate, freeze or cause toxic or leveling problems. It's inexpensive, too.

The Magnehelic® gage is the industry standard to measure fan and blower pressures, filter resistance, air velocity, furnace draft, pressure drop across orifice plates, liquid levels with bubbler systems and pressures in fluid amplifier or fluidic systems. It also checks gas-air ratio controls and automatic valves, and monitors blood and respiratory pressures in medical care equipment.

Mounting

A single case size is used for most models of Magnehelic® gages. They can be flush or surface mounted with standard hardware supplied. Although calibrated for vertical position, many ranges above 1˝ may be used at any angle by simply re-zeroing. However, for maximum accuracy, they must be calibrated in the same position in which they are used. These characteristics make Magnehelic® gages ideal for both stationary and portable applications. A 4-9/16˝ hole is required for flush panel mounting. Complete mounting and connection fittings, plus instructions, are furnished with each instrument. See page 7 for more information on mounting accessories.



Flush, Surface or Pipe Mounted

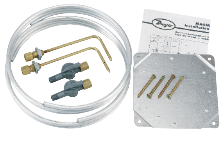
Enclosure Mounted

SPECIFICATIONS

Service: Air and non-combustible, compatible gases (natural gas option available).
Note: May be used with hydrogen. Order a Buna-N diaphragm. Pressures must be less than 35 psi.
Wetted Materials: Consult factory.
Housing: Die cast aluminum case and bezel, with acrylic cover. Exterior finish is coated gray to withstand 168 hour salt spray corrosion test.
Accuracy: ±2% of FS (±3% on - 0, -100 Pa, -125 Pa, 10MM and ±4% on - 00, -60 Pa, -6MM ranges), throughout range at 70°F (21.1°C).
Pressure Limits: -20 in Hg to 15 psig† (-0.677 to 1.034 bar); MP option: 35 psig (2.41 bar); HP option: 80 psig (5.52 bar).
Overpressure: Relief plug opens at approximately 25 psig (1.72 bar), standard gages only. See Overpressure Protection Note on next page.
Temperature Limits: 20 to 140°F* (-6.67 to 60°C). -20°F (-28°C) with low temperature option.
Size: 4˝ (101.6 mm) diameter dial face.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Process Connections: 1/8˝ female NPT duplicate high and low pressure taps - one pair side and one pair back.
Weight: 1 lb 2 oz (510 g), MP & HP 2 lb 2 oz (963 g).
Standard Accessories: Two 1/8˝ NPT plugs for duplicate pressure taps, two 1/8˝ pipe thread to rubber tubing adapter, and three flush mounting adapters with screws. (Mounting and snap ring retainer substituted for three adapters in MP & HP gage accessories.)
Agency Approval: RoHS. **Note:** -SP models not RoHS approved.
†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options at lower left.

ACCESSORIES

Model A-432 Portable Kit
Combine carrying case with any Magnehelic® gage of standard range, except high pressure connection. Includes 9 ft (2.7 m) of 3/16˝ ID rubber tubing, standhang bracket and terminal tube with holder $48.00



Model A-605 Air Filter Gage Accessory Kit
Adapts any standard Magnehelic® gage for use as an air filter gage. Includes aluminum surface mounting bracket with screws, two 5 ft (1.5 m) lengths of 1/4˝ aluminum tubing two static pressure tips and two molded plastic vent valves, integral compression fittings on both tips and valves **35.00**

A-605B Air Filter Gage Accessory Kit, Air filter kit with two plastic open/close valves, two 4˝ steel static tips, plastic tubing and mounting flange **26.00**

A-605C Air Filter Gage Accessory Kit, Air filter kit with two plastic open/close valves, two plastic static tips, plastic tubing and mounting flange **21.00**

Series 2000

Magnehelic® Gage Models & Ranges

Bezel provides flange for flush mounting in panel.

Clear plastic face is highly resistant to breakage. Provides undistorted viewing of pointer and scale.

Precision litho-printed scale is accurate and easy to read.

Red tipped pointer of heat treated aluminum tubing is easy to see. It is rigidly mounted on the helix shaft.

Pointer stops of molded rubber prevent pointer over-travel without damage.

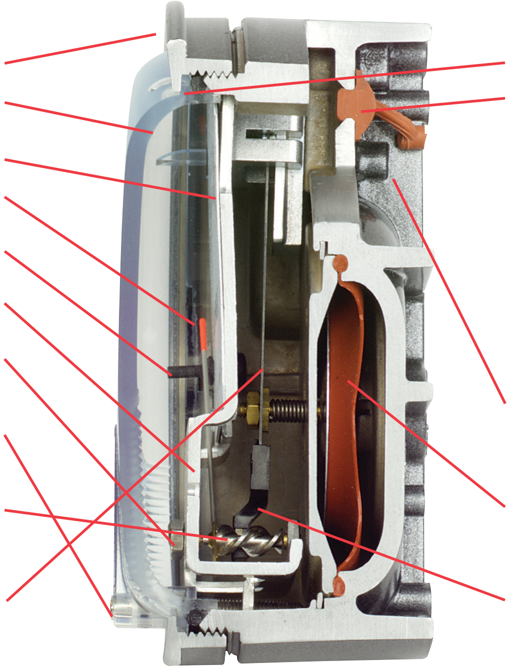
"Wishbone" assembly provides mounting for helix, helix bearings and pointer shaft.

Jeweled bearings are shock-resistant mounted; provide virtually friction-free motion for helix. Motion damped with high viscosity silicone fluid.

Zero adjustment screw is conveniently located in the plastic cover, and is accessible without removing cover. O-ring seal provides pressure tightness.

Helix is precision made from an alloy of high magnetic permeability. Mounted in jeweled bearings, it turns freely, following the magnetic field to move the pointer across the scale.

Calibrated range spring is flat spring steel. Small amplitude of motion assures consistency and long life. It reacts to pressure on diaphragm. Live length adjustable for calibration.



O-ring seal for cover assures pressure integrity of case.

OVERPRESSURE PROTECTION
Blowout plug is comprised of a rubber plug on the rear which functions as a relief valve by unseating and venting the gage interior when over pressure reaches approximately 25 psig (1.7 bar). To provide a free path for pressure relief, there are four spacer pads which maintain 0.023˝ clearance when gage is surface mounted. Do not obstruct the gap created by these pads. The blowout plug is not used on models above 180˝ of water pressure, medium or high pressure models, or on gages which require an elastomer other than silicone for the diaphragm.
The blowout plug should not be used as a system overpressure control. High supply pressures may still cause the gage to fail due to over pressurization, resulting in property damage or serious injury. Good engineering practices should be utilized to prevent your system from exceeding the ratings or any component.

Die cast aluminum case is precision made and iridite-dipped to withstand 168 hour salt spray corrosion test. Exterior finished in baked dark gray hammerloid. One case size is used for all standard pressure options, and for both surface and flush mounting.

Silicone rubber diaphragm with integrally molded O-ring is supported by front and rear plates. It is locked and sealed in position with a sealing plate and retaining ring. Diaphragm motion is restricted to prevent damage due to overpressures.

Samarium Cobalt magnet mounted at one end of range spring rotates helix without mechanical linkages.

Model	Range Inches of Water	Price
2000-00N†••	.05-0-.2	**$77.45**
2000-00†••	0-.25	**73.00**
2000-0†•	0-.50	**63.50**
2001	0-1.0	**63.50**
2002	0-2.0	**63.50**
2003	0-3.0	**63.50**
2004	0-4.0	**63.50**
2005	0-5.0	**63.50**
2006	0-6.0	**63.50**
2008	0-8.0	**63.50**
2010	0-10	**63.50**
2012	0-12	**63.50**
2015	0-15	**63.50**
2020	0-20	**63.50**
2025	0-25	**63.50**
2030	0-30	**63.50**
2040	0-40	**63.50**
2050	0-50	**63.50**
2060	0-60	**63.50**
2080	0-80	**63.50**
2100	0-100	**63.50**
2120	0-120	**63.50**
2150	0-150	**63.50**
2160	0-160	**63.50**
2180*	0-180	**148.50**
2250*	0-250	**148.50**
Zero Center Ranges		
2300-00†••	0.125-0-0.125	**$74.00**
2300-0†•	.25-0-.25	**74.00**
2301	.5-0-.5	**74.00**
2302	1-0-1	**74.00**
2304	2-0-2	**74.00**
2310	5-0-5	**74.00**
2320	10-0-10	**74.00**
2330	15-0-15	**74.00**

Model	Range PSI	Price
2201	0-1	**$67.95**
2202	0-2	**67.95**
2203	0-3	**67.95**
2204	0-4	**67.95**
2205	0-5	**67.95**
2210*	0-10	**127.95**
2215*	0-15	**127.95**
2220*	0-20	**127.95**
2230**	0-30	**207.50**

Model	Range, CM of Water	Price
2000-15CM	0-15	**$63.50**
2000-20CM	0-20	**63.50**
2000-25CM	0-25	**63.50**
2000-50CM	0-50	**63.50**
2000-80CM	0-80	**63.50**
2000-100CM	0-100	**63.50**
2000-150CM	0-150	**67.95**
2000-200CM	0-200	**67.95**
2000-250CM	0-250	**67.95**
2000-300CM	0-300	**67.95**
Zero Center Ranges		
2300-4CM	2-0-2	**$78.45**
2300-10CM	5-0-5	**78.45**
2300-30CM	15-0-15	**78.45**

†These ranges calibrated for vertical scale position.
• Accuracy +/-3%
• • Accuracy +/-4%
*MP option standard
**HP option standard

Model	Range MM of Water	Price
2000-6MM†••	0-6	**$73.00**
2000-10MM†•	0-10	**63.50**
2000-15MM	0-15	**63.50**
2000-25MM	0-25	**63.50**
2000-30MM	0-30	**63.50**
2000-50MM	0-50	**63.50**
2000-80MM	0-80	**63.50**
2000-100MM	0-100	**63.50**
2000-125MM	0-125	**63.50**
2000-150MM	0-150	**63.50**
2000-200MM	0-200	**63.50**
2000-250MM	0-250	**63.50**
2000-300MM	0-300	**63.50**
Zero Center Ranges		
2300-6MM†••	3-0-3	**$99.00**
2300-10MM†•	5-0-5	**74.00**
2300-20MM†•	10-0-10	**74.00**

Model	Range, Pa	Price
2000-60NPA†••	10-0-50	**$77.45**
2000-60PA†••	0-60	**73.00**
2000-100PA†•	0-100	**63.50**
2000-125PA†•	0-125	**63.50**
2000-250PA	0-250	**63.50**
2000-300PA	0-300	**63.50**
2000-500PA	0-500	**63.50**
2000-750PA	0-750	**63.50**
2000-1000PA	0-1000	**63.50**

Zero Center Ranges

Model	Range, Pa	Price
2300-60PA†••	30-0-30	**$74.00**
2300-100PA†•	50-0-50	**74.00**
2300-120PA	60-0-60	**74.00**
2300-200PA	100-0-100	**74.00**
2300-250PA	125-0-125	**74.00**
2300-300PA	150-0-150	**74.00**
2300-500PA	250-0-250	**74.00**
2300-1000PA	500-0-500	**74.00**

Model	Range, kPa	Price
2000-0.5KPA	0-0.5	**$63.50**
2000-1KPA	0-1	**63.50**
2000-1.5KPA	0-1.5	**63.50**
2000-2KPA	0-2	**63.50**
2000-2.5KPA	0-2.5	**63.50**
2000-3KPA	0-3	**63.50**
2000-4KPA	0-4	**63.50**
2000-5KPA	0-5	**63.50**
2000-8KPA	0-8	**63.50**
2000-10KPA	0-10	**63.50**
2000-15KPA	0-15	**63.50**
2000-20KPA	0-20	**63.50**
2000-25KPA	0-25	**63.50**
2000-30KPA	0-30	**63.50**
Zero Center Ranges		
2300-1KPA	.5-0-.5	**$74.00**
2300-2KPA	1-0-1	**74.00**
2300-2.5KPA	1.25-0-1.25	**74.00**
2300-3KPA	1.5-0-1.5	**74.00**

Dual Scale Air Velocity Units
For use with pitot tube

Model	Range in W.C./ Velocity F.P.M.	Price
2000-00AV†••	0-.25/ 300-2000	**$98.00**
2000-0AV†•	0-.50/ 500-2800	**88.50**
2001AV	0-1.0/ 500-4000	**67.95**
2002AV	0-2.0/ 1000-5600	**67.95**
2005AV	0-5.0/ 2000-8800	**67.95**
2010AV	0-10/ 2000-12500	**67.95**

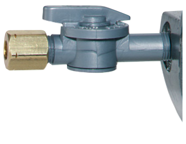
Dual Scale English/Metric Models

Model	Range, in w.c.	Range, Pa or kPa	Price
2000-00D†••	0-.25	0-62 Pa	**$73.00**
2000-0D†•	0-0.5	0-125 Pa	**67.95**
2001D	0-1.0	0-250 Pa	**67.95**
2002D	0-2.0	0-500 Pa	**67.95**
2003D	0-3.0	0-750 Pa	**67.95**
2004D	0-4.0	0-1.0 kPa	**67.95**
2005D	0-5.0	0-1.25 kPa	**67.95**
2006D	0-6.0	0-1.5 kPa	**67.95**
2008D	0-8.0	0-2.0 kPa	**67.95**
2010D	0-10	0-2.5 kPa	**67.95**
2015D	0-15	0-3.7 kPa	**67.95**
2020D	0-20	0-5 kPa	**88.50**
2025D	0-25	0-6.2 kPa	**88.50**
2050D	0-50	0-12.4 kPa	**88.50**
2060D	0-60	0-15 kPa	**88.50**

VELOCITY AND VOLUMETRIC FLOW UNITS
Scales are available on the Magnehelic® that read in velocity units (FPM, m/s) or volumetric flow units (SCFM, m^3/s, m^3/h). Stocked velocity units with dual range scales in inches w.c. and feet per minute are shown above. For other ranges contact the factory.
When ordering volumetric flow scales please specify the maximum flow rate and its corresponding pressure. Example: 0.5 in w.c. = 16,000 CFM.

ACCESSORIES

A-321, Safety Relief Valve	**35.25**
A-448, 3-piece magnet kit for mounting Magnehelic® gage directly to magnetic surface	**10.75**
A-135, Rubber gasket for panel mounting	**1.50**
A-401, Plastic Carry Case	**26.25**



A-310A 3-Way Vent Valves **$16.50**
In applications where pressure is continuous and the Magnehelic® gage is connected by metal or plastic tubing which cannot be easily removed, we suggest using Dwyer A-310A vent valves to connect gage. Pressure can then be removed to check or re-zero the gage.

RadonAway™

INSTALLATION & OPERATING INSTRUCTIONS
Instruction P/N IN015 Rev E
FOR *CHECKPOINT IIa* TM P/N 28001-2 & 28001-3
RADON SYSTEM ALARM

INSTALLATION INSTRUCTIONS
(WALL MOUNTING)

Select a suitable wall location near a vertical section of the suction pipe. The unit should be mounted about four or five feet above the floor and as close to the suction pipe as possible. Keep in mind that with the plug-in transformer provided, the unit must also be within six feet of a 120V receptacle. **NOTE: The Checkpoint IIa is calibrated for vertical mounting, horizontal mounting will affect switchpoint calibration.**

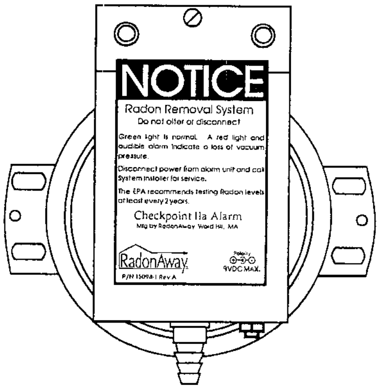
Drill two ¼" holes 4" apart horizontally where the unit is to be mounted.

Install the two ¼" wall anchors provided.

Hang the CHECKPOINT IIa from the two mouting holes located on the mounting bracket. Tighten the mounting screws so the unit fits snugly and securely against the wall.

Drill a 5/16" hole into the side of the vent pipe about 6" higher than the top of the unit.

Insert the vinyl tubing provided about 1" inside the suction pipe.



NOTICE

Radon Removal System
Do not alter or disconnect

Green light is normal. A red light and audible alarm indicate a loss of vacuum pressure.

Disconnect power from alarm unit and call System installer for service.

The EPA recommends testing Radon levels at least every 2 years.

Checkpoint IIa Alarm
Mfg by RadonAway Ward Hill, MA

Cut a suitable length of vinyl tubing and attach it to the pressure switch connector on the CHECKPOINT IIa.

CALIBRATION AND OPERATION.

The CHECKPOINT IIa units are calibrated and sealed at the factory to alarm when the vacuum pressure falls below the factory setting and should not normally require field calibration. Factory Settings are:
28001-2 -.25" WC Vacuum
28001-3 -.10" WC Vacuum

To Verify Operation:

With the exhaust fan off or the pressure tubing disconnected and the CHECKPOINT IIa plugged in, both the red indicator light and the audible alarm should be on.

Turn the fan system on or connect the pressure tubing to the fan piping. The red light and the audible alarm should go off. The green light should come on.

Now turn the fan off. The red light and audible alarm should come on in about two or three seconds and the green light should go out.

WARRANTY INFORMATION

Subject to applicable consumer protection legislation, RadonAway warrants that the CHECKPOINT IIa will be free from defective material and workmanship for a period of (1) year from the date of purchase. Warranty is contingent on installation in accordance with the instructions provided. This warranty does not apply where repairs or alterations have been made or attempted by others; or the unit has been abused or misused. Warranty does not include damage in shipment unless the damage is due to the negligence of RadonAway. All other warranties, expressed or written, are not valid. To make a claim under these limited warranties, you must return the defective item to RadonAway with a copy of the purchase receipt. RadonAway is not responsible for installation or removal cost associated with this warranty. In no case is RadonAway liable beyond the repair or replacement of the defective product FOB RadonAway.

THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. THERE IS NO WARRANTY OF MERCHANTIBILITY. ALL OTHER WARRANTIES, EXPRESSED OR WRITTEN, ARE NOT VALID.

For service under these warranties, contact RadonAway for a Return Material Authorization (RMA) number and shipping information. **No returns can be accepted without an RMA.** If factory return is required, the customer assumes all shipping costs to and from factory.

Manufactured by:
RadonAway
Ward Hill, MA
(978)-521-3703

Appendix 14 Project Schedule

11-28 31st Drive - Estimated Remediation Project Schedule

ID	Task	Durantion	Start	Finish
1	Construction Notice Fact Sheet			
2	Obtain Permits	10 days?	Mon 10/3/13	Wed 10/12/16
3	Demolition of Existing Building	20 days?	Thur 10/13/16	Tue 11/1/16
4	RAWP Implementation	90 days?	Wed 11/2/16	Thur 2/2/17
5	Final Engineering Report (FER) & Site Management Plan (SMP)	61 days?	Fri 2/3/17	Mon 4/3/17
6	FER Fact Sheet	1 day	Tue 4/4/17	Tue 4/4/17
7	DEC Review and Approval of FER and SMP	25 days?	Wed 4/5/17	Mon 5/1/17
8	Certificate of Completion	1 day?	Mon 5/15/17	Mon 5/15/17
9	IC/EC Notice Fact Sheet (within 10 days of Notice)	1 day?	Fri 5/27/17	Fri 5/27/17
10	Environmental Easment Development/Filing	30 days?	Wed 3/1/16	Wed 3/31/16
11	Implement SMP (Operations, Maintainence and Annual Inspections)	TBD	TBD	TBD