FORMER NU-CLEAR CLEANERS SITE
180 E. Park Avenue
Long Beach, NY
Block 59 Lots 32-35

REMEDIAL ACTION WORK PLAN

JUNE 2020

Prepared for:

180 Park Avenue LLC
54 Regent Drive
Lido Beach, NY 11561

AMC Engineering, PLLC
18-36 42nd Street,
Astoria, NY 11105
(516) 545-0474

CERTIFICATIONS

I ___________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).

___________________________	_________________	_________________
NYS Professional Engineer #	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.

TABLE OF CONTENTS
REMEDIAL ACTION WORK PLAN
Former Nu-Clear Cleaners Site

EXECUTIVE SUMMARY i

1.0 INTRODUCTION 1
  1.1 SITE LOCATION AND DESCRIPTION 1
  1.2 CONTEMPLATED REDEVELOPMENT PLAN 2
  1.3 DESCRIPTION OF SURROUNDING PROPERTY 2

2.0 DESCRIPTION OF REMEDIAL INVESTIGATION FINDINGS 3
  2.1 SUMMARY OF REMEDIAL INVESTIGATIONS PERFORMED 3
    2.1.1 Soil Borings 3
    2.1.2 Monitoring Wells 3
    2.1.3 Samples Collected 4
      2.1.3.1 Soil Samples 4
      2.1.3.2 Groundwater Samples 4
      2.1.3.3 Soil Gas Samples 5
    2.1.4 Chemical Analytical Work Performed 5
    2.1.5 Documentation 5
  2.2 SIGNIFICANT THREAT 5
  2.3 SITE HISTORY 6
    2.3.1 Past Uses and Ownership 6
    2.3.2 Summary of Previous Reports 6
  2.4 GEOLOGICAL CONDITIONS 10
  2.5 CONTAMINATION CONDITIONS 11
    2.5.1 Conceptual Model of Site Contamination 11
    2.5.2 Description of Areas of Concern 11
    2.5.3 Soil/Fill Contamination 11
      2.5.3.1 Summary of Soil/Fill Contamination 12
      2.5.3.2 Comparison of Soil/Fill to SCGs 12
    2.5.4 Groundwater Contamination 12
      2.5.4.1 Summary of Groundwater Contamination 12
      2.5.4.2 Comparison of Groundwater with SCGs 13
    2.5.5 Soil Vapor Contamination 13
      2.5.5.1 Summary of Soil Vapor Contamination 13
  2.6 ENVIRONMENTAL AND PUBLIC HEALTH ASSESSMENTS 14
    2.6.1 Qualitative Human Health Exposure Assessment 14
    2.6.2 Fish & Wildlife Remedial Impact Analysis 16
  2.7 REMEDIAL ACTION OBJECTIVES 17
    2.7.1 Groundwater 17
    2.7.2 Soil 17
    2.7.3 Soil Vapor 18

TABLE OF CONTENTS
REMEDIAL ACTION WORK PLAN
Former Nu-Clear Cleaners Site

3.0 DESCRIPTION OF REMEDIAL ACTION PLAN 19
- 3.1 EVALUATION OF REMEDIAL ALTERNATIVES 19
- 3.2 STANDARDS, CRITERIA AND GUIDANCE (SCG) 19
  - 3.3 ALTERNATIVE ANALYSIS 21
- 3.4 REMEDIAL ALTERNATIVE 1 23
  - 3.4.1 Overall Protection of Human Health and the Environment 23
  - 3.4.2 Compliance with Remedial Goals, SCGs and RAOs 23
  - 3.4.3 Long-Term Effectiveness and Permanence 23
  - 3.4.4 Reduction in Toxicity, Mobility or Volume Through Treatment 24
  - 3.4.5 Short-Term Effectiveness 24
  - 3.4.6 Implementability 24
  - 3.4.7 Cost…… 25
  - 3.4.8 Compatibility with Land Use 25
  - 3.4.9 Community Acceptance 25
- 3.5 REMEDIAL ALTERNATIVE 2 26
  - 3.5.1 Overall Protection of Human Health and the Environment 26
  - 3.5.2 Compliance with Remedial Goals, SCGs and RAOs 26
  - 3.5.3 Long-term Effectiveness and Permanence 27
  - 3.5.4 Reduction in Toxicity, Mobility or Volume through Treatment 27
  - 3.5.5 Short-term Effectiveness 27
  - 3.5.6 Implementability 28
  - 3.5.7 Cost…… 28
  - 3.5.8 Compatibility with Land Use 28
  - 3.5.9 Community Acceptance 28
- 3.6 REMEDIAL ALTERNATIVE 3 29
  - 3.6.1 Overall Protection of Human Health and the Environment 29
  - 3.6.2 Compliance with Remedial Goals, SCGs and RAOs 29
  - 3.6.3 Long-term Effectiveness and Permanence 29
  - 3.6.4 Reduction in Toxicity, Mobility or Volume through Treatment 29
  - 3.6.5 Short-term Effectiveness 30
  - 3.6.6 Implementability 30
  - 3.6.7 Cost…… 30
  - 3.6.8 Compatibility with Land Use 31
  - 3.6.9 Community Acceptance 31
- 3.7 SELECTION OF THE PREFERRED REMEDY 31
  - 3.7.1 Preferred Land Use Factor Evaluation 31
- 3.8 SUMMARY OF SELECTED REMEDIAL ACTIONS 34

TABLE OF CONTENTS
REMEDIAL ACTION WORK PLAN
Former Nu-Clear Cleaners Site

4.0 REMEDIAL ACTION PROGRAM 36
  4.1 GOVERNING DOCUMENTS 36
    4.1.1 Health and Safety Plan (HASP) 36
    4.1.2 Quality Assurance Project Plan (QAPP) 37
    4.1.3 Construction Quality Assurance Plan (CQAP) 38
    4.1.4 Soil/Materials Management Plan (SoMP) 39
    4.1.5 Erosion and Sediment Control Plan (ESCP) 39
    4.1.6 Community and Environment Response Plan (CERP) 39
    4.1.7 Contractors Site Operations Plan (SOP) 39
    4.1.8 Community Participation Plan (CPP) 40
  4.2 GENERAL REMEDIAL ACTION INFORMATION 41
    4.2.1 Project Organization 41
    4.2.2 Remedial Engineer 41
    4.2.3 Remedial Action Schedule 41
    4.2.4 Work Hours 42
    4.2.5 Site Security 42
    4.2.6 Traffic Control 42
    4.2.7 Worker Training and Monitoring 43
    4.2.8 Agency Approvals 44
    4.2.9 Pre-Construction Meeting with NYSDEC 44
    4.2.10 Emergency Contact Information 44
    4.2.11 Remedial Action Costs 45
  4.3 SITE PREPARATION 45
    4.3.1 Mobilization 45
    4.3.2 Erosion and Sedimentation Controls 45
    4.3.3 Stabilized Construction Entrance(s) 45
    4.3.4 Utility Marker and Easements Layout 46
    4.3.5 Sheeting and Shoring 46
    4.3.6 Equipment and Material Staging 46
    4.3.7 Decontamination Area 47
    4.3.8 Site Fencing 47
    4.3.9 Demobilization 47
  4.4 REPORTING ………........ 47
    4.4.1 Daily Reports 47
    4.4.2 Monthly Reports 48
    4.4.3 Other Reporting 48
    4.4.4 Complaint Management Plan 49
    4.4.5 Deviations from the Remedial Action Work Plan 49

TABLE OF CONTENTS
REMEDIAL ACTION WORK PLAN
Former Nu-Clear Cleaners Site

5.0 REMEDIAL ACTION: MATERIAL REMOVAL FROM SITE 50
  5.1 SOIL EXCAVATION 50
    5.1.1 Soil Cleanup Objectives 51
  5.2 REMEDIAL PERFORMANCE EVALUATION (END-POINT) 51
    5.2.1 End-Point Sampling Frequency 51
    5.2.2 Methodology 51
  5.2.3 Reporting of Results 52
    5.2.4 QA/QC 52
    5.2.5 DUSR 53
    5.2.6 Reporting of End-Point Data in FER 53
  5.3 ESTIMATED MATERIAL REMOVAL QUANTITIES 53
  5.4 SOIL/MATERIALS MANAGEMENT PLAN 53
  5.4.1 Excavation of Petroleum / CVOC Contaminated Soil 55
    5.4.2 Excavation of Historic Fill Materials 55
    5.4.3 Excavation of Native Soils 56
    5.4.4 Soil Screening Methods 56
    5.4.5 Soil Stockpile Methods 57
    5.4.6 Materials Excavation and Load Out 57
    5.4.7 Materials Transport Off-Site 58
    5.4.8 Materials Disposal Off-Site 59
    5.4.9 Materials Reuse On-Site 64
    5.4.10 Fluids Management 65
    5.4.11 Backfill from Off-Site Sources 65
    5.4.12 Stormwater Pollution Prevention 67
    5.4.13 Contingency Plan 67
    5.4.14 Community Air Monitoring Plan 67
    5.4.15 Odor, Dust and Nuisance Control Plan 68
      5.4.15.1 Odor Control Plan 68
      5.4.15.2 Dust Control Plan 69
      5.4.15.3 Nuisance Control Plan 69

6.0 REMEDIAL ACTION: GROUNDWATER TREATMENT 70
  6.1 CHEMICAL OXIDANT TREATMENT PLAN 70
  6.2 TREATMENT AREA 70
  6.3 OXIDANT MATERIALS 70
  6.4 INJECTION PROCEDURES 71
  6.5 REMEDIAL PERFORMANCE EVALUATION (GROUNDWATER) 72
    6.5.1 Methodology 73
    6.5.2 Reporting of Results 75
    6.5.3 QA/QC 76
    6.5.4 DUSR 76
    6.5.5 Reporting of End-Point Data in FER 77

TABLE OF CONTENTS

REMEDIAL ACTION WORK PLAN
Former Nu-Clear Cleaners Site

7.0 RESIDUAL CONTAMINATION TO REMAIN ONSITE 78

8.0 ENGINEERING CONTROLS 79

9.0 INSTITUTIONAL CONTROLS 80
  9.1 ENVIRONMENTAL EASEMENT 80
  9.2 SITE MANAGEMENT PLAN 81

10.0 FINAL ENGINEERING REPORT 84
  10.1 CERTIFICATIONS 85

11.0 SCHEDULE ……….. 87

TABLE OF CONTENTS
REMEDIAL ACTION WORK PLAN
Former Nu-Clear Cleaners Site

LIST OF TABLES

Table 1 Soil Cleanup Objectives
Table 2 Laboratory Results – Soil Samples, Volatile Organic Compounds
Table 3 Laboratory Results – Soil Samples, Semi-Volatile Organic Compounds
Table 4 Laboratory Results – Soil Samples, TAL Metals
Table 5 Laboratory Results – Soil Samples, Pesticides/PCBs
Table 6 Laboratory Results – Groundwater Samples, Volatile Organic Compounds (1/11/17)
Table 7 Laboratory Results – Groundwater Samples, Semi-Volatile Organic Compounds (1/11/17)
Table 8 Laboratory Results – Groundwater Samples, Total Metals (1/11/17)
Table 9 Laboratory Results – Groundwater Samples, Pesticides/PCBs
Table 10 Laboratory Results – Groundwater Samples, Volatile Organic Compounds (1/25-26/17)
Table 11 Permits
Table 12 Emergency Contact Numbers

LIST OF FIGURES

Figure 1 Site Location Map
Figure 2 Site Plan
Figure 3 Surrounding Property
Figure 4 Sampling Locations
Figure 5 Groundwater Elevation Map
Figure 6 Posted Soil VOC Results
Figure 7 Posted Groundwater VOC Results above AWQS
Figure 8 Posted Groundwater Pesticide/PCB/Metals Results above AWQS
Figure 9 Truck Routes
Figure 10 Excavation Plan
Figure 11 Endpoint Soil Sampling Plan
Figure 12 ISCO Application Plan

ATTACHMENTS

Attachment A Metes and Bounds Description of Property
Attachment B Construction Health & Safety Plan (CHASP)
Attachment C Quality Assurance Project Plan (QAPP)
Attachment D Community Air Monitoring Plan (CAMP)
Attachment E Resumes
Attachment F Estimated Remedial Costs
Attachment G ISCO Specifications

LIST OF ACRONYMS

Acronym	Definition
AMC	AMC Engineering
AWQS	Ambient Water Quality Standards
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CQMP	Construction Quality Management Plan
DUSR	Data Usability Statement Report
EBC	Environmental Business Consultants
FER	Final Engineering Report
HDPE	High Density Polyethylene
IRM	Interim Remedial Measure
NYC	New York City
NYCDEP	New York City Department of Environmental Protection
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PS	Public School
PVC	Polyvinyl Chloride
RAO	Remedial Action Objectives
RAWP	Remedial Action Work Plan
RI	Remedial Investigation
RSCOs	Recommended Site Cleanup Objectives
SCG	Standards, Criteria, and Guidelines
SMMP	Soil/Materials Management Plan
SMP	Site Management Plan
SSDS	Sub-slab Depressurization System
SWPPP	Stormwater Pollution Prevention Plan
SVOCs	Semi-Volatile Organic Compounds
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds

EXECUTIVE SUMMARY

Site Description/Physical Setting/Site History

This Remedial Action Work Plan (RAWP) was prepared on behalf of QB Development Owner LLC for the property located at 180 E Park Avenue, Long Beach, New York (the Site). The property is currently listed as Class 2 site on the Inactive Hazard Waste Site registry, Site No. 341998. An application for acceptance into the New York State Brownfield Cleanup Program (BCP) is being submitted with this RAWP.

When completed, the Site will be redeveloped with a new 2-story commercial retail building.

The Site is located in the City of Long Beach in Nassau County (**Figure 1**) and is comprised of four rectangular shaped tax parcels identified as Section 59, Block 119, Lots 32, 33, 34 and 35. The Site is located in a commercial strip along the E. Park Avenue retail corridor. The Site has 80 feet of street frontage along E. Park Avenue and 100 feet of frontage along Long Beach Boulevard (**Figure 2**) for a total area of 8,000 sf (0.18 acres).

Summary of the Remedial Investigation

A Remedial Investigation was completed at the Site by AEI consultants from December 2016 through January 2017 and documented in a Remedial Investigation Report dated August 22, 2017. The goals of the Remedial Investigation were to define the nature and extent of contamination in soil, groundwater and any other impacted media; to identify the source(s) of the contamination; to assess the impact of the contamination on public health and/or the environment; and to provide information to support the development of a Remedial Action Work Plan to address the contamination.

Activities completed under the RI:

- Sampling for non-petroleum contaminants such as pesticides, PCBs and metals in soil and groundwater including the analysis of soil and groundwater samples;
- Soil sampling and analysis in soil samples from 9 soil boring locations;

- The installation of 5 groundwater monitoring wells;
- The collection and analysis of groundwater samples for petroleum compounds; and,
- The collection of analysis of soil gas samples for VOCs from 2 soil gas sampling locations.

The sampling performed during the RI identified residual chlorinated VOC contamination "Hotspots" present at two locations including shallow soil (3 ft) in the southeast corner of the Site within the former storage area, and in the northwest area of the Site to a depth of 8.5 feet below grade.

Hotspot 1 in the northwest area of the Site had a tetrachloroethylene (PCE) concentration of 3,700 ug/kg. PCE contamination at Hotspot 2 in the southeast area of the Site ranged from 48,000 to 1,3000,000 ug/kg. PCE in an off-site drywell located in the municipal parking lot behind the building was reported at a concentration of 7,400,000 ug/kg. No other chlorinated or petroleum VOCs were reported in soil at the Site.

Petroleum related VOCs and chlorinated VOCs were reported in the northwest corner of the Site above NYSDEC Ambient Water Quality Standards (AWQS) at a single location (MW10). Total petroleum VOCs in groundwater at this location was reported as 796 µg/L. Total CVOCs were reported at 156 µg/L. DP1 located south of MW10 also contained a mixed plume of petroleum VOCs and chlorinated VOCs. Petroleum VOCs at this location totaled 1,095 µg/L. Chlorinated VOCs totaled 8,230. The highest concentration of chlorinated VOCs were reported in the southeast former storage area (TWP1) at a 296,630 µg/L. Chlorinated VOCs south of this area at TWP9 were reported at 13,700 µg/L. There were no petroleum VOCs reported in this area of the Site.

Off-site chlorinated VOCs were reported adjacent to a former drywell at a concentration of 35,500 µg/L. The drywell has since been remediated.

Qualitative Human Health Exposure Assessment

The qualitative exposure assessment identified media and potential human exposure to soil (through dermal contact, incidental ingestion, and inhalation of particulates and vapors), and groundwater (through dermal contact, incidental ingestion, and inhalation of vapors). COPCs were identified by comparison of maximum detected concentrations to applicable soil and groundwater criteria. The COPCs identified in on-Site groundwater include VOCs (PCE, TCE, cis-1,2-DCE, vinyl chloride and gasoline-related compounds). Additional volatile compounds were flagged as COPCs for the soil-to-indoor air pathway. No COPCs were identified in off-Site soils. The COPCs identified in off-Site groundwater include several VOCs (PCE, TCE, cis-1,2-DCE, vinyl chloride). The potentially exposed on-site receptors include future employees, patrons of the business or construction/utility workers. The potentially exposed off-Site receptors include adjacent residents, employees and patrons of the adjacent strip mall businesses, and construction/utility workers.

Summary of the Remedy

The remedy recommended for the Site is a Track 1 alternative (Alternative 1) which consists of excavating the Site to a minimum depth of 3 feet with excavation of two soil hotspot areas to depths of 4 feet and 9 feet respectively. Chemical oxidants will be applied in both hotspot areas along with a third area to treat groundwater. The remedy will include the following items:

1. Demolition of the existing building to allow remediation to proceed;
2. Excavation of soil/fill exceeding Track 1 unrestricted use SCOs as listed in **Table 1** to a minimum depth of 3 feet across the Site with additional excavation to 4 feet and 9 feet in two CVOC residual soil hotspot areas;
3. ISCO treatment of groundwater in the three groundwater hotspot areas;
4. Screening for indications of contamination (by visual means, odor, and monitoring with PID) of all excavated soil during any intrusive Site work;
5. Shoring and SOE work as required to facilitate excavation;
6. Collection and analysis of end-point samples to evaluate the performance of the remedy with respect to attainment of Track 1;

7. Appropriate off-Site disposal of all material removed from the Site in accordance with all Federal, State and local rules and regulations for handling, transport, and disposal;
8. Import of materials to be used for backfill and cover in compliance with: (1) chemical limits and other specifications included in **Table 1**, (2) all Federal, State and local rules and regulations for handling and transport of material;
9. If Track 1 is not achieved, an Environmental Easement will be filed to restrict the land use to commercial.

REMEDIAL ACTION WORK PLAN

1.0 INTRODUCTION

This Remedial Action Work Plan (RAWP) was prepared on behalf of 180 Park Ave LLC for the property located at 180 E Park Avenue, Long Beach, New York (the Site). The property is currently listed as Class 2 site on the Inactive Hazard Waste Site registry, Site No. 341998. An application for acceptance into the New York State Brownfield Cleanup Program (BCP) is being submitted with this RAWP.

This RAWP summarizes the nature and extent of contamination as determined from data gathered during the Remedial Investigation (RI), performed in December 2016 / January 2017. 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 RI for this Site did not identify fish and wildlife resources.

A formal Remedial Design document will not be prepared.

1.1 SITE LOCATION AND DESCRIPTION

The Site is located in the City of Long Beach in Nassau County (**Figure 1**) and is comprised of four rectangular shaped tax parcels identified as Section 59, Block 119, Lots 32, 33, 34 and 35. The Site is located in a commercial strip along the E. Park Avenue retail corridor. The Site has 80 feet of street frontage along E. Park Avenue and 100 feet of frontage along Long Beach Boulevard (**Figure 2**) for a total area of 8,000 sf (0.18 acres).

The Site is bordered to the north by East Park Avenue, to the east by Long Beach Boulevard, to the south by a municipally-owned paved parking area, and to the west by a private commercial/retail property. Currently the Site is developed with a 1-story commercial retail building which was formerly occupied by a dry cleaner and office. The building is currently vacant.

The elevation of the property is approximately 9 feet above mean sea level. The topography within the immediate area is generally flat. Groundwater occurs beneath the Site at a depth of approximately 5 to 6 feet below grade. Based on groundwater elevation at the Site, groundwater flow is to the east and southeast.

1.2 CONTEMPLATED REDEVELOPMENT PLAN

The Volunteer intends to redevelop the property with a new 2-story commercial retail building.

1.3 DESCRIPTION OF SURROUNDING PROPERTY

Surrounding land use (**Figure 3**) includes a strip of commercial – retail buildings along the north and south sides of E. Park Avenue with a parking lot in-between the east and west bound lanes. Single family residential homes are present to the north and south of the commercial strip along E. Park Avenue.

There was one school identified within 1,000 feet of the Site: Harriet Eisman Community School located at 165 E Park Avenue which is approximately 250 feet to the north. There were no day-care centers, nursing homes or hospitals identified within 1,000 feet of the Site.

2.0 DESCRIPTION OF REMEDIAL INVESTIGATION FINDINGS

The field work portion of the Remedial Investigation was conducted by AEI Consultants in December 2016 through January 2017. The investigation is summarized in the sections below. Further details are provided in the Remedial Investigation Report (AEI, August 22, 2017).

2.1 SUMMARY OF REMEDIAL INVESTIGATIONS PERFORMED

2.1.1 Soil Borings

A total of 9 soil borings were advanced between December 19, 2016, and December 21, 2016, to identify source areas and to obtain general soil quality information present at the Site. See **Figure 4** for the locations of all soil borings.

The borings were advanced by Cascade drilling using truck and track-mounted direct-push drill rigs depending upon access at each location. The borings were advanced to depths ranging from 19 to 30 ft-bgs.

The borings were advanced using three (3) inch outer diameter rods and samples were collected by advancing the rods with acetate sample liners in approximately five-foot intervals. After each interval, the core was retrieved, core barrel disassembled, and the sample liner was removed and transferred to the onsite geologist. The sample liners were measured and soils logged using the Unified Soil Classification System.

A photo ionization detector (PID) was used to screen soils in the field and the PID readings are included on each boring log. PID readings were taken every six (6) inches, and ranged from 0 to 290 parts per million (ppm). The samples were placed in laboratory-supplied containers and submitted under chain-of-custody in an ice-filled cooler to a NY-certified analytical laboratory, Alpha Analytical of Westborough, Massachusetts.

2.1.2 Monitoring Wells

Installation of the monitoring wells occurred from December 19, 2016 through December 21, 2016, five permanent groundwater monitoring wells (DP-1, MW-9 through MW-12) were installed by Cascade Drilling. The permanent monitoring well boreholes were advanced using steel casing and direct-push drilling techniques. The permanent monitoring wells are constructed of a 10-foot length of an outer layer 65 mesh stainless steel screen, sand packed with 20 by 40 silica sand over the inner 0.010-inch slotted schedule 40 PVC Screen. The well dimensions are 2.05-inch inner diameter by 2.8-inch outer diameter installed to depths ranging from of 9 to 18 ft-bgs. Monitoring well locations are identified in **Figure 4.**

The wells were extended to ground surface using 2-inch diameter solid PVC riser pipe. Once the wells were installed through the hollow casing, the casing was removed, and the remaining annulus spaces above the screens were filled with hydrated bentonite chips. Flush-mount steel casing/lids set in concrete pads completed the wells at ground surface, and the top of the PVC well casings were secured with lockable caps. Following the well completion, the permanent monitoring wells and top of inner casing were surveyed by a NYS-licensed surveyor. The monitoring wells were developed by purging the screened interval using a whale pump for approximately 20 minutes until the water was free of silt and apparent turbidity. The development water was run through a granular activated carbon filtering system and back to the ground surface.

2.1.3 Samples Collected

A summary of the sampling performed during the RI is provided below and in **Tables 2-10**.

2.1.3.1 Soil Samples

A total of 9 soil samples were retained for laboratory analysis from the 9 soil borings. The soil samples were analyzed for: VOCs EPA Method 8260B, semi-volatiles by EPA Method 8270C, pesticide / PCBs by EPA Method 8081/8082, TAL metals EPA 6010 and herbicides by EPA Method 8151A.

2.1.3.2 Groundwater Samples

Groundwater samples were obtained from all five monitoring wells. All groundwater samples from the monitoring wells were analyzed for VOCs EPA Method 8260B, semi-volatiles by EPA Method 8270C, pesticide / PCBs by EPA Method 8081/8082, TAL metals EPA 6010 and herbicides by EPA Method 8151A.

2.1.3.3 Soil Gas Samples

Soil gas samples were not collected as part of the RI. Soil gas and indoor air samples were previously collected under a separate work plan.

2.1.4 Chemical Analytical Work Performed

Laboratory services for soil and groundwater sample analysis were provided by Alpha Analytical of Westborough, Massachusetts, a New York State ELAP certified environmental laboratory.

Retained soil and groundwater samples were analyzed VOCs EPA Method 8260B, SVOCs by EPA Method 8270, pesticide / PCBs by EPA Method 8081/8082, TAL metals by EPA 6010 and herbicides by EPA Method

2.1.5 Documentation

A map showing the sampling locations is provided in **Figure 4**. The results of sample soil, and groundwater samples collected during the RI are summarized in **Tables 2** through **10** and **Figures 6** through **8**. Below is a summary of the RI findings.

2.2 SIGNIFICANT THREAT

The NYSDEC and NYSDOH have reviewed the RI Report and have determined that the Site poses a significant threat to human health and the environment. Notice of that determination will be provided during the public comment period and the Decision Document.

2.3 SITE HISTORY

2.3.1 Past Uses and Ownership

The Site is currently owned by 180 Park LLC. The property is developed with a 1-story commercial building which is vacant and unoccupied. A metes and bounds descrioption of the Site is provided in **Attachment A – Metes and Bounds**.

The environmental history of the subject property was previously investigated through the review of Federal and State Environmental databases and files and Nassau County Tax Assessor records.

According to the review of these sources the Site was developed with the current building in 1962. Nu-Clear Cleaners has operated at the site as a commercial dry cleaning facility for approximately 58 years since the building was constructed. Nu-Clear had been using tetrachloroethylene (PCE) as part of its dry cleaning operations. In November 2014, the site was inspected and investigated for Resource Conservation and Recovery Act (RCRA) violations and subsequently referred for further action under the State Superfund program. The property was listed as a NYSDEC Class 2 Inactive Hazardous Waste Site in 2016 (Site No. 130221).

2.3.2 Summary of Previous Reports

Environmental investigations performed at the Site include the following:

- Limited soil sampling conducted by the NYSDEC in January 2015;
- Site Investigation (SI) conducted by AEI, July 2015; report dated August 20, 2015;
- Tidal Survey conducted by AEI, December 2015;
- Remedial Investigation conducted by AEI, December 2015; report dated February 8, 2016;
- Vapor Intrusion Investigation conducted by AEI, March 2016; report dated May 20, 2016;
- Remedial Investigation conducted by AEI, December 2016 through January 2017; report dated August 22, 2017.

As summarized by AEI, the 2015 Supplemental SI included:

- Using a Membrane Interface Probe (MIP) /direct-push rig to conduct real-time screening of total VOCs and CVOCs (including PCE and related compounds) at seven (7) locations.
- Advanced seven (7) additional soil borings to 20 ft-bgs in the southeast portion of the Site, and the municipal lot south of the Site.
- Installation of five (5) additional permanent monitoring wells to the south and east of the Site, and groundwater sampling for analysis of VOCs.
- Removal and off-site disposal of approximately 500 gallons of stormwater/groundwater (nine, 55-gallon drums), and approximately 4,500 pounds (four, 55-gallon drums) of PCE impacted soil/sediment (i.e., potential source material) from the interior of the dry well.

The 2016 Vapor Intrusion Investigation included:

- Collection of two (2) sub-slab (SS) vapor samples from beneath the Nu-Clear Cleaners building, and three (3) sub-slab vapor samples from beneath the commercial building (168-172 East Park Avenue) to the west over a 24-hour period.
- Collection of six (6) indoor air samples from within the adjacent commercial building.
- Collection of one background/outdoor air sample (BG-01) from outside the commercial building.
- Analysis of the sub-slab vapor, and indoor/background air samples for VOCs via TO-15 method.

The 2016/2017 RI fieldwork included:

- Advanced nine (9) soil borings for the collection of soil samples at varying depths.
- Analyzed soil samples from the borings for Target Compound List (TCL) VOCs, Semi-VOCs, polychlorinated biphenyls (PCBs), pesticides, herbicides and Target Analyte List (TAL) metals.
- Installed permanent monitoring wells at five (5) soil boring locations.
- Completed two rounds of groundwater sampling and analyzed the samples for TCL VOCs, SVOCs, PCBs, pesticides, TAL metals and herbicides.

The results of the SI and RI investigations indicated that the subsurface soils at the Site consist of grey medium to fine sand with occasional silty clay lenses, and some organic material. There are two (2) continuous low-permeability layers of grey silty-clay with organic material present below the Site at depths of approximately 22 to 23 ft-bgs and at 30 to 32 ft-bgs. Two additional layers may also be continuous at depths of approximately 37 to 39 feet and at 44 to 45 ft-bgs. Two discontinuous layers were also observed at depths of approximately 10 to 11 ft-bgs and 24 to 26 ft-bgs.

Site-related chlorinated VOCs (TCE and PCE) were detected in sub-slab soil gas beneath the Nu-Clear building as well as the adjacent commercial building complex (168 – 172 East Park Avenue). In three (3) of the four (4) sub-slab soil gas samples, the detected concentrations of TCE were greater than “mitigate” levels identified in the May 2017 Matrix A, which is referenced as part of the NYSDOH Guidance Document. Although sub-slab soil gas concentrations of PCE and TCE are elevated, the indoor air concentrations at all indoor air sample locations sampled (IA-01, 02, 03, 06, 07, and IA-08) did not exceed the NYSDOH indoor air values for PCE and TCE.

Soil samples have been collected northwest, west, north, south, and east of the Site building as well as within the building footprint at various depths to investigate soil contamination. Analytical results indicated the following:

- Except for the soil samples collected by the NYSDEC in 2015 along the open trench inside building in 2015, no CVOC impacts were detected in soils above the groundwater table on-site or off-site; in fact, no compound exceeded the most-stringent NYSDEC soil cleanup objectives (SCOs), the NYSDEC Unrestricted SCOs.
- No other SVOCs exceeded any of the NYSDEC SCOs.
- Metals, PCBs, pesticides and herbicides were either not detected, or were detected at concentrations less than their applicable NYSDEC Unrestricted SCOs.

Groundwater samples were collected from permanent monitoring wells located northwest, west, north, south and east of the Site building as well as within the building (DP-1). Analytical results indicated the following:

- Metals, PCBs, pesticides and herbicides were either not detected, or were detected at concentrations less than their applicable NYS Ambient Water Quality Standards (AWQSs) an groundwater samples collected.
- Immediately beneath the on-Site building, shallow well DP-1 had several VOCs exceeding the applicable NYS AWQS. Although PCE and TCE were not detected above laboratory detection limits, PCE daughter compounds cis-1,2-Dichloroethylene (DCE) and vinyl chloride were detected at 2,600 micrograms per liter (ug/l) and 5,600 ug/l.
- Groundwater delineation is complete to the northwest and west. The two wells northwest and west of the subject building (MW-11 and MW-12) indicate VOC concentrations do not exceed their respective NYSDEC AWQS. Therefore, these wells horizontally delineate the outer extent of the PCE plume northwest and west of the Site.
- Groundwater delineation is complete to the north. The two wells north of the Site building (MW-1 and MW-10) had several VOC concentrations exceeding the applicable NYSDEC objectives; however, the compounds are mainly petroleum contaminants. Therefore, these wells horizontally delineate the outer extent of the PCE plume north of the Site.
- Groundwater delineation is complete to the east and southeast. Groundwater sample results at MW-5, MW-6 and MW-7 delineate the extent of the PCE plume to the east and southeast of the subject building, as no PCE or daughter products were detected.
- Groundwater delineation is complete to the south. Groundwater sample results at MW-2 shows PCE concentration above the respective NYSDEC AWQS, whereas MW-3 does not have detections or exceedances of VOC concentrations. MW-8 and MW-9 do not have detections or exceedances of PCE or daughter-compounds. Therefore, these two wells horizontally delineate the outer extent of the PCE plume south of the Site.
- Groundwater is vertically delineated. Monitoring well MW-4D was screened from 40-45 ft-bgs, below a silty clay confining layer at 30 ft-bgs, to vertically-delineate PCE impacts.

Based on the results, contamination extends to this depth, but it is unlikely that contamination extends deeper than 45 ft-bgs due to the low concentration (6.2 ug/l). Based on the results of the previous investigations and the RI, Site-related chlorinated VOCs have been delineated vertically and horizontally relative to the applicable NYSDEC cleanup objectives in soil, groundwater, and vapor.

2.4 GEOLOGICAL CONDITIONS

According to the Remedial Investigation Report (AEI 4/23/18), surficial soils in Long Beach are generally nearly level or gently sloping, excessively drained to moderately well drained, contains coarse textured soils, beaches, and urban land on barrier beaches. They include isolated clay lenses within the sandy soil that create a perch for groundwater. The thickness reportedly ranges from four to 10 feet thick, and overlie organic tidal marsh sediments.

Groundwater in the shallow, unconsolidated sediments is generally encountered at depths greater than four feet beneath ground surface (ft-bgs), and generally flows south towards the Atlantic Ocean. The Site is located approximately 1,900 feet from the ocean. The entire property is located within a designated 1% (100yr) flood zone with a base flood elevation of 10 ft.

Long Beach obtains its water from deep wells screened in the deepest water bearing formation in Nassau County, the Lloyd formation. The formation lies approximately 1,200 feet beneath the surface and rests upon bedrock varying between 1,400 and 1,500 feet below sea level. The surface of the bedrock slopes at a rate of 60 to 80 feet per mile or 1½ percent to the southeast. The rock consists primarily of schists and gneisses.

Soil at the site consists of medium sand and gravel to at least 30 ft below grade. The depth to groundwater varies from 5 to 6 feet below grade. According to groundwater elevation as measured at the Site, the flow direction is east to southeast (**Figure 5**).

2.5 CONTAMINATION CONDITIONS

2.5.1 Conceptual Model of Site Contamination

Chlorinated solvent tetrachloroethene (PCE) was released at the Site sometime during its long use (50+yrs) as a dry cleaner. The contamination in soil is limited to two "hotspot" areas including the southeast corner of the building in an area where it was reported that both waste solvent and new solvent had been stored, and in the northwest area of the Site in the parking lot. For the southeast hotspot, the solvent was likely released to the subsurface from incidental spillage near the storage area and into a shallow trench located in this area. One released the solvent impacted shallow soil 1 to 3 feet below the slab and transferred to the shallow groundwater located 5 to 6 feet below grade. How PCE was discharged to the northwest hotspot is unknown but the contamination was reported at a depth of 8.5 feet below the surface suggesting that a former drywell or cesspool was located in this area.

PCE in groundwater came into contact with dissolved phase petroleum VOCs which were likely related to minor releases from parked cars and trucks. This resulted in reductive dechlorinization of the PCE to trichloroethene (TCE), cis-1,2-dichloroethene (cis-DCE) and vinyl chloride in sequence.

PCE and TCE are off-gassing from the shallow soil and to a lesser extent groundwater and have accumulated under the building slab.

2.5.2 Description of Areas of Concern

The primary area of concern is the former storage area located in the southeast corner of the Site.

2.5.3 Soil/Fill Contamination

Residual chlorinated VOC contamination is present in shallow soil in the southeast corner of the Site within the former storage area. The vertical extent of impact is limited to the top 3 feet of soil. A second hotspot is present in the northwest area of the site to a depth of 8.5 feet below grade.

No evidence of fill material or soil with non CVOC parameters above unrestricted soil cleanup objectives (SSOs) has been reported at the Site.

2.5.3.1 Summary of Soil/Fill Data

Soil sample results from the RI are summarized in **Tables 2-5**. Further information on soil sample collection, handling and analysis can be found in the RI Report (AEI August 2017).

2.5.3.2 Comparison of Soil/Fill with SCGs

Tables 3-5 are compared to unrestricted, restricted residential and restricted commercial SCOs. **Figure 6** is a spider map which shows soil sampling locations and summarizes sample results above Track 1 Unrestricted SCOs for all overburden soil.

2.5.4 On-Site and Off-Site Groundwater Contamination

Petroleum related VOCs and chlorinated VOCs were reported in the northwest corner of the Site above NYSDEC Ambient Water Quality Standards (AWQS) at a single location (MW10). Total petroleum VOCs in groundwater at this location was reported as 796 µg/L. Total CVOCs were reported at 156 µg/L. DP1 located south of MW10 also contained a mixed plume of petroleum VOCs and chlorinated VOCs. Petroleum VOCs at this location totaled 1,095 µg/L. Chlorinated VOCs totaled 8,230. The highest concentration of chlorinated VOCs were reported in the southeast former storage area (TWP1) at a 296,630 µg/L. Chlorinated VOCs south of this area at TWP9 were reported at 13,700 µg/L. There were no petroleum VOCs reported in this area of the Site.

Off-site chlorinated VOCs were reported adjacent to a former drywell at a concentration of 35,500 µg/L. The drywell has since been remediated.

2.5.4.1 Summary of Groundwater Data

The results of groundwater samples collected during the RI are summarized in **6-10**. Further information on groundwater sample collection, handling and analysis can be found in the RI Report (AEI August 2017).

2.5.4.2 Comparison of Groundwater with SCGs

Spider maps which show groundwater sampling locations and summarize results above GA groundwater standards prior to the remedy are shown in **Figures 7 and 8**.

2.5.5 On-Site and Off-Site Soil Vapor Contamination

Subslab vapor samples were collected from two locations on the Site: SS6 located in the west central area of the Site and SS7 located in the south central area of the Site. The results are as follows:

- Chloroform was detected in SS-03 and SS-06 at 51.3 and 213 µg/m3.
- Tetrachloroethylene (PCE) was detected in SS-07 and SS-06 at 10,400 and 1,990 µg/m3.
- Trichloroethylene (TCE) was detected in SS-02 at 2,970 µg/m3, SS-03 at 650 µg/m3, SS-06 at 1,090 µg/m3 and SS-07 at 3,960 µg/m3.

Three off-site samples subslab vapor samples (SS-01 to SS-03) and six indoor air samples (IA-01 to IA-03 and IA-06 to IA-08) were collected from adjacent commercial buildings to the west and two residential homes located to the southwest.

The analytical results for indoor air samples collected within the commercial building complex to the west of the Site did not indicate any constituent concentrations exceeded their applicable EPA VISLs. Additionally, the concentrations of TCE, PCE and other VOCs detected in the background (outdoor) air sample were similar to, or higher than, comparable constituent concentrations in samples collected from within the commercial tenant spaces. Therefore, detection of these compounds in indoor air is likely attributable to background/outdoor sources. The concentrations of PCE and TCE detected in the background (outdoor) air samples were 3.1 ug/m3 and 0.75 ug/m3, respectively.

2.5.5.1 Summary of Soil Vapor Data

Information on soil gas sample collection, handling and analysis can be found in the Vapor Intrusion Technical Memorandum (AEI 4/22/2015).

2.6 ENVIRONMENTAL AND PUBLIC HEALTH ASSESSMENTS

2.6.1 Qualitative Human Health Exposure Assessment

The objective of the qualitative exposure assessment under the Brownfields Cleanup Program (BCP) is to identify potential receptors to the contaminants of concern (COC) that are present at, or migrating from, the Site. The identification of exposure pathways describes the route that the COC takes to travel from the source to the receptor. An identified pathway indicates that the potential for exposure exists; it does not imply that exposures actually occur. An exposure pathway has five elements; a contaminant source, release and transport mechanisms, point of exposure, route of exposure and a receptor population.

An exposure pathway is complete if the following elements are present:

- A source or a release from a source;
- A probable environmental migration route of a Site-related Contaminant of potential concern (COPC);
- An exposure point where a receptor may come in contact with a Site-related COPC (e.g., surface and subsurface soil);
- A route by which a Site-related COPC may enter a potential receptor's body (e.g., ingestion, dermal contact, or inhalation); and,
- A receptor population which is potentially exposed.

If any of these elements are not present, the exposure pathway is considered incomplete and does not contribute to the total exposure from the Site. The first element, a source or release from a source, is satisfied at the Site. The remaining elements are described as follows:

- <u>Potential Migration</u> - During ground intrusive activity, such as excavating soil for utility trenching or general construction, COPCs could volatilize into ambient air and be inhaled by a construction/utility worker. During potential future excavation activities, groundwater may accumulate or pool in the bottom of the excavation, therefore direct contact with groundwater by a construction/utility worker would be considered to be a complete exposure pathway both on-Site and off-Site. Potential on-Site receptors would include employees, and potential off-Site receptors would include adjacent residents and employees of the adjacent strip mall property. The VOCs can migrate into the indoor air of a building constructed over impacted soil and groundwater. Thus, exposure to indoor air concentrations resulting from soil and groundwater impacts is a potentially complete on-Site exposure pathway for the employees, and off-Site for residents and employees.

- <u>Potential Exposure Points</u> – Since the Site is covered in impervious surface, exposure pathways for COPCs present in undisturbed soils is limited to construction/utility workers. The indoor air exposure pathway for COPCs present in groundwater and soils has a potential to be complete however; the data from the Vapor Intrusion Technical Memorandum noted that while the sub-slab soil gas concentrations of PCE and TCE were elevated, the indoor air concentrations did not exceed the NYSDOH indoor air values. These data suggest that the existing slab is serving as an effective engineering control to mitigate vapor intrusion from the subsurface.

- <u>Potential Exposure Routes</u> - Based on the physical conditions of the Site and off-Site locations, potential exposure routes associated with soil include incidental ingestion, direct dermal contact, and inhalation (airborne particulate and/or vapors). Potential exposure routes associated with groundwater include incidental ingestion, direct dermal contact, and inhalation (vapors). Based on the affected media and impervious surfaces, the potential exposure route for incidental ingestion and direct dermal contact to soil and/or groundwater would be limited to construction or utility workers.

- <u>Exposure Pathways</u> - Based on an understanding of the components of an exposure pathway and the current/future conditions of the Site, potential human exposure pathways were identified in the assessment. The potential human populations considered relevant to the assessment include on-Site workers involved in general construction activities or utility excavations, future workers and patrons of the on-site and adjacent businesses and off-Site adjacent residents or workers involved in general construction activities or utility excavations. Based on the affected media and impervious surfaces, the potential exposure pathway for incidental ingestion and direct dermal contact is limited to construction or utility workers.

The qualitative exposure assessment identified media and potential human exposure to soil (through dermal contact, incidental ingestion, and inhalation of particulates and vapors), and groundwater (through dermal contact, incidental ingestion, and inhalation of vapors). COPCs were identified by comparison of maximum detected concentrations to applicable soil and groundwater criteria. The COPCs identified in on-Site groundwater include VOCs (PCE, TCE, cis-1,2-DCE, vinyl chloride and gasoline-related compounds). Additional volatile compounds were flagged as COPCs for the soil-to-indoor air pathway. No COPCs were identified in off-Site soils. The COPCs identified in off-Site groundwater include several VOCs (PCE, TCE, cis-1,2-DCE, vinyl chloride). The potentially exposed on-site receptors include future employees, patrons of the business or construction/utility workers. The potentially exposed off-Site receptors include adjacent residents, employees and patrons of the adjacent strip mall businesses, and construction/utility workers.

Potential human exposure to COPCs via inhalation applies to on-site employees, construction/utility workers, patrons of the adjacent strip mall business, and off-site residents. However, potential human exposure to COPCs via direct dermal contact or ingestion of soil and/or groundwater is limited to on-site construction/utility workers.

On-Site construction / remediation workers involved in the redevelopment of the property may be exposed to CVOCs through inhalation, ingestion and dermal contact. A site-specific Health and Safety Plan has been developed to identify and minimize the potential hazards to on-site workers.

Off-site workers in adjacent buildings, off-Site residents and future on-site workers may be exposed to CVOCs in soil vapor if remedial actions are not taken. Remediation of the source area and installation of a vapor barrier beneath the new building are expected to significantly reduce or eliminate this potential.

2.6.2 Fish & Wildlife Remedial Impact Analysis

In accordance with the DER-10 subsection 3.10.1, an evaluation of the resources was conducted for the Site on January 25th, 2017. The Site is impervious ground (covered with concrete and asphalt) and does not provide terrestrial habitats or a potential for overland surface water flow. There are no wetland areas or streams on or within a half mile of the Site. There are no fish, wildlife or species of special concern on or within a half mile of the Site. The soil analytical results from samples collected from the exterior of the building within the surface to two ft-bgs do not have detections of target compound concentrations. The results of the FWRIA indicated that further sampling and completion of an Ecological Impact Assessment is not warranted.

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.

2.7.1 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

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

2.7.2 Soil

RAOs for Public Health Protection

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

RAOs for Environmental Protection

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

2.7.3 Soil Vapor

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

3.0 DESCRIPTION OF REMEDIAL ACTION PLAN

3.1 EVALUATION OF REMEDIAL ALTERNATIVES

The goal of the remedy selection process under the BCP 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 RAOs for media in which chemical constituents were found in exceedance of NYSDEC standards, criteria and guidance values (SCGs). A remedy is then developed based on the following nine criteria:

- Protection of human health and the environment;
- Compliance with 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 first two criteria are threshold criteria and must be satisfied in order for an alternative to be considered for selection. The remaining seven criteria are balancing criteria which are used to compare the positive and negative aspects of each of the remedial alternatives, provided the alternative satisfies the threshold criteria.

3.2 STANDARDS, CRITERIA AND GUIDANCE (SCG)

A criterion for remedy selection is evaluation for conformance with SCGs that are applicable, relevant and appropriate. Principal SCGs that are applicable, relevant and appropriate for evaluating the alternatives for remediation of this BCP site include the following:

- 29 CFR Part 1910.120 - Hazardous Waste Operations and Emergency Response

- 10 NYCRR Part 67 – Lead
- 6 NYCRR Part 371 - Identification and Listing of Hazardous Wastes (November 1998)
- 6 NYCRR Part 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities (November 1998)
- 6 NYCRR Subpart 374-1 - Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities (November 1998)
- 6 NYCRR Part 375 - 6 NYCRR Part 375 Environmental Remediation Programs Subparts 375-1, 375-3 and 375-6 (December 2006)
- 6 NYCRR Part 376 - Land Disposal Restrictions
- 6 NYCRR Part 608 - Use and Protection of Waters
- 6 NYCRR Parts 700-706 - Water Quality Standards (June 1998)
- 6 NYCRR Part 750 through 758 - Implementation of NPDES Program in NYS (“SPDES Regulations”)
- 6 NYCRR Part 375-6 Soil Cleanup Objectives
- New York State Groundwater Quality Standards – 6 NYCRR Part 703;
- NYSDEC Ambient Water Quality Standards and Guidance Values – TOGS 1.1.1;
- NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation - May 2010;
- NYSDEC Draft Brownfield Cleanup Program Guide – May 2004;
- New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan
- NYS Waste Transporter Permits – 6 NYCRR Part 364;
- NYS Solid Waste Management Requirements – 6 NYCRR Part 360 and Part 364.
- TAGM 4059 - Making Changes To Selected Remedies (May 1998)
- STARS #1 - Petroleum-Contaminated Soil Guidance Policy
- TAGM 3028 - "Contained In" Criteria for Environmental Media: Soil Action Levels (August 1997)
- DER-10, Technical Guidance for Site Investigation and Remediation, May 2010
- DER-23 / Citizen Participation Handbook for Remedial Programs, January 2010

- OSWER Directive 9200.4-17 - Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites (November 1997)

Additional regulations and guidance are applicable, relevant, and appropriate to the remedial alternatives and will be complied in connection with implementation of the remedial program; however, the list above is intended to represent the principal SCGs which should be considered in evaluating the remedial alternatives for the BCP site.

Conformance with the appropriate standards for remediation of contaminated soil is an important criterion in evaluating the remedial alternatives for the BCP site. Presently, in New York State 6 NYCRR Part 375 establishes the primary SCGs associated with remediation of contaminated soil at sites which are in the BCP. If proposing remediation pursuant to a Track other than Track 1 (Unrestricted Use), 6 NYCRR Part 375 requires evaluation of at least one remedial alternative pursuant to Track I (Unrestricted Use) and one other alternative developed by the applicant for the proposed use of the BCP site. The remedial alternatives presented in Section 3.3 of this work plan have been prepared in conformance with this requirement.

3.3 ALTERNATIVES ANALYSIS

The goal of the remedy selection process under the BCP 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 RAOs for media in which chemical constituents were found in exceedance of NYSDEC standards, criteria and guidance values (SCGs). A remedy is then developed based on the nine criteria identified in section 3.1.

The following is a detailed description of the alternatives analysis and remedy selection to address impacted media at the Site. This analysis was prepared in accordance with 6 NYCRR Part 375-1.8(f) and Part 375-3.8(f) and Section 4.3(c) of NYSDEC DER-10. As required, a minimum of two remedial alternatives (including a Track 1 scenario) are evaluated, as follows:

- Alternative 1 - Track 1. This alternative requires remediation of all soils above bedrock to unrestricted use criteria. This would include excavation to a minimum depth of 3 feet across the Site, with additional excavation in two hotspot areas to depths of 9 feet (northwest area) and to 4 feet (southeast area). The Alternative would also include treatment of groundwater beneath the Site with in-situ chemical oxidant injections to remediate groundwater. This alternative does not allow the use of long-term institutional /engineering controls to address impacted media or prevent exposures which may be required beneath the new building. An SSD system is not expected to be required for this alternative following remediation of the source. However, if long term operation of an SSD was required this Alternative would not be achieved.

- Alternative 2 - Track 2. This alternative requires remediation of all soils to commercial use criteria to a depth of 15 feet if soils below 15 feet do not represent a source of contamination. Meeting this alternative would require a lesser degree of excavation than Alternative 1 to meet SCOs including excavation to a depth of 4 feet and 9 feet within the two source areas only. In-situ chemical oxidant (ISCO) injections will be performed to treat groundwater within the source area. This alternative does not allow the use of long-term institutional /engineering controls to meet soil cleanup objectives. Long-term institutional /engineering controls are allowed to address or prevent exposures from other impacted media. An SSD system is not expected to be required for this alternative though it would be allowed under this alternative.

- Alternative 3 – Track 4. A Track 4 cleanup will require the remediation / replacement of all soils in the upper two feet to meet Restricted Residential SCOs or covering with the building slab or other impervious cover. This alternative would require capping of the entire site with the building slab. Since this alternative allows the use of long-term Institutional/Engineering Controls (>5yrs) to meet soil cleanup objectives and to address or prevent exposures from other impacted media such as soil gas, it is presented as a contingency to Alternative 2 in the event that on-going engineering controls are required. Since this alternative would leave residual CVOCs behind, an SSDS would be required.

3.4 REMEDIAL ALTERNATIVE 1

The following sections provide an evaluation of Alternative 1 based on the nine evaluation criteria as previously discussed.

3.4.1 Overall Protection of Human Health and the Environment

Alternative 1 will be protective of human health and the environment by eliminating constituents in soil related to CVOCs and remediating groundwater. The potential for human and environmental exposure to these constituents on-site will be eliminated by excavation all CVOC impacted soils with parameters in excess of unrestricted criteria, disposing of excavated materials off-site, treatment of groundwater with chemical oxidants and backfilling as needed with certified clean fill, virgin mined materials or recycled concrete materials from a NYSDEC permitted recycling facility. Potential post-remediation exposures to on-site residents from soil vapors are not expected to require the operation of SSD systems, though groundwater use will be restricted at the Site until groundwater quality recovers. A soil vapor intrusion evaluation may be needed to determine if CVOCs in soil gas have the potential to impact the new building.

During remedial and construction activity workers and area residents may be exposed to impacted soil and vapors. Worker exposure to soil and vapors will be minimized through implementation of a Health and Safety Plan. Exposures to area residents from dust and/or vapors will be minimized through the use of engineering controls and through implementation of a Community Air Monitoring Plan (CAMP).

3.4.2 Compliance with Remedial Goals, SCGs and RAOs

Alternative 1 will achieve compliance with the remedial goals, SCGs and RAOs for soil through source removal to Track 1 unrestricted cleanup levels. SCGs for groundwater will also be achieved as impacted groundwater will be treated with chemical oxidants. Compliance with SCGs for soil vapor is expected following completion of the remedial action.

3.4.3 Long-Term Effectiveness and Permanence

Alternative 1 achieves long term effectiveness and permanence by permanently removing and/or remediating all soils affected by Site contaminants or historic fill materials and by remediating groundwater. Under this Alternative, risk from soil impacts and groundwater will be eliminated. Alternative 1 will continue to meet RAOs for soil, groundwater and soil vapor in the future, providing a permanent long-term solution for the Site.

3.4.4 Reduction in Toxicity, Mobility or Volume through Treatment

Alternative 1 will permanently eliminate the toxicity, mobility, and volume of contaminants from on-site soil by meeting unrestricted objectives through excavation and from on-site groundwater by in-situ treatment.

3.4.5 Short-Term Effectiveness

The potential for short-term adverse impacts and risks to the workers, the community, and the environment during the implementation of Alternative 1 is minimal.

Short-term exposure to on-site workers during excavation and loading activities will be addressed with a HASP and mitigated through the use of personal protective equipment, monitoring and engineering controls. Potential short-term exposure to the surrounding community will be addressed through the use of odor and dust-suppression techniques and through the implementation of a CAMP which will require air monitoring activities during all excavation and soil disturbance activities.

Other potential impacts to the community such as construction-related noise, vibrations and traffic, will be controlled and regulated under the terms of the NYC Department of Buildings issued building permit which can place a Stop Work Order on the property for unsafe conditions, community impacts or violation of the terms and conditions of the permit. Decontamination procedures of equipment, including trucks transporting soil to off-site disposal facilities, will minimize the potential for impacted soil to be dispersed beyond the Site boundary. A truck traffic plan has also been prepared to minimize disturbance to the local roads and community.

3.4.6 Implementability

The techniques, materials and equipment to implement Alternative 1 are readily available and have been proven effective in remediating the contaminants associated with the Site. Excavation for the remediation of soils and the injection of chemical oxidants for remediation of groundwater are reliable methods which have a long and proven track record on the remediation of hazardous waste and petroleum spill sites.

3.4.7 Cost

Costs associated with Alternative 1 are estimated at approximately $ 319,231. This cost estimate includes the following elements and assumptions:

- Excavate to a minimum depth of 3 feet across the Site with the exception of two CVOC hotspot areas;
- Excavate two CVOC hotspot areas to depths of 9 ft and 4 feet, respectively;
- Loading, transportation and disposal of approximately 130 cy of hazardous PCE contaminated soil;
- Loading, transportation and disposal of approximately 936 cy of historic fill / non-hazardous CVOC impacted soil;
- Chemical Oxidant application to treat impacted groundwater;
- Waste characterization and endpoint verification sampling and analysis;
- HASP and CAMP monitoring for the duration of the remedial activities; and,
- Preparation of a Final Engineering Report.

3.4.8 Compatibility with Land Use

The proposed redevelopment of the Site is compatible with its current B1 commercial zoning. Following remediation, the Site will meet unrestricted use objectives which will exceed the objectives for its planned commercial-retail use.

3.4.9 Community Acceptance

This RAWP will be subject to a 45-day public comment period to determine if the community has comments on the presented remedial alternatives and selected remedy. If no comments are received regarding Alternative 1, it will be considered to be acceptable to the community.

3.5 REMEDIAL ALTERNATIVE 2

The following sections provide an evaluation of Alternative 2 based on the nine evaluation criteria as previously discussed.

3.5.1 Overall Protection of Human Health and the Environment

Alternative 2 will be protective of human health and the environment by eliminating constituents in soil related to CVOCs and by remediating groundwater. The potential for human and environmental exposure to these constituents on-site will be eliminated by excavation / remediation of all CVOC contaminated soil with parameters in excess of commercial criteria within the top 15 feet and groundwater through ISCO application, disposing of excavated materials off-site and backfilling as needed with certified clean fill, virgin mined materials or recycled concrete materials from a NYSDEC permitted recycling facility.

Potential post-remediation exposures to on-site residents from soil vapors are not expected to require the operation of SSD systems, though groundwater use will be restricted at the Site until groundwater quality recovers. A soil vapor intrusion evaluation may be needed to determine if the CVOCs have the potential to impact the new building.

During remedial and construction activity, workers and area residents may be exposed to impacted soil and vapors. Worker exposure to soil and vapors will be minimized through implementation of a HASP. Exposures to area residents from dust and or vapors will be minimized through the use of engineering controls and through implementation of a CAMP.

3.5.2 Compliance with Remedial Goals, SCGs and RAOs

Alternative 2 will achieve compliance with the remedial goals, SCGs and RAOs for soil through source removal to commercial use cleanup levels for the top 15 feet. SCGs for groundwater will also be achieved as impacted groundwater will be remediated through chemical oxidant application. Compliance with SCGs for soil vapor is expected following completion of the remedial action by removal of all soil with parameters above commercial SCOs, and through the application of chemical oxidants to treat groundwater.

3.5.3 Long-term Effectiveness and Permanence

Alternative 2 achieves long term effectiveness and permanence by permanently removing and/or remediating all soils affected by Site contaminants above commercial use objectives to a depth of 15 feet and by remediating groundwater. Under this Alternative risk from soil impacts and groundwater will be eliminated. Alternative 2 will continue to meet RAOs for soil, groundwater and soil vapor in the future, providing a permanent long-term solution for the Site.

3.5.4 Reduction in Toxicity, Mobility or Volume through Treatment

Alternative 2 will permanently eliminate the toxicity, mobility, and volume of contaminants from on-site soil by meeting commercial objectives in the upper 15 feet and remediating groundwater through oxidant application.

3.5.5 Short-term Effectiveness

The potential for short-term adverse impacts and risks to the workers, the community, and the environment during the implementation of Alternative 2 is minimal. Short-term exposure to on-site workers during excavation and loading activities will be addressed with a HASP and mitigated through the use of personal protective equipment, monitoring and engineering controls. Potential short-term exposure to the surrounding community will be addressed through the use of odor and dust-suppression techniques and through the implementation of a CAMP which will require air monitoring activities during all excavation and soil disturbance activities.

Other potential impacts to the community such as construction-related noise, vibrations and traffic will be controlled and regulated under the terms of the NYC Department of Buildings issued building permit which can place a Stop Work Order on the property for unsafe conditions, community impacts or violation of the terms and conditions of the permit. Decontamination procedures of equipment, including trucks transporting soil to off-site disposal facilities will minimize the potential for impacted soil to be dispersed beyond the Site boundary. A truck traffic plan will also be prepared to minimize disturbance to the local roads and community.

3.5.6 Implementability

The techniques, materials and equipment to implement Alternative 2 are readily available and have been proven effective in remediating the contaminants associated with the Site. Excavation and the in-situ use of chemical oxidants for the remediation of soils and groundwater are reliable methods which have a long and proven track record on the remediation of hazardous waste and petroleum spill sites.

3.5.7 Cost

Costs associated with Alternative 2 are estimated at approximately $ 211,306. This cost estimate includes the following elements and assumptions:

- Excavate two CVOC hotspot areas to depths of 9 ft and 4 feet, respectively;
- Loading, transportation and disposal of approximately 130 cy of hazardous PCE contaminated soil;
- Chemical Oxidant application to treat impacted groundwater;
- Waste characterization and endpoint verification sampling and analysis;
- HASP and CAMP monitoring for the duration of the remedial activities;
- Preparation of a Final Engineering Report; and,
- Preparation and filing of an Environmental Easement.

3.5.8 Compatibility with Land Use

The proposed redevelopment of the Site is compatible with its current zoning. Following remediation, the Site will meet restricted-residential use objectives which will meet objectives for its planned mixed residential, commercial-retail and community use.

3.5.9 Community Acceptance

This RAWP will be subject to a 45-day public comment period to determine if the community has any comments on the presented remedial alternatives and selected remedy. If no comments are received, it will be considered to be acceptable to the community.

3.6 REMEDIAL ALTERNATIVE 3

The following sections provide an evaluation of Alternative 3 based on the nine evaluation criteria as previously discussed.

3.6.1 Overall Protection of Human Health and the Environment

Alternative 3 will be protective of human health and the environment by capping the residual CVOC areas and installing an SSD system to prevent vapor intrusion into the new building to be constructed on the Site. The potential for human and environmental exposure to these constituents on-Site will be eliminated by capping the residual CVOC hotspot areas and by continuous operation of an SSD system.

During remedial and construction activity, workers and area residents may be exposed to impacted soil and vapors. Worker exposure to soil and vapors will be minimized through implementation of a CHASP. Exposures to area residents from dust and or vapors will be minimized through the use of engineering controls and through implementation of a CAMP.

3.6.2 Compliance with Remedial Goals, SCGs and RAOs

Alternative 3 will achieve compliance with the remedial goals and RAOs for soil through the capping of residual CVOC contaminated soil and through the continuous operation of an SSD system to prevent vapor exposures. SCGs will not be reached for soil and groundwater under this alternative.

3.6.3 Long-term Effectiveness and Permanence

Alternative 3 achieves long term effectiveness and permanence by permanently capping the residual CVOC areas. Under this Alternative risk from soil impacts is eliminated for on-site occupants. Impacted soil and groundwater will not be effectively or permanently remediated. It will be managed in place providing a long-term solution for the Site.

3.6.4 Reduction in Toxicity, Mobility or Volume through Treatment

Alternative 3 will not reduce the toxicity, mobility or volume of contaminants from on-Site soil or groundwater.

3.6.5 Short-term Effectiveness

The potential for short-term adverse impacts and risks to the workers, the community, and the environment during the implementation of Alternative 3 is minimal. Short-term exposure to on-site workers will be addressed with a HASP and mitigated through the use of personal protective equipment, monitoring and engineering controls. Potential short-term exposure to the surrounding community will be addressed through the use of odor and dust-suppression techniques and through the implementation of a CAMP which will require air monitoring activities during any soil disturbance activities.

Other potential impacts to the community such as construction-related noise, vibrations and traffic will be controlled and regulated under the terms of the NYC Department of Buildings permit which can place a Stop Work Order on the property for unsafe conditions, community impacts or violation of the terms and conditions of the permit.

3.6.6 Implementability

The techniques, materials and equipment to implement Alternative 3 are readily available and have been proven effective in managing contamination in place. Capping for the isolation of soils and operation of an SSD system to mitigate vapor exposure are reliable and proven methods on remediation of hazardous waste and petroleum spill sites.

3.6.7 Cost

Costs associated with Alternative 3 are estimated at approximately $193,142. This cost estimate includes the following elements and assumptions:

- Capping the Site with the concrete building slab, asphalt or 2 ft of soil meeting Commercial SCOs;
- Installation of an SSDS.
- Preparation of a Final Engineering Report;
- Preparation of a Site Management Plan; and,
- Preparation and recording of an Environmental Easement.

3.6.8 Compatibility with Land Use

The proposed redevelopment of the Site is compatible with its current zoning. Following remediation, the Site will meet commercial-retail, residential and community use. A groundwater use restriction may be required to prevent future exposure to affected groundwater**.**

3.6.9 Community Acceptance

Considering the remaining potential for vapor intrusion into the new building and adjacent structures, Alternatives 1 or 2 would likely be preferred by the community over Alternative 3. This RAWP will be subject to a 45-day public comment period to determine if the community has any comments on the presented remedial alternatives and selected remedy. If no comments are received, it will be considered to be acceptable to the community.

3.7 SELECTION OF THE PREFERRED REMEDY

The remedy recommended for the site is the Track 1 alternative (Alternative 1) which consists of excavating the entire site to a depth of three feet below grade, excavation of two hot spot CVOC to depths of 4 feet and 9 feet and treatment of impacted groundwater within the two hotspot areas with ISCO application.

Any backfill materials used at the site will either consist of clean native soil excavated from other areas of the site, virgin mined materials, recycled materials or certified fill which meet unrestricted SCOs.

3.7.1 Preferred Remedy Land Use Factor Evaluation

As required by Article 27, Title 14 of the Environmental Conservation Law 27-1415, the following land use factor evaluation examines whether the preferred alternative is acceptable based on the 14 criteria presented in the following subsections.

Zoning

All of the lots are currently zoned as a Business A District. According to the City of Long Beach the following uses are permitted in a Business A zone:

(1) A market, restaurant, store or other retail business or service, bank, office, place of assembly, except that no "open-front" store, retail business or service, office, or place of assembly shall be permitted. A public garage or a gasoline filling station shall not be permitted in the Business A District.

(2) Any manufacturing on the same premises with and clearly incidental to one of the above uses, provided that it does not occupy more than twenty-five (25) per cent of a building or the part thereof occupied by such use, and provided further that the major part of any products manufactured are to be sold at retail on the premises. Any use which would be injurious, noxious or offensive to the neighborhood by reason of dust, fumes, gas, noise, odor, smoke or vibration shall not be permitted.

The proposed project, which includes a 2-story retail building / dance studio, will be in full compliance with the current zoning.

Applicable Comprehensive Community Master Plans or Land Use Plans

There are no adopted land use plans covering the project Site.

Surrounding Property Uses

Surrounding land use includes a strip of commercial – retail buildings along the north and south sides of E. Park Avenue with a parking lot in-between the east and west bound lanes. Single family residential homes are present to the north and south of the commercial strip along E. Park Avenue.

The proposed project is compatible with the surrounding land use and will be in compliance with the current zoning.

Citizen Participation

Citizen participation for implementation of the preferred alternative will be performed in accordance with DER 23 and NYCRR Part 375-1.10 and Part 375-3.10. A Citizen Participation will be prepared within 20 days following the execution of the BCA and will be placed in the document repositories.

Environmental Justice Concerns

The Site is located within a potential environmental justice area. The NYSDEC defines a potential environmental justice area as a "minority or low-income community that may bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies."

Environmental justice means the fair treatment and meaningful involvement of all people regardless of race, color, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies.
The proposed remedy fully addresses environmental justice concerns by attaining the highest level of cleanup.

Land use designations

The proposed remedy is consistent with land-use designations.

Population growth patterns

Population growth patterns support the proposed use for the Site. The preferred remedy will not negatively affect on population growth patterns.

Accessibility to existing infrastructure

The Site is accessible to existing infrastructure. The location of the Site on E. Park Avenue will assist soil transportation and contractor access to the Site. The preferred remedy will not alter accessibility to existing infrastructure.

Proximity to cultural resources

The proposed remedy will not negatively impact cultural resources.

Proximity to natural resources

The proposed remedy will improve the local environment and will not negatively impact affect natural resources.

Off-Site groundwater impacts

The proposed remedy will not affect natural resources other than to improve the quality of groundwater on a local basis.

Proximity to floodplains

The Site is located approximately 1,900 feet from the ocean. The entire property is located within a designated 1% (100yr) flood zone with a base flood elevation of 10 ft. The remedy which includes the removal of all contaminated soils considers the site location with respect to potential flooding.

Geography and geology of the Site

The selected remedy will excavate contaminated soils to a depth of 3 feet across the site with additional excavation within two hotspot areas to depths of 4 feet and 9 feet respectively. The selected alternative and development of the site have considered the geography and geology of the Site.

Current Institutional Controls

There are no institutional controls presently assigned to the Site.

3.8 SUMMARY OF SELECTED REMEDIAL ACTIONS

The remedy recommended for the Site is a Track 1 alternative (Alternative 1) which consists of excavating the Site to a minimum depth of 3 feet with excavation of two hotspot areas to depths of 4 feet and 9 feet respectively. Chemical oxidants will be applied in both hotspot areas plus a third area to treat groundwater. The remedy will include the following items:

1. Demolition of the existing building to allow remediation to proceed;

2. Excavation of soil/fill exceeding Track 1 unrestricted use SCOs as listed in **Table 1** to a minimum depth of 3 feet across the Site with additional excavation to 4 feet and 9 feet in two CVOC residual soil hotspot areas;
3. ISCO treatment of groundwater in the three groundwater hotspot areas;
4. Screening for indications of contamination (by visual means, odor, and monitoring with PID) of all excavated soil during any intrusive Site work;
5. Shoring and SOE work as required to facilitate excavation;
6. Collection and analysis of end-point samples to evaluate the performance of the remedy with respect to attainment of Track 1;
7. Appropriate off-Site disposal of all material removed from the Site in accordance with all Federal, State and local rules and regulations for handling, transport, and disposal;
8. Import of materials to be used for backfill and cover in compliance with: (1) chemical limits and other specifications included in **Table 1**, (2) all Federal, State and local rules and regulations for handling and transport of material;
9. If Track 1 is not achieved, an Environmental Easement will be filed to restrict the land use to commercial.

All responsibilities associated with the Remedial Action, including permitting requirements and pretreatment requirements, will be addressed in accordance with all applicable Federal, State and local rules and regulations.

Remedial activities will be performed at the Site in accordance with this NYSDEC-approved RAWP. Any anticipated deviations to the RAWP shall be submitted to the NYSDEC for review.

4.0 REMEDIAL ACTION PROGRAM

The objective of this section of the Remedial Action Work Plan, is to present a scope of work which will be approved by NYSDEC and when completely implemented will ready the BCP site for development under the contemplated use consistent with the requirements of the Brownfield Cleanup Program.

4.1 GOVERNING DOCUMENTS

Governing documents and procedures included in the Remedial Work Plan include a Site-specific Health and Safety Plan (HASP), a Community Air Monitoring Plan (CAMP), a Citizen Participation Plan, a Soil Management Plan (SoMP), a Quality Assurance Project Plan (QAPP), fluid management procedures, and contractors' site operations and quality control procedures. Highlights of these documents and procedures are provided in the following sections.

4.1.1 Health & Safety Plan (HASP)

Contractors and subcontractors will have the option of adopting this HASP or developing their own site-specific document. If a contractor or subcontractor chooses to prepare their own HASP, the Remedial Engineer will insure that it meets the minimum requirements as detailed in the site-specific HASP prepared for the Site.

Activities performed under the HASP will comply with applicable parts of OSHA Regulations, primarily 29 CFR Parts 1910 and 1926. Modifications to the HASP may be made with the approval of the Remedial Engineer (RE), Site Safety Manager (SSM) and/or Project Manager (PM).

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 Mr. Thomas Gallo. His resume is provided in **Attachment E**. Confined space entry will comply with all OSHA requirements to address the potential risk posed by combustible and toxic gasses. A copy of the Site Specific Health and Safety Plan is provided in **Attachment B.**

4.1.2 Quality Assurance Project Plan (QAPP)

The fundamental QA objective with respect to accuracy, precision, and sensitivity of analysis for laboratory analytical data is to achieve the QC acceptance of the analytical protocol. The accuracy, precision and completeness requirements will be addressed by the laboratory for all data generated.

Collected samples will be appropriately packaged, placed in coolers and shipped via overnight courier or delivered directly to the analytical laboratory by field personnel. Samples will be containerized in appropriate laboratory provided glassware and shipped in plastic coolers. Samples will be preserved through the use of ice or a cold-pak(s) to maintain a temperature of 4^{o}C.

Dedicated disposable sampling materials will be used for both soil and groundwater samples (if collected), eliminating the need to prepare field equipment (rinsate) blanks. However, if non-disposable equipment is used, (stainless steel scoop, etc.) field rinsate blanks will be prepared at the rate of 1 for every eight samples collected.

Decontamination of non-dedicated sampling equipment will consist of the following:

- Gently tap or scrape to remove adhered soil
- Rinse with tap water
- Wash with alconox® detergent solution and scrub
- Rinse with tap water
- Rinse with distilled or deionized water

Prepare field blanks by pouring distilled or deionized water over decontaminated equipment and collecting the water in laboratory provided containers. Trip blanks will accompany samples each time they are transported to the laboratory. Matrix spike and matrix spike duplicates (MS/MSD) will be collected at the rate of one per 20 samples submitted to the laboratory. Laboratory reports will be upgradeable to ASP category B deliverables for use in the preparation of a data usability report (DUSR). The QAPP for the Site is provided in **Attachment C**.

4.1.3 Construction Quality Assurance Plan (CQAP)

All construction work related to the remedy (i.e. soil excavation) will be monitored by EBC / AMC field personnel under the direct supervision of the Remedial Engineer. Monitoring during soil excavation will be performed to protect the health of site workers and the surrounding community. A Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP) have been specifically developed for this project. These plans specify the monitoring procedures, action levels, and contingency measures that are required to protect public health.

All intrusive and soil disturbance activities will be monitored by an environmental professional (EP) under the direct supervision of the Remedial Engineer who will record observations in the site field book and complete a photographic log of the daily activities. The EP will provide daily updates to the Project Manager and Remedial Engineer who will both make periodic visits to the site as needed to assure construction quality. Daily updates will also be submitted to the NYSDEC. See section 4.4.1 Daily Reports.

4.1.4 Soil/Materials Management Plan (SoMP)

A SoMP has been prepared for excavation, handling, storage, transport and disposal of all soils/materials that are disturbed / excavated at the Site. The SoMP 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. The SoMP is presented in Section 5.4.

4.1.5 Erosion and Sediment Control Plan (ESCP)

Erosion and sediment controls will be performed in conformance with requirements presented in the New York State Guidelines for Urban Erosion and Sediment Control. Typical measures that will be utilized at various stages of the project to limit the potential for erosion and migration of soil include the use of hay bales, temporary stabilized construction entrances/exits, placement of silt fencing and/or hay bales around soil stockpiles, and dust control measures.

4.1.6 Community Air Monitoring Plan (CAMP)

The CAMP provides measures for protection for on-site workers and the downwind community (i.e., off-site receptors including residences, businesses, and on-site workers not directly involved in the remedial work) from potential airborne contaminant releases resulting from remedial activities.

The action levels specified require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that the remedial work did not spread contamination off-site through the air. The primary concerns for this site are vapors, nuisance odors and dust particulates.

The primary concerns for this site are vapors, nuisance odors and dust particulates. The CAMP prepared for implementation of the RAWP is provided in **Attachment D**.

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.

4.1.8 Citizen Participation Plan (CPP)

The public will be informed of key project documents and events through the distribution of fact sheets through the Department's List Serv. The public was initially informed of the Site and the opportunity to join the List Serv through an ad placed in the local newspaper and mailed fact sheets.

No changes will be made to 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.

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

Long Beach Public Library - Public library
111 W Park Ave, Long Beach, NY 11561
(516) 432-7201

Hours

Mon	11:00 AM - 5:00 PM
Tue	11:00 AM - 5:00 PM
Wed	2:00 PM - 8:00 PM
Thu	11:00 AM - 5:00 PM
Fri	11:00 AM - 5:00 PM
Sat	11:00 AM - 5:00 PM
Sun	Closed

4.2 GENERAL REMEDIAL ACTION INFORMATION

4.2.1 Project Organization

The Project Manager for the Remedial Activity will be Mr. Keith Butler. Overall responsibility for the BCP project will be Mr. Charles B. Sosik, P.G., P.HG. The Remedial Engineer for this project is Mr. Ariel Czemerinski, P.E. Resumes of key personnel involved in the Remedial Action are included in **Attachment E**.

4.2.2 Remedial Engineer

The Remedial Engineer for this project will be Mr. Ariel Czemerinski, P.E. 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 Site. 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 review all pre-remedial plans submitted by 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, and will certify compliance in the Final Remediation Report. The Remedial Engineer will provide the certifications listed in Section 10.1 in the Final Engineering Report.

4.2.3 Remedial Action Schedule

The remedial action will begin with mobilization of equipment and material to the Site, which will begin approximately 1 week following RAWP approval and 10 days after the distribution of the remedial construction Fact Sheet. A pre-construction meeting will be held among NYSDEC, the Remedial Engineer, and the selected remedial contractor prior to site mobilization. Mobilization will be followed by soil removal and disposal and confirmation sampling. The work is expected to take 6 months as part of the construction excavation and foundation installation.

4.2.4 Work Hours

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

4.2.5 Site Security

A construction fence will be erected around the entire property as required by the Department of Buildings. The fence will be maintained as required and secured at the end of each work day.

4.2.6 Traffic Control

The Volunteer's construction management personnel will direct the arrival or departure of construction vehicles, and provide flag services as needed to maintain safe travel exiting and entering the Site from Bedford Avenue. Traffic related to on-going remedial activity will require the staging of 10-wheel dump trucks on Stewart Avenue on a daily basis during soil excavation activity. The soil disposal transport route will be as follows:

- ENTERING SITE - from the Van Wyck Expressway (I-678) heading south; take the Nassau Expressway (878) east exit (Exit 1) continue east and south on Nassau Expressway to Park Street. Turn left on Park Street heading east to Ohio Avenue. Turn left on Ohio Avenue heading north to W. Park Avenue. Turn right on W. Park Avenue heading east. Continue east on W. Park Avenue approximately 2.25 miles to the Site entrance on the right.

- EXITING SITE – Turn left onto E. Park Avenue heading west to Ohio Avenue. Turn left heading south on Ohio Avenue to Park Street. Turn right heading west on Park Street to Nassau Expressway (878). Turn right onto Nassau Expressway heading north and west to the Van Wyck Expressway.

A map showing the truck routes is included as **Figure 9**.

4.2.7 Worker Training and Monitoring

An excavation contractor with appropriate experience, personnel and training is required to perform the removal of the CVOC impacted soil. The excavation contractor's on-site personnel engaged in this work will all have a minimum of 40 hour Hazardous Waste Operations and Emergency Response Operations (HAZWOPPER) training for excavating CVOC impacted soil classified as hazardous and a minimum of 24 hr HAZWOPPER training for all other soil excavation.

All field personnel involved in remedial activities will participate in training, if required under 29 CFR 1910.120, including 24 and 40-hour hazardous waste operator training and annual 8-hour refresher training. The excavation contractor will be responsible for maintaining workers training records and for providing them to the Site Safety Officer.

Personnel entering any exclusion zone will be trained in the provisions of the HASP and be required to sign a HASP acknowledgment.

All on-site personnel engaged in remedial or sampling activities must receive adequate site-specific training in the form of an on-site Health and Safety briefing prior to participating in field work with emphasis on the following:

- Protection of the adjacent community from hazardous vapors and / or dust which may be released during intrusive activities.
- Identification of chemicals known or suspected to be present on-site and the health effects and hazards of those substances.
- The need for vigilance in personnel protection, and the importance of attention to proper use, fit and care of personnel protective equipment.
- Decontamination procedures.
- Site control including work zones, access and security.
- Hazards and protection against heat or cold.

- The proper observance of daily health and safety practices, such as entry and exit of work zones and site. Proper hygiene during lunch, break, etc.
- Emergency procedures to be followed in case of fire, explosion and sudden release of hazardous gases.

4.2.8 Agency Approvals

The Applicant has addressed all SEQRA requirements for this Site. All permits or government approvals required for remedial construction have been, 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 **Table 11**. 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.

4.2.9 Pre-Construction Meeting with NYSDEC

A pre-construction meeting or teleconference call with the Project Manager, Remedial Engineer, Construction Manager, Owner’s Representative and the NYSDEC will take place prior to the start of major construction activities.

4.2.10 Emergency Contact Information

An emergency contact sheet with names and phone numbers is included in **Table 12**. That document will define the specific project contacts for use by NYSDEC and NYSDOH in the case of a day or night emergency.

4.2.11 Remedial Action Costs

The total estimated cost of the Remedial Action is $ $ 319,231. An itemized and detailed summary of estimated costs for all remedial activity is attached as **Attachment F**. This will be revised based on actual costs and submitted as an Appendix to the Final Remediation Report.

4.3 SITE PREPARATION

4.3.1 Mobilization

Mobilization will include the delivery of construction equipment and materials to the site. All construction personnel will receive site orientation and training in accordance with the site specific HASP, CAMP and established policies and procedures to be followed during the implementation of the RAWP. The remediation contractor, construction manager and all associated subcontractors will each receive a copy of the RAWP and the site specific HASP and will be briefed on their contents.

4.3.2 Erosion and Sedimentation Controls

Soil erosion and sediment control measures for management of storm water will be installed in accordance with the New York Guidelines for Urban Erosion and Sediment Control. Haybales and/or silt fence will be placed by the remedial contractor at locations surrounding excavation areas and within the perimeter fencing as needed, to control stormwater runoff and surface water from exiting the excavation. These control measures will be installed prior to initiating the soil excavation.

4.3.3 Stabilized Construction Entrance(s)

Stabilized construction entrances will be installed at all points of vehicle ingress and egress to the Site. The stabilized entrances will be constructed of a 4 to 6-inch bed of crushed stone or crushed concrete which will be sloped back toward the interior of the Site. The stabilized entrances will be inspected on a daily basis during soil loading activities and reinforced as needed with additional stone/concrete material to prevent the accumulation of ruts, mud or soil.

4.3.4 Utility Marker and Easements Layout

The Applicant 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 Applicant and its contractors are solely responsible for safe execution of all invasive and other work performed under this RAWP. The Applicant 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 including excavation is the sole responsibility of the Applicant and its contractors. The Applicant and its contractors are solely responsible for safe execution of all invasive and other work performed under this Plan. The Applicant 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 Applicant 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.

The exact means and methods for the support of excavation (SOE) have not been determined yet and will be forwarded to DEC upon receipt.

4.3.6 Equipment and Material Staging

All equipment and work materials will be staged on-Site in areas as designated by the General Contractor, and / or Construction Site Superintendant.

4.3.7 Decontamination Area

A temporary truck decontamination pad will be constructed to decontaminate trucks and other vehicles/equipment leaving the Site. The pad will be constructed by placing a 4 to 6-inch bed of stone aggregate such as crushed rock or RCA. The pad will be bermed at the sides and sloped back to the interior of the Site. The truck pad will be sized to accommodate the largest construction vehicle used and located in line with the stabilized construction entrance. The pad will be inspected on a daily basis during soil loading activities and reinforced as needed with additional stone/concrete material to prevent the accumulation of ruts, mud or soil.

4.3.8 Site Fencing

An 8-foot high construction fence will be erected around the portions of the Site which are not bordered by adjacent buildings with entrance / exit gates located on E. Park Avenue and Long Beach Road. This fence will be properly secured at the end of the day and supplemented, as needed, by installing orange safety fencing around open excavations to ensure on-site worker safety.

4.3.9 Demobilization

Demobilization will consist of the restoration of material staging areas and the disposal of materials and/or general refuse in accordance with acceptable rules and regulations. Materials used in remedial activities will be removed and disposed properly. All equipment will be decontaminated prior to leaving the Site.

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 in which remedial activity takes place. Daily reports will include:

- An update of progress made during the reporting day;
- Quantities of oxidant material applied at specific locations of the Site;
- 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.

These reports will include a summary of air sampling results, odor and dust problems and corrective actions, and all complaints received from the public.

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, PDF) 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 included in the daily reports as needed, and a comprehensive collection of photos will be included in the Final Engineering Report.

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

Complaints from the public regarding nuisance or other Site conditions including noise, odor, truck traffic etc., will be recorded in the Site field book and reported to the NYSDEC via email on the same day as the complaint is received.

4.4.5 Deviations from the Remedial Action Work Plan

Minor deviations from the RAWP will be identified in the daily update report and will be noted in the Final Engineering Report. When deviations are reported, a brief discussion will be provided which will state the following:

- Reasons for deviating from the approved RAWP;
- Effect of the deviations on overall remedy.

Major changes to the scope of work must be discussed with the NYSDEC and the NYSDOH prior to implementation. If the changes are considered to be significant enough, an addendum to the RAWP Work Plan will be prepared and submitted to NYSDEC / NYSDOH for review.

5.0 REMEDIAL ACTIONS: MATERIAL REMOVAL FROM THE SITE

5.1 SOIL EXCAVATION

Excavation work includes the following; the removal and off-Site disposal of the top 3 feet of soil across the Site with additional excavation in two CVOC hotspot areas to depths of 4 feet and 9 feet. Soil excavation will be performed using conventional equipment such as track-mounted excavators, backhoes and loaders.

All excavation work will be performed in accordance with the Site-specific HASP and CAMP. In the unlikely event that an unknown UST is discovered during excavation, the NYSDEC Project Manager will be immediately notified and the UST removed and closed in accordance with DER-10, NYSDEC PBS regulations and NYC Fire Department regulations.

It is anticipated that the excavation of CVOC hazardous soils will be performed by an excavation contractor using appropriately trained personnel (40 hr HAZWOPER). Non hazardous classified soil and native soils will be performed by the excavation contractor for the construction project using personnel with 24 hr HAZWOPER training.

Soils will be excavated to a depth of approximately 3 feet across the Site to meet Unrestricted SCOs. CVOC hazardous contaminated soil within the identified southeast hotspot area will be excavated to a depth of 4 feet while CVOC non-hazardous soil within the northwest area of the Site will be excavated to a depth of 9 feet. Note that a non-hazardous classification of CVOC impacted soil will require a contained-in determination. If the contained in determination is not received then all CVOC impacted soil will be classified as hazardous by default. Over excavated areas will be backfilled using clean native soil excavated from other areas of the Site, or imported material meeting unrestricted SCOs. An excavation plan showing the excavation depths to achieve the Track 1 remedy is provided in **Figure 10**.

Dewatering is not expected to be required for the excavation of contaminated areas or for foundation construction (See section 5.4.10)

5.1.1 Soil Cleanup Objectives

The Soil Cleanup Objectives for this Site are listed in **Table 1**. Spider maps showing all soil samples that exceed the SCOs proposed for this Remedial Action are shown in **Figure 6**.

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

Post excavation (endpoint) soil samples will be collected from across the Site to verify that remedial goals have been achieved. Confirmatory soil samples will be collected from the Site as follows:

(1) Site-wide: bottom of excavation endpoint soil samples will be collected following removal of all of the top 3 feet of soil at the Site to verify that remedial goals have been achieved (**Figure 11**). The Site-wide endpoint soil samples will be analyzed for VOCs, SVOCs, pesticides, PCBs and metals. Ten percent of the samples will be analyzed for emerging contaminants (PFOS, 1,4-dioxane).

(2) CVOC Hotspots: bottom and sidewall endpoint soil samples will be collected from each of the CVOC hotspot areas. Bottom and sidewall endpoint samples collected from the lead hotspot areas will be analyzed for VOCs.

5.2.1 End-Point Sampling Frequency

Endpoint sampling frequency will be in accordance with DER-10 section 5.4 which recommends the collection of one bottom sample per 900 sf of bottom area and one sidewall sample per 30 liner feet. Sidewall samples only be collected from the CVOC hotspot areas.

5.2.2 Methodology

Collected samples be placed in glass jars supplied by the analytical laboratory and stored in a cooler with ice to maintain a temperature of 4 degrees C. Samples will either be picked up at the Site by a laboratory dispatched courier at the end of the day or transported back to the EBC /AMC office where they will be picked up the following day by the laboratory courier. All samples will be analyzed by a NYSDOH ELAP certified environmental laboratory

All site-wide post-excavation (endpoint) soil samples will be analyzed for VOCs by EPA Method 8260B, SVOCs by EPA method 8270, pesticides/PCBs by EPA method 8081/8082 and TAL metals. Ten percent of the samples will be analyzed for emerging contaminants (PFOS, 1,4-dioxane) by EPA method 8270 (1,4-dioxane) and EPA method 537 (PFOS). Post-excavation soil samples from the hotspot areas will be analyzed for VOCs by EPA Method 8260.

5.2.3 Reporting of Results

Sample analysis will be provided by a New York State certified environmental laboratory. Laboratory reports will include ASP category B deliverables for use in the preparation of a data usability summary report (DUSR). All results will be provided in accordance with the NYSDEC Environmental Information Management System (EIMS) electronic data deliverable (EDD) format.

5.2.4 QA/QC

The fundamental QA objective with respect to accuracy, precision, and sensitivity of analysis for laboratory analytical data is to achieve the QC acceptance of the analytical protocol. The accuracy, precision and completeness requirements will be addressed by the laboratory for all data generated.

Collected samples will be appropriately packaged, placed in coolers and shipped via overnight courier or delivered directly to the analytical laboratory by field personnel. Samples will be containerized in appropriate laboratory provided glassware and shipped in plastic coolers. Samples will be preserved through the use of ice or cold-pak(s) to maintain a temperature of 4^{o}C. Dedicated disposable sampling materials will be used for soil samples, eliminating the need to prepare field equipment (rinsate) blanks. However, if non-disposable equipment is used, (stainless steel scoop, etc.) field rinsate blanks will be prepared at the rate of 1 for every eight samples collected. Field blanks will be prepared by pouring distilled or deionized water over decontaminated equipment and collecting the water in laboratory provided containers.

Trip blanks will accompany samples each time they are transported to the laboratory. Matrix spike and matrix spike duplicates (MS/MSD) will be collected at the rate of one per 20 samples submitted to the laboratory.

5.2.5 DUSR

The DUSR provides a thorough evaluation of analytical data without third party data validation. The primary objective of a DUSR is to determine whether or not the data, as presented, meets the site/project specific criteria for data quality and data use. Verification and/or performance monitoring samples collected under this RAWP will be reviewed and evaluated in accordance with the Guidance for the Development of Data Usability Summary Reports as presented in Appendix 2B of DER-10. The completed DUSR for verification/performance samples collected during implementation of this RAWP will be included in the final Engineering Report.

5.2.6 Reporting of End-Point Data in FER

All endpoint data collected as part of this remedial action will be summarized and presented in the Final Engineering Report. The summary tables will include comparison of results to unrestricted SCOs to verify attainment of Track 1. Laboratory reports and the DUSR will be included as an appendix in the FER.

5.3 ESTIMATED MATERIAL REMOVAL QUANTITIES

It is expected that 130 cubic yards (208 tons) of hazardous CVOC soil will be generated by excavating the two CVOC hotspot areas as shown on **Figure 10** to depths of approximately 4 feet and 9 feet. Its possible that a good portion of this soil will be classified as non-hazardous through a contained-in determination made by DEC. To meet unrestricted SCOs the remainder of the site will be excavated to a depth of 3 feet below grade generating an estimated 936 cubic yards (1497 tons) of non-hazardous soil for disposal.

5.4 SOIL/MATERIALS MANAGEMENT PLAN

Pre-characterization samples will be collected to allow the soil to be loaded directly on to trucks for transport to the disposal facility. Soils excavated from the CVOC hotspot will be classified as hazardous unless a contained-in determination is made by DEC for a portion of the soil. The remainder of the soils are expected to be classified as non-hazardous. The final determination on classification will be based on the results of waste characterization analysis and the NYSDEC. Soil excavation will be performed in accordance with the procedures described under Section 5.5 of DER-10 as follows:

- A description and photographic documentation of the excavation.
- Examination of the excavation floor and sidewalls for physical evidence of contamination (odor, staining, sheen, etc.).
- Periodic field screening (through bucket return) of the floor and sidewalls of the excavation with a calibrated photoionization detector (PID).

Final excavation depth, length, and width will be determined by the Remedial Engineer or his designee, and will depend on the horizontal and vertical extent of contaminated soils as identified through physical examination (PID response, odor, staining, etc.). Expansion of the excavation beyond the planned hotspot areas are anticipated and can easily be accommodated.

The following procedure will be used for the excavation of impacted soil (as necessary and appropriate):

- Wear appropriate health and safety equipment as outlined in the HASP;

- Prior to excavation, ensure that the area is clear of utility lines or other obstructions. Lay plastic sheeting on the ground next to the area to be excavated;

- Using a rubber-tired backhoe or track mounted excavator, remove overburden soils and stockpile or dispose of separate from the impacted soil;

- If USTs are discovered, the NYSDEC will be notified and the best course of action to remove the structure should be determined in the field. This may involve the continued removal of overburden to access the top of the structure or continued trenching around the perimeter to minimize its disturbance;

- If physically contaminated soil is present (e.g., staining, odors, sheen, PID response, etc), an attempt will be made to remove it to the extent not limited by the site boundaries. If possible, physically impacted soil will be removed using the backhoe or excavator, segregated from clean soils and overburden, and staged on separate dedicated plastic sheeting or live loaded into trucks from the disposal facility. Removal of the impacted soils will continue until visibly clean material is encountered and monitoring instruments indicate that no contaminants are present;

- Excavated soils which are temporarily stockpiled on-site will be covered with 6-mil polyethylene sheeting while disposal options are determined. Sheeting will be checked on a daily basis and replaced, repaired or adjusted as needed to provide full coverage. The sheeting will be shaped and secured in such a manner as to drain runoff and direct it toward the interior of the property;

- Once the Remedial Engineer is satisfied with the removal effort, verification or confirmatory samples will be collected from the excavation as described in **Section 5.2** of this document.

5.4.1 Excavation of Hazardous CVOC Soil

Hazardous CVOC soil is present in two areas to a depth of approximately 4 feet and 9 feet below grade respectively. Confirmatory sampling will be performed to determine the limits of the excavation and to confirm removal of all CVOC impacted soil has been removed. The excavation of the hot-spot areas will be performed by a qualified contractor and trained (40 hr HAZWOPER) personnel.

5.4.2 Excavation of Non-Hazardous Soil

The remainder of soil at the Site contains some CVOC parameters and other constituents above unrestricted SCOs in the top three feet. Do to the low level CVOC impact this soil will likely require a contained-in determination to be classified as non-hazardous. Given the CVOC concentrations this determination is anticipated to be issued. The non-hazardous soil will be segregated from the hotspot soil and disposed of off-Site at a permitted disposal facility.

If this material is classified as non-hazardous, then the excavation of will be performed by the excavation contractor for the construction project using trained personnel (24 hr HAZWOPER). If this material is classified as hazardous, then 40 hr HAZWOPER trained personnel will be needed to perform the excavation of this material.

5.4.3 Excavation of Native Soils

Although native soils are present directly below the impacted soil, it is not expected that clean native soil will require excavation for the foundation components during construction of the new building.

However, if clean native soils were excavated they will be stockpiled on-site and characterized for reuse on-site in areas over excavated to remove CVOC hotspots. Any excess soil will be disposed of off-site as a beneficial re-use material or reused on-site if found to meet SCOs through testing and if acceptable to the structural engineer.

It is anticipated that if the excavation of native soil materials were needed that it will be performed by the excavation contractor for the construction project.

5.4.4 Soil Screening Methods

Visual, olfactory and PID soil screening and assessment will be performed by an environmental professional 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 environmental professionals. Resumes will be provided for all personnel responsible for field screening (i.e. those representing the Remedial Engineer) of invasive work for unknown contaminant sources during remediation and development work.

5.4.5 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. Soils which exhibit strong odors will be completely sealed with heavy tarps or vapor suppressant foam.

5.4.6 Materials Excavation and Load Out

The Remedial Engineer or an EP 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.

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).

Where effective, the equipment will be “dry” decontaminated using a broom and/or brushes. If significant amounts of soil or other contaminants remain after the dry decontamination, the equipment will also be pressure washed before leaving the Site. The EP will be responsible for ensuring that all outbound trucks are dry-brushed or washed on the truck wash/equipment pad 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 EP 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.

Development-related grading cuts and fills will not interfere with, or otherwise impair or compromise, the performance of remediation required by this plan.

Mechanical processing of historical fill material and contaminated soil on-Site is prohibited. All primary contaminant sources (including but not limited to tanks and hotspots) identified during Site Characterization, Remedial Investigation, and Remedial Action will be located and shown on maps to be reported in the Final Engineering Report.

5.4.7 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 as follows:

- ENTERING SITE - from the Van Wyck Expressway (I-678) heading south; take the Nassau Expressway (878) east exit (Exit 1) continue east and south on Nassau Expressway to Park Street. Turn left on Park Street heading east to Ohio Avenue. Turn left on Ohio Avenue heading north to W. Park Avenue. Turn right on W. Park Avenue heading east. Continue east on W. Park Avenue approximately 2.25 miles to the Site entrance on the right.

- EXITING SITE – Turn left onto E. Park Avenue heading west to Ohio Avenue. Turn left heading south on Ohio Avenue to Park Street. Turn right heading west on Park Street to

Nassau Expressway (878). Turn right onto Nassau Expressway heading north and west to the Van Wyck Expressway.

These routes are shown in **Figure 9**. These are the most appropriate routes to and from the Site 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 residential neighborhoods around 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. Material transported by trucks exiting the Site will be secured with covers. Wet loads are not anticipated since the entire site will be dewatered prior to excavating soils. However, if wet soils are excavated they will be stockpiled within the excavation to dry or blended with dry soils. No loads of material capable of generating free liquid will be allowed to leave the Site. All trucks will be inspected, dry-brushed and / or washed, as needed, before leaving the site.

5.4.8 Materials Disposal Off-Site

Multiple disposal facility designations may be employed for the materials removed from the Site. Once final arrangements have been made, the disposal facility acceptance letters will be provided to the NYSDEC Project Manager before the start of excavation activities. It is anticipated that the soil will be disposed of at up to 2 different facilities, based on the following classification:

- Hazardous - Contaminated CVOC Impacted Soil
- Non Hazardous - Contaminated CVOC impacted soil and fill

The total quantity of material expected to be disposed off-Site is 1,066 cubic yards, including 130 cubic yards of hazardous CVOC soil and 936 cubic yards of non-hazardous CVOC impacted soil and fill with parameters above unrestricted use SCOs.

Hazardous Soil Disposal and Transport

It is expected that up to 130 cy of soil will be classified as hazardous and will be shipped under a hazardous waste manifest system. All hazardous waste transported and disposed of must have a USEPA ID Number and waste code and must be distributed in accordance with the regulatory requirements.

The multi-part manifest will be filled out for each load of soil shipped off of the Site. At a minimum, the following information will be recorded on each manifest:

1) Generator's Name, Address, and Phone Number
2) Destination Facility Name, Address and Phone Number
3) EPA ID Number
4) Waste classification code
5) Transporter Name, Address, Phone Number, License Plate Number, Driver Name, and SW Haulers Permit #
6) Signatures – Generator or an authorized agent for the generator shall print, sign, and date each non-hazardous material manifest after each truck is loaded. The transporter shall then sign and date noting time material was picked up at the site. Both the transporter and a representative of the disposal facility will sign the non-hazardous material manifest when the material has been delivered to disposal facility.

Non-Hazardous Soil Disposal and Transport

Non-hazardous historic fill material will be handled, at a minimum, as a Municipal Solid Waste per 6NYCRR Part 360-1.2. Historical fill material 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 DSHM. 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. Soil classified as non-hazardous fill will be transported under a non-hazardous waste manifest obtained from the selected disposal facility. The multi-part manifest will be filled out for each load of soil shipped off of the Site. At a minimum, the following information will be recorded on each manifest:

1) Generator's Name, Address, and Phone Number
2) Destination Facility Name, Address and Phone Number
3) Transporter Name, Address, Phone Number, License Plate Number, Driver Name, and SW Haulers Permit #
4 Signatures – Generator or an authorized agent for the generator shall print, sign, and date each non-hazardous material manifest after each truck is loaded. The transporter shall then sign and date noting time material was picked up at the site. Both the transporter and a representative of the disposal facility will sign the non-hazardous material manifest when the material has been delivered to disposal facility.

A copy of the manifest will be retained by AMC on-Site personnel for each shipment. Final signed manifests will be forwarded by the disposal facility to the generator. Copies of the final manifests will be presented in the FER.

Clean Soil Disposal

Clean native soil removed from the Site for development purposes (i.e. basement levels) will be handled as unregulated or beneficial use disposal. This soil will undergo a testing program to confirm that it meets Unrestricted Use SCOs or Residential / Groundwater Protection SCOs prior to unregulated disposal or meets Unrestricted Use SCOs prior to reuse on-Site. Soil testing for off-site unregulated disposal will be in accordance with Part 360 sampling frequencies:

Fill Material Quantity (cubic yards)	Minimum Number of Analyses for Volatile Organic Compounds, if Required	Minimum Number of Analyses for all other parameters
0-300	2	1
301-1000	4	2
1001-10,000	6	3
10,001+	10,001+ Two for every additional 10,000 cubic yards or fraction thereof	One per every additional 10,000 cubic yards or fraction thereof

(1) Sample method and frequency. Samples must be representative of the fill material. The sampling program must be designed and implemented by or under the direction of a qualified environmental professional (QEP), using the table above as a minimum sampling frequency. Written documentation of the sampling program with certification from the QEP that samples were representative of the fill material must be retained for three years after the sampling occurs and must be provided to the department upon request.

(2) Analytical parameters. Fill material samples must be analyzed for:

- (i) the Metals, PCBs/Pesticides, and Semivolatile organic compounds listed in section 375-6.8(b) of this Title;
- (ii) asbestos if demolition of structures has occurred on the site;
- (iii) volume of physical contaminants, if present, based on visual observation; and
- (iv) volatile organic compounds listed in section 375-6.8(b) of this Title, if their presence is possible based on site events such as an historic petroleum spill, odors, photoionization detector meter or other field instrument readings.

(3) Laboratory and analytical requirements. Laboratory analyses must be performed by a laboratory currently certified by the New York State Department of Health's Environmental Laboratory Approval Program (ELAP).

Confirmation testing of clean soils for on-site re-use or import into the Site for backfill will be in accordance with DER-10 Section 5.4(e)(10) as follows:

Contaminant	**VOCs**	**SVOCs, Inorganics & PCBs/Pesticides**	
Soil Quantity (cubic yards)	**Discrete Samples**	**Composite**	**Discrete Samples/Composite**
0-50	1	1	Each composite sample for analysis is created from 3-5 discrete samples from representative locations in the fill.
50-100	2	1	
100-200	3	1	
200-300	4	1	
300-400	4	2	
400-500	5	2	
500-800	6	2	
800-1000	7	2	
1000	Add an additional 2 VOC and 1 composite for each additional 1000 Cubic yards or consult with DER		

Uncontaminated native soil confirmed by the above testing program and removed from the site, will be disposed of as C&D material or sent to a beneficial re-use facility. Note that clean soils disposed of at an out-of-state facility will be subject to the testing requirements of that facility in lieu of testing program outlined above. The final destination of soils whether classified as contaminated or uncontaminated must be approved by the Remedial Engineer.

C&D and Scrap Metal Disposal

Concrete demolition material generated on the Site from building slabs, parking areas and other structures will be segregated, sized and shipped to a concrete recycling facility. Concrete crushing or processing on-Site is prohibited. Asphalt removed from the parking areas will be sent to a separate recycling facility.

Additionally, it is common to encounter scrap metals and large boulders (greater than one foot in diameter) during excavation which may not be accepted by either the licensed disposal facility or the C&D facility. These materials will be segregated and subsequently recycled at local facilities. Uncontaminated metal objects will be taken to a local scrap metal facility.

Bricks and other C&D material are also not accepted by most soil disposal facilities if present at greater then 5% by volume. This material, if encountered, will be sent to a C&D landfill or other C&D processing facility. C&D material of this type is most often encountered on sites in which former basement structures have been filled in with material from demolishing a former building. There was no evidence of former basement areas identified during previous investigations performed at the Site.

Scale Tickets

All trucks to be utilized for transport of hazardous or non-hazardous contaminated soil shall be weighed before and after unloading at the disposal facility. Disposal facilities must provide truck scales capable of generating load tickets measured in tons. The tonnage transported and disposed will be determined by the disposal facility and reported on a certified scale ticket which will be attached to each returned manifest. Weights will be reported on the certified scale ticket as Tare and Gross weights.

C&D Transport Tickets / Bills of Lading

Bill of Lading system or equivalent will be used for the disposal of C&D and related materials generated during the remedial action. Documentation for materials disposed of at recycling facilities (such as metal, concrete, asphalt) and as non-regulated C&D will include transport tickets for each load stating the origin of the material, the destination of the material and the quantity transported. This information will be reported in the Final Engineering Report.

Disposal Facility Documentation

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 Applicant 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.

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.

5.4.9 Materials Reuse On-Site

Re-use of on-Site clean native soil will only be allowed if the material is found to meet Unrestricted Use SCOs (for Track 1) through the verification testing program detailed above. The Remedial Engineer will ensure that procedures defined for materials reuse in this RAWP are followed and that unacceptable material will not remain on-Site.

Acceptable demolition material proposed for reuse on-Site, if any, will be sampled for asbestos. Concrete crushing or processing on-Site is prohibited. Contaminated on-Site material, including historic fill material 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.

5.4.10 Fluids Management

As the depth to groundwater at the site is approximately 3 feet below the planned excavation depth, dewatering operations are not anticipated. However if localized dewatering is needed, fluids will be handled, transported and disposed of in accordance with applicable local, State, and Federal regulations. Liquids discharged into the Nassau County sewer system will be addressed through approval by the NCDPW.

Dewatered fluids will not be recharged back to the land surface or subsurface of the Site. A supplemental dewatering work plan will be submitted to the NYSDEC, which will include elements such as the quantity of dewatering expected, equipment specifications, pumping, storage, and discharge locations, and the dewatering treatment required. The supplemental dewatering work plan will be approved by the NYSDEC prior to the start of work.

5.4.11 Backfill from Off-Site Sources

Off-site fill material may be needed to stabilize the entrance - exit areas of the Site, for temporary driveways for loading trucks and as an underlayment to structural components of the new buildings including slabs and footings. Recycled Concrete Aggregate (RCA) derived from recognizable and uncontaminated concrete and supplied by facilities permitted by, and in full compliance with Part 360-16 and DSNY regulations, is an acceptable form of backfill material. The Remedial Engineer is responsible for ensuring that the facility is compliant with the registration and permitting requirements of 6 NYCRR Part 360 and DSNY regulations at the time the RCA is acquired. RCA imported from compliant facilities does not require additional testing unless required by NYS DEC and DSNY under its terms of operations for the facility. Documentation of part 360-16 and DSNY compliance must be provided to the Remedial Engineer before the RCA is transported to the Site.

Fill material may also consist of virgin mined sand, gravel or stone products or non-virgin clean fill supplied by a facility, construction Site or other source. Gravel or stone material from a virgin mined source may be imported to the Site without testing provided that that the material meets the specifications of the geotechnical engineer, Remedial Engineer, and Redevelopment Construction Documents and that the source of the material is approved by the Remediation Engineer and the NYSDEC Project Manager. This material must contain less than 10% fines and not be blended with soil or other material. As per DER-10, if soil from sourced from a virgin mine or pit is imported, at least one round of characterization sampling for the first 100 cubic yards is required in accordance with Table 4 of CP-51/Table 5.4(e)10 of DER-10.
The source approval process will require a review of the following information:

- The origin of the material;
- The address of the facility which mines/processes the material;
- A letter from the facility stating that the material to be delivered to the site is a virgin mined material and that it has not been co-mingled with other materials during processing or stockpiling.

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 or other potentially contaminated sites will not be imported to the Site. Fill from non-virgin sources must be testing in accordance with table 5.4 in DER10 and confirmed to meet the SCOs for the Site (unrestricted for Track 1, commercial/protection of groundwater for Track 2).

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".

Under no circumstances will fill materials be imported to the site without prior approval from the NYSDEC Project Manager. Any soil imported to the site needs to be tested in accordance with Table 4 of NYSDEC CP-51 Soil Cleanup Guidance Policy. Soils that meet 'exempt' fill requirements under 6 NYCRR Part 360, but do not meet backfill or cover soil objectives for this Site, will not be imported onto the Site without prior approval by NYSDEC. Solid waste will not be imported onto the Site.

5.4.12 Stormwater 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.

5.4.13 Contingency Plan

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.

5.4.14 Community Air Monitoring Plan

The Community Air Monitoring Plan (CAMP) provides measures for protection for on-site workers and the downwind community (i.e., off-site receptors including residences, businesses, and on-site workers not directly involved in the remedial work) from potential airborne contaminant releases resulting from remedial activities at construction sites.

The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that the remedial work did not spread contamination off-site through the air. The primary concerns for this site are odors associated with groundwater purging and sampling. Exceedances observed in the CAMP will be reported to NYSDEC and NYSDOH Project Managers and included in the Daily Report. The complete CAMP developed for this site is included in **Attachment D**.

5.4.15 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."

5.4.15.1 Odor Control Plan

This odor control plan is capable of controlling emissions of nuisance odors off-Site and on-Site. 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 Applicant's Remediation 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) use of closed settling tanks and carbon treatment of exhaust air from the pumping / dewatering system (b) limiting the area of open excavations; (c) shrouding open excavations with tarps and other covers; and (d) using foams to cover exposed odorous soils. If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: (e) direct load-out of soils to trucks for off-Site disposal; (f) use of chemical odorants in spray or misting systems, (g) use of perimeter misting systems; and, (h) 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.

5.4.15.2 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:

- Dust suppression will be achieved though spraying water directly onto off-road areas including excavations and stockpiles.
- 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 application.

5.4.15.3 Nuisance Control Plan

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 conforms, to NYCDEP noise control standards.

6.0 REMEDIAL ACTION: GROUNDWATER TREATMENT

6.1 CHEMICAL OXIDANT TREATMENT PLAN

To remediate dissolved phase CVOCs in the two hotspot areas, chemical oxidants will be applied to each hotspot area following the removal of impacted soil. Oxidants applied at these locations will travel through the impacted zone allowing it to flow with groundwater. The application of oxidant within Hotspot 1 will be as a dry powder broadcast directly into the open excavation. Oxidant application in the Hotspot 2 area will be completed as a solution though injection tooling using a geoprobe drill machine. Oxidant application to a third impacted groundwater area will also be through geoprobe injections

6.2 TREATMENT AREA

The area of treatment is within each of the two residual hotspot areas plus a third area with groundwater impact only (**Figure 12**). The area of Hotspot 1 located in the northwest area of the Site is estimated to be 125 sf. The area of Hotspot 2 located in the southeast corner of the Site is estimated to be 427 sf. The area of the third groundwater impact area, located south of Hotspot 1 is estimated to be 125 sf.

6.3 OXIDANT MATERIALS

The oxidant selected is a self activating sodium persulfate / calcium peroxide product (Klosur CR). Sodium persulfate is a robust oxidant which has a long residence time (anion lifetime) in the subsurface. Activated persulfate provides fast contaminant reaction kinetics capable of destroying a wide range of organics including the petroleum and chlorinated VOCs present at the Site. Klozur® CR will be delivered to the site as a dry powder and broadcast directly into the open excavation at Hotspot 1 which will extend several feet into the water table. For Hotspot 2 and the third groundwater impact area, Klosur CR will be mixed with water on-site to provide a 20% (wt) slurry.

The overall oxidant demand, in pounds of activated persulfate, needed to complete the remediation of the Site, requires an estimate of contaminant mass in groundwater. The estimate of total contaminant mass was performed by assigning average concentrations reported in groundwater as reported during the RI. The total contaminant mass was then calculated by multiplying the area of the zone by the depth of impact, porosity and stoichiometric demand. The total contaminant demand to remediate the VOCs in groundwater in the Hotspot 1 area was calculated at 0.38 pounds of oxidant. This has been increased to 20 pounds to account for natural oxidant demand and to include a safety factor to eliminate the possible need for subsequent applications. The amount of oxidant needed to treat the chlorinated VOCs in Hotspot 2 were calculated at 28.69 pounds and at 0.75 pounds for the third groundwater impact area. These amounts were increased to 1,500 pounds and 45 pounds respectively.

For the initial application, the injections at Hotspot 2 and the third groundwater impacted area will be completed throughout the entire hotspot areas. The chemical solution will be injected from 0 to 8 feet below the water table at 10 locations within Hotspot 2 and at 2 locations within the third groundwater impact area. Injections will be spaced approximately 10 feet apart. Approximately 150 gallons of 20% solution will be injected at each location. Chemical injection locations are shown on **Figure 12**.

Chemical oxidant calculations and manufacturer's product specifications are included in **Attachment G**. The need for subsequent applications will be determined following the collection and analysis of performance monitoring samples.

6.4 INJECTION PROCEDURES

When conducting chemox injections, the contractor must have spill kits to prevent the oxidant from reaching any storm sewer in case of an accidental spill or equipment leaks.

Chemical injections will be performed by an environmental drilling contractor with the experience and equipment needed to perform chemical injections:

1. C Squared Environmental
2. Coastal Environmental Drilling
3. Eastern Environmental

Contractor selection will be based on availability, price and drilling equipment if problems are encountered. AMC / EBC field personnel will oversee and document the injections activities.

The injections will be performed by first mixing a 20% slurry of oxidant in the mixing tank. This will require 1.07 gallons of water for every pound of oxidant mixed. So for a 150 gallon mixture, 140 pounds of oxidant will be added to the tank. The mixing procedure consists of adding water to the tank first followed by the oxidant and then recirculating the mixture with the transfer pump. The mixture is recirculated for approximately 10 minutes or until the oxidant has fully dissolved into the solution.

The water will be sourced from an adjacent property, from a fire hydrant or from a tanker truck. The ratios are measured by monitoring the water volume (gallons) in the tank and adding the corresponding amount of oxidant to make the solution. Sodium permanganate will be delivered to the Site in 45 lb pails. For each 45 pound pail 48 gallons of dilution water will be needed. For each 5 gallon pail, 5.35 gallons of dilution water will be needed.

A pressure line is connected to the injection tooling or wellhead with a pressure relief valve. Injection pressure will be gravity generated at approximately 6 psi. Increased pressure may be required in tight materials. The release side of the pressure relief valve will be fitted with a discharge hose which will be routed back to the mixing tank or other overflow vessel.

Injections performed through the Geoprobe rods will utilize a 2-foot long injection probe head. The probe in its drive position is covered in a stainless steel sheath. It is then driven to the desired depth (approximately 20 ft below grade). The rods are then pulled back 2 ft to expose the probe head. Injections then begin and continue as the rods are slowly pulled up 7 ft to the top of the water table. The rods are then removed and the process repeats at the next injection location.

6.5 REMEDIAL PERFORMANCE EVALUATION (POST TREATMENT SAMPLING)

The monitoring wells will be constructed of 2-inch diameter pvc casing and 0.020 inch slotted pvc well screen. The wells will have 10 feet of screen set 7 to 8 feet below the water table. A No.

1 Morie or equivalent filer sand will be placed in the borehole to within 2 feet above the top of the screen. A 1-foot hydrated bentonite seal will be placed on top of the filter sand and the remainder of the borehole will be backfilled to grade.

Groundwater performance monitoring samples will be collected from four downgradient monitoring wells (20MW1 – 20 MW4) to be installed within each of the hotspot areas (see Figure 1**2**). Groundwater samples will be collected prior to performing the ISCO application to establish baseline conditions. Post ISCO performance samples will be collected approximately 2 weeks and four weeks after the injections are completed. Analysis will include VOCs by Method 8260C.

The need for subsequent sampling of the wells will be made in consultation with the NYSDEC. All monitoring wells will be surveyed to determine relative casing elevation to the nearest 0.01 ft and horizontal position to the nearest 0.1ft.

6.5.1 Methodology

Groundwater samples will be collected from the four monitoring wells using a persistaltic pump and new polyethylene tubing. All groundwater sampling activities will be recorded in the project dedicated field book. This will include a description of:

- Date and time of sample collection
- Sample location
- Purging time, duration and volume;
- Sample appearance
- Analytical methodology:

Groundwater samples will be collected using a peristaltic pump in accordance with standard low-flow sampling procedures as follows:

- Record pump make & model on sampling form.
- Wear appropriate health and safety equipment as outlined in the Health and Safety Plan

- Inspect each well for any damage or evidence of tampering and note condition in field logbook.
- Remove the well cap
- Lay out plastic sheeting and place the monitoring, purging and sampling equipment on the sheeting.
- To avoid cross-contamination, do not let any downhole equipment touch the ground.
- Measure well headspace with a PID or FID and record the reading in the field logbook.
- A synoptic water level measurement round should be performed (in the shortest possible time) before any purging and sampling activities begin. Measure and record the depth to water using a water level meter or interface probe to the nearest 0.01 ft. Record the measurement in the field logbook. Do not measure the depth to the bottom of the well at this time (to avoid disturbing any sediment that may have accumulated). Obtain depth to bottom information from installation information in the field logbook or soil boring logs.
- Collect samples in order from wells with lowest contaminant concentration to highest concentration.
- Connect the polyethylene tubing to the pump and lower the tubing into the well to approximately the middle of the screen. The tubing should be a minimum of 2 feet above the bottom of the well as this may cause mobilization of any sediment present in the bottom of the well.
- Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no water level drawdown (less than 0.3 feet). If the minimal drawdown that can be achieved exceeds 0.3 feet but remains stable, continue purging until indicator field parameters stabilize.
- There should be at least 1 foot of water over the end of the tubing / pump so there is no risk of entrapment of air in the sample. Pumping rates should be reduced to the minimum capabilities of the pump, if needed, to avoid purging the well dry. However, if the recharge rate of the well is very low and the well is purged dry, then wait until the well has recharged to a sufficient level and collect the appropriate volume of sample.
- During well purging, monitor indicator field parameters (temperature and pH) every three to five minutes (or less frequently, if appropriate). Note: during the early phase of purging emphasis should be put on minimizing and stabilizing pumping stress, and

recording those adjustments. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at three (3) to five (5) minute intervals, are within the following limits:

  - temperature (3%),
  - pH (± 0.1 unit)
  - If stability is not reached within a reasonable time period purging may be stopped and the sample collected. This should be noted on the sampling log.

- VOC samples should be collected directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence. Fill each container with sample to just overflowing so that no air bubbles are entrapped inside. Cap each bottle as it is filled.
- Label the samples, and record them on the chain of custody form. Place immediately into a cooler for shipment and maintain at 4°C.
- Remove the tubing from the well. The polyethylene tubing must either be dedicated to each well or discarded. If dedicated the tubing should be placed in a large plastic garbage bag, sealed, and labeled with the appropriate well identification number. The silicone pump tubing must also be dedicated or disposed of between sampling locations.
- Close and lock the well.

The sample will be drawn directly into pre-cleaned laboratory supplied glassware, stored in a cooler with ice. Samples will either be picked up at the Site by a laboratory dispatched courier at the end of the day or picked up the following day by the laboratory courier. All samples will be analyzed by a NYSDOH ELAP certified environmental laboratory certified in the appropriate category. Groundwater samples will be submitted for analysis of VOCs by EPA method 8260C.

6.5.2 Reporting of Results

Sample analysis will be provided by a New York State ELAP certified environmental laboratory. Laboratory reports will include Analytical Systems Protocol July 2005 (ASP) category B data deliverables for use in the preparation of a data usability summary report (DUSR). All results will be provided in accordance with the NYSDEC Environmental Information Management System (EIMS) electronic data deliverable (EDD) format.

6.5.3 QA/QC

The fundamental QA objective with respect to accuracy, precision, and sensitivity of analysis for laboratory analytical data is to achieve the QC acceptance of the analytical protocol. The accuracy, precision and completeness requirements will be addressed by the laboratory for all data generated.

Collected samples will be appropriately packaged, placed in coolers and shipped via overnight courier or delivered directly to the analytical laboratory by field personnel. Samples will be stored in the field in a cooler containing ice or cold-pak(s) to maintain a temperature of 4 degrees C. Samples will be containerized in appropriate laboratory provided glassware and shipped in plastic coolers. Samples will be preserved through the use of ice or cold-pak(s) to maintain a temperature of 4^{o}C, +/- 2 ^{o}C.

Dedicated disposable sampling materials will be used for all groundwater samples, eliminating the need to prepare field equipment (rinsate) blanks. However, if non-disposable equipment is used, field rinsate blanks will be prepared at the rate of 1 for every eight samples collected. Field blanks will be prepared by pouring distilled or deionized water over decontaminated equipment and collecting the water in laboratory provided containers.

Trip blanks will accompany samples each time they are transported to the laboratory. Matrix spike, matrix spike duplicates (MS/MSD) and blind duplicates will be collected at the rate of one per 20 samples submitted to the laboratory.

6.5.4 DUSR

The DUSR provides a thorough evaluation of analytical data with full third party data validation. The primary objective of a DUSR is to determine whether or not the data, as presented, meets the site/project specific criteria for data quality and data use. Verification and/or performance monitoring samples collected under this RAWP will be reviewed and evaluated in accordance with the Guidance for the Development of Data Usability Summary Reports as presented in Appendix 2B of DER-10. The completed DUSR for verification/performance samples collected during implementation of this RAWP will be included in the Final Engineering Report.

6.5.5 Reporting of Performance Data in FER

Chemical labs used for all performance monitoring and final post-remedial sampling analysis will be NYSDOH ELAP laboratory certified in the appropriate categories. The FER will provide a tabular and map summary of all performance monitoring and post-remedial sample results and exceedances of water quality standards.

7.0 RESIDUAL CONTAMINATION TO REMAIN ON-SITE

If a Track 1 cleanup is achieved on the Track 1 portion of the Site, all soil remaining on this portion of the Site after completion of remediation will meet Track 1 Unrestricted Use SCOs, a bulk reduction of groundwater contamination to asymptotic levels will have occurred, and an Institutional Control (IC) will not be required to protect human health and the environment.

If Track 1 is not achieved, long-term management of an IC will be executed under an environmental easement recorded with the County.

Long-term management of ICs/ECs, if needed, will be executed under a site-specific Site Management Plan (SMP) that will be developed and submitted to DEC. The FER will report residual contamination on the Site in tabular and map form.

8.0 ENGINEERING CONTROLS

The intent of this project is to achieve Track 1 Unrestricted Use remedy. If a Track 1 Cleanup cannot be achieved, then a Track 2 Commercialal cleanup is proposed. If neither a Track 1 nor Track 2 Cleanup can be achieved, then a Track 4 Cleanup will be achieved.

If a Track 4 remedy is achieved, the Site will be restricted to Restricted-Residential, Commercial and Industrial uses and a site cover may be required to allow for the intended use of the Site. The cover will consist either of the structures such as buildings, pavement, sidewalks comprising the site development or two feet of soil meeting the SCOs as set forth in 6 NYCRR Part 375-6.7(d) and Table 375-6.8(b). The soil cover will be placed over a demarcation layer, with the upper six inches of the soil of sufficient quality to maintain a vegetation layer. Any fill material brought to the Site will meet the requirements for the identified site use as set forth in 6 NYCRR Part 375-6.7(d).

9.0 INSTITUTIONAL CONTROLS

Since the intent of this project is to achieve Track 1 cleanup criteria, institutional controls are not expected to be part of the final remedy for the Site.

If Track 1 cleanup is not achieved, ICs will be incorporated into the remedy to render the overall Site remedy protective of public health and the environmental. Two elements have been designed to ensure continual and proper management of residual contamination in perpetuity: an Environmental Easement and a SMP.

If required, a Site-Specific Environmental Easement will be recorded with the City of New York 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 the 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 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. Since the Track 4 portion of the Site will have residual contamination after completion of all Remedial Actions, an Environmental Easement will be required for that area of the Site. An Environmental Easement approved by NYSDEC for the Track 4 portion of the Site will be filed and recorded with the City of New York. The Environmental Easement will be submitted as part of the Final Remediation Report.

The Environmental Easement renders the Site a Controlled Property. The Environmental Easement must be recorded with the City of New York before the Certificate of Completion can be issued by NYSDEC. 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 (SMP), which provides all of the methods and procedures to be followed to comply with this remedy.

The Institutional Controls which will be needed to support Engineering Controls are:

- Use of groundwater underlying the Controlled Property is prohibited without treatment rendering it safe for intended purpose;

- Compliance with the Environmental Easement by the Grantee and the Grantee's successor's is required;

- 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 Controls; and,

- 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 (SMP) is submitted as a separate and independent document from the FER. 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, 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 SMP 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.

No exclusions for handling of residual contaminated soils will be provided in the 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 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 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 _________certify that I am currently a NYS registered professional engineer, I had primary direct responsibility for the implementation of the subject construction program, and I certify that the Remedial Work Plan (or Remedial Design or Plans and Specifications) was implemented and that all construction activities were completed in substantial conformance with the DER-approved Remedial Work Plan (or Remedial Design or Plans and Specifications).

Additionally, I certify that:

- *All documents generated in support of this report have been submitted in accordance with the DER's electronic submission protocols and have been accepted by the Department;*
- *All data generated in support of this report have been submitted in accordance with the Department's electronic data deliverable and have been accepted by the Department;*

- *All information and statements in this certification form are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law. I, [name], of [business address], am certifying as Owner's Designated Site Representative: [and I have been authorized and designated by all site owners to sign this certification] for this site.*

If the Remedial Action Work Plan (or Remedial Design or Plans and Specifications) identifies time frames to be achieved by the remedial program, the certification must include:

The data submitted to DER demonstrates that the remediation requirements set forth in the Remedial Work Plan (or Remedial Design or Plans and Specifications) and all applicable statutes and regulations have been or will be achieved in accordance with the time frames, if any, established in the work plan (or Remedial Design or Plans and Specifications).

If the remedial program requires ICs or ECs, the certification will include:

All use restrictions, institutional controls, engineering controls and/or any operation and maintenance requirements applicable to the site are contained in an environmental easement created and recorded pursuant to ECL 71-3605 and that any affected local governments, as defined in ECL 71-3603, have been notified that such easement has been recorded.

If the remedial program requires applicable SMP, the certification will include:

A Site Management Plan has been submitted for the continual and proper operation, maintenance, and monitoring of any engineering controls employed at the site including the proper maintenance of any remaining monitoring wells, and that such plan has been approved by DER.

If the remedial program requires financial assurance, the certification will include:

Any financial assurance mechanisms required by DEC pursuant to Environmental Conservation Law have been executed.

11.0 SCHEDULE

The remedial action will begin with mobilization of equipment and material to the Site which will begin approximately 3 weeks following RAWP approval and within 10 days of the distribution of the Construction Fact Sheet. Mobilization will be followed by the installation of shoring structures, excavation and disposal of the CVOC hotspot areas and the top 3 feet of soil across the Site, baseline groundwater sampling, application of oxidants and confirmatory groundwater sampling. The work is expected to take approximately 3 months as part of the construction excavation and foundation installation. The schedule of tasks completed under this RAWP is as follows:

Conduct pre-construction meeting with NYSDEC	Within 3 weeks of RAWP approval
Mobilize equipment to the site and construct truck pad and other designated areas	Within 3 weeks following the pre-construction meeting and issuance of Pre-Construction Fact Sheet
Mobilize excavation contractor & equipment to the Site	Within 3 weeks following the pre-construction meeting
Excavate CVOC Hotspot areas	Begin upon mobilization, duration: 1 week
Excavate top 3 ft of soil across the Site	Following CVOC excavation: 2 weeks
Perform endpoint verification of entire site	Performed in sequence as final depth of each excavated area is complete.
Install groundwater monitoring wells and collect baseline groundwater samples	Immediately after reaching the final excavation depth
Perform ISCO applications	Immediately following the collection of baseline groundwater samples
Collect post ISCO groundwater samples	Two weeks and four weeks following ISCO application
Submit SMP (as a contingency) if Track 1 Cleanup is not achieved	By August 15th of the year in which the COC is sought or as required by DEC.
Submit FER	By September 15th of the year in which the COC is sought or as required by DEC.

TABLES

TABLE 1
Soil Cleanup Objectives

Contaminant	CAS Number	Protection of Public Health		Unrestricted Use
		Restricted-Residential	Commercial	
METALS				
Arsenic	7440-38 -2	16f	16f	13 [c]
Barium	7440-39 -3	400	400	350 [c]
Beryllium	7440-41 -7	72	590	7.2
Cadmium	7440-43 -9	4.3	9.3	2.5 [c]
Chromium, hexavalent [h]	18540-29-9	110	400	1[b]
Chromium, trivalent[h]	16065-83-1	180	1,500	30 [c]
Copper	7440-50 -8	270	270	50
Total Cyanide [h]		27	27	27
Lead	7439-92 -1	400	1,000	63 [c]
Manganese	7439-96 -5	2,000f	10,000 d	1600 [c]
Total Mercury		0.81j	2.8j	0.18 [c]
Nickel	7440-02 -0	310	310	30
Selenium	7782-49 -2	180	1,500	3.9[c]
Silver	7440-22 -4	180	1,500	2
Zinc	7440-66 -6	10,000 d	10,000 d	109 [c]
PESTICIDES / PCBs				
2,4,5-TP Acid (Silvex)	93-72-1	100a	500b	3.8
4,4'-DDE	72-55-9	8.9	62	0.0033 [b]
4,4'-DDT	50-29-3	7.9	47	0.0033 [b]
4,4'-DDD	72-54-8	13	92	0.0033 [b]
Aldrin	309-00-2	0.097	0.68	0.005 [c]
alpha-BHC	319-84-6	0.48	3.4	0.02
beta-BHC	319-85-7	0.36	3	0.036
Chlordane (alpha)	5103-71 -9	4.2	24	0.094
delta-BHC	319-86-8	100a	500b	0.04
Dibenzofuran	132-64-9	59	350	7
Dieldrin	60-57-1	0.2	1.4	0.005[c]
Endosulfan I	959-98-8	24i	200i	2.4
Endosulfan II	33213-65-9	24i	200i	2.4
Endosulfan sulfate	1031-07 -8	24i	200i	2.4
Endrin	72-20-8	11	89	0.014
Heptachlor	76-44-8	2.1	15	0.042
Lindane	58-89-9	1.3	9.2	0.1
Polychlorinated biphenyls	1336-36 -3	1	1	0.1
SEMI-VOLATILES				
Acenaphthene	83-32-9	100a	500b	20
Acenapthylene	208-96-8	100a	500b	100 [a]
Anthracene	120-12-7	100a	500b	100 [a]
Benz(a)anthracene	56-55-3	1f	5.6	1[c]
Benzo(a)pyrene	50-32-8	1f	1f	1[c]
Benzo(b) fluoranthene	205-99-2	1f	5.6	1[c]
Benzo(g,h,i) perylene	191-24-2	100a	500b	100
Benzo(k) fluoranthene	207-08-9	3.9	56	0.8 [c]
Chrysene	218-01-9	3.9	56	1[c]
Dibenz(a,h) anthracene	53-70-3	0.33e	0.56	0.33 [b]
Fluoranthene	206-44-0	100a	500b	100 [a]
Fluorene	86-73-7	100a	500b	30
Indeno(1,2,3-cd) pyrene	193-39-5	0.5f	5.6	0.5 [c]
m-Cresol	108-39-4	100a	500b	0.33 [b]
Naphthalene	91-20-3	100a	500b	12
o-Cresol	95-48-7	100a	500b	0.33 [b]
p-Cresol	106-44-5	100a	500b	0.33 [b]
Pentachlorophenol	87-86-5	6.7	6.7	0.8[b]
Phenanthrene	85-01-8	100a	500b	100
Phenol	108-95-2	100a	500b	0.33[b]
Pyrene	129-00-0	100a	500b	100

Contaminant	CAS Number	Protection of Public Health		Unrestricted Use
		Restricted-Residential	Commercial	
VOLATILES				
1,1,1-Trichloroethane	71-55-6	100a	500b	0.68
1,1-Dichloroethane	75-34-3	26	240	0.27
1,1-Dichloroethene	75-35-4	100a	500b	0.33
1,2-Dichlorobenzene	95-50-1	100a	500b	1.1
1,2-Dichloroethane	107-06-2	3.1	30	0.02[c]
cis-1,2-Dichloroethene	156-59-2	100a	500b	0.25
trans-1,2-Dichloroethene	156-60-5	100a	500b	0.19
1,3-Dichlorobenzene	541-73-1	49	280	2.4
1,4-Dichlorobenzene	106-46-7	13	130	1.8
1,4-Dioxane	123-91-1	13	130	0.1 [b]
Acetone	67-64-1	100b	500b	0.05
Benzene	71-43-2	4.8	44	0.06
Butylbenzene	104-51-8	100a	500b	12
Carbon tetrachloride	56-23-5	2.4	22	0.76
Chlorobenzene	108-90-7	100a	500b	1.1
Chloroform	67-66-3	49	350	0.37
Ethylbenzene	100-41-4	41	390	1
Hexachlorobenzene	118-74-1	1.2	6	0.33[b]
Methyl ethyl ketone	78-93-3	100a	500b	0.12
Methyl tert-butyl ether	1634-04 -4	100a	500b	0.93
Methylene chloride	75-09-2	100a	500b	0.05
n-Propylbenzene	103-65-1	100a	500b	3.9
sec-Butylbenzene	135-98-8	100a	500b	11
tert-Butylbenzene	98-06-6	100a	500b	5.9
Tetrachloroethene	127-18-4	19	150	1.3
Toluene	108-88-3	100a	500b	0.7
Trichloroethene	79-01-6	21	200	0.47
1,2,4-Trimethylbenzene	95-63-6	52	190	3.6
1,3,5-Trimethylbenzene	108-67-8	52	190	8.4
Vinyl chloride	75-01-4	0.9	13	0.02
Xylene (mixed)	1330-20 -7	100a	500b	0.26

All soil cleanup objectives (SCOs) are in parts per million (ppm). NS=Not specified. See Technical Support Document (TSD). Footnotes

a The SCOs for residential, restricted-residential and ecological resources use were capped at a maximum value of 100 ppm. See TSD section 9.3.

b The SCOs for commercial use were capped at a maximum value of 500 ppm. See TSD section 9.3.

c The SCOs for industrial use and the protection of groundwater were capped at a maximum value of 1000 ppm. See TSD section 9.3.

d The SCOs for metals were capped at a maximum value of 10,000 ppm. See TSD section 9.3.

e For constituents where the calculated SCO was lower than the contract required quantitation limit (CRQL), the CRQL is used as the SCO value.

TABLE - 2
SOIL ANALYTICAL SUMMARY VOCs - DECEMBER 19-21, 2017
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION					**MW-10 8.0-8.5**		**MW-11 14.0-14.5**		**MW-11 14.0-14.5X**		**MW-12 13.5-14.0**		**MW-9 16.5-17**	
SAMPLING DATE					**12/19/2016**		**12/19/2016**		**12/19/2016**		**12/20/2016**		**12/19/2016**	
SAMPLE DEPTH (ft.)					**8.0-8.5 (feet bgs)**		**14.0-14.5 (feet bgs)**		**14.0-14.5 (feet bgs)**		**13.5-14.0 (feet bgs)**		**16.5-17 (feet bgs)**	
	NY-RESC	**NY-RESRR**	**NY-UNRES**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Volatile Organics by 8260/5035														
1,1,1,2-Tetrachloroethane				mg/kg	ND		ND		ND		ND		ND	
1,1,1-Trichloroethane	500	100	0.68	mg/kg	ND		ND		ND		ND		ND	
1,1,2,2-Tetrachloroethane				mg/kg	ND		ND		ND		ND		ND	
1,1,2-Trichloroethane				mg/kg	ND		ND		ND		ND		ND	
1,1-Dichloroethane	240	26	0.27	mg/kg	ND		ND		ND		ND		ND	
1,1-Dichloroethene	500	100	0.33	mg/kg	ND		ND		ND		ND		ND	
1,1-Dichloropropene				mg/kg	ND		ND		ND		ND		ND	
1,2,3-Trichlorobenzene				mg/kg	ND		ND		ND		ND		ND	
1,2,3-Trichloropropane				mg/kg	ND		ND		ND		ND		ND	
1,2,4,5-Tetramethylbenzene				mg/kg	ND		0.00019	J	0.00019	J	ND		ND	
1,2,4-Trichlorobenzene				mg/kg	ND		ND		ND		ND		ND	
1,2,4-Trimethylbenzene	190	52	3.6	mg/kg	ND		ND		ND		ND		ND	
1,2-Dibromo-3-chloropropane				mg/kg	ND		ND		ND		ND		ND	
1,2-Dibromoethane				mg/kg	ND		ND		ND		ND		ND	
1,2-Dichlorobenzene	500	100	1.1	mg/kg	ND		ND		ND		ND		ND	
1,2-Dichloroethane	30	3.1	0.02	mg/kg	ND		ND		ND		ND		ND	
1,2-Dichloroethene, Total				mg/kg	11		0.09	J	0.24	J	ND		ND	
1,2-Dichloropropane				mg/kg	ND		ND		ND		ND		ND	
1,3,5-Trimethylbenzene	190	52	8.4	mg/kg	ND		ND		ND		ND		ND	
1,3-Dichlorobenzene	280	49	2.4	mg/kg	ND		ND		ND		ND		ND	
1,3-Dichloropropane				mg/kg	ND		ND		ND		ND		ND	
1,3-Dichloropropene, Total				mg/kg	ND		ND		ND		ND		ND	
1,4-Dichlorobenzene	130	13	1.8	mg/kg	ND		ND		ND		0.00053	J	ND	
1,4-Dioxane	130	13	0.1	mg/kg	ND		ND		ND		ND		ND	
2,2-Dichloropropane				mg/kg	ND		ND		ND		ND		ND	
2-Butanone	500	100	0.12	mg/kg	ND		ND		ND		ND		ND	
2-Hexanone				mg/kg	ND		ND		ND		ND		ND	
4-Methyl-2-pentanone				mg/kg	ND		ND		ND		ND		ND	
Acetone	500	100	0.05	mg/kg	0.21		0.0044	J	0.0059	J	0.0048	J	ND	
Acrylonitrile				mg/kg	ND		ND		ND		ND		ND	
Benzene	44	4.8	0.06	mg/kg	ND		ND		0.00042	J	ND		ND	
Bromobenzene				mg/kg	ND		ND		ND		ND		ND	
Bromochloromethane				mg/kg	ND		ND		ND		ND		ND	
Bromodichloromethane				mg/kg	ND		ND		ND		ND		ND	
Bromoform				mg/kg	ND		ND		ND		ND		ND	
Bromomethane				mg/kg	ND		ND		ND		ND		ND	
Carbon disulfide				mg/kg	ND		0.002	J	0.0024	J	0.0016	J	ND	
Carbon tetrachloride	22	2.4	0.76	mg/kg	ND		ND		ND		ND		ND	
Chlorobenzene	500	100	1.1	mg/kg	ND		ND		ND		ND		ND	
Chloroethane				mg/kg	ND		ND		ND		ND		ND	
Chloroform	350	49	0.37	mg/kg	ND		ND		ND		ND		ND	
Chloromethane				mg/kg	ND		ND		ND		ND		ND	
cis-1,2-Dichloroethene	500	100	0.25	mg/kg	11		0.09		0.24		ND		ND	
cis-1,3-Dichloropropene				mg/kg	ND		ND		ND		ND		ND	
Dibromochloromethane				mg/kg	ND		ND		ND		ND		ND	
Dibromomethane				mg/kg	ND		ND		ND		ND		ND	
Dichlorodifluoromethane				mg/kg	ND		ND		ND		ND		ND	
Ethyl ether				mg/kg	ND		ND		ND		ND		ND	
Ethylbenzene	390	41	1	mg/kg	ND		ND		ND		ND		ND	
Hexachlorobutadiene				mg/kg	ND		ND		ND		ND		ND	
Isopropylbenzene				mg/kg	ND		ND		ND		ND		ND	
Methyl tert butyl ether	500	100	0.93	mg/kg	ND		ND		0.00016	J	ND		ND	
Methylene chloride	500	100	0.05	mg/kg	ND		ND		ND		ND		ND	
Naphthalene	500	100	12	mg/kg	ND		ND		ND		ND		ND	
n-Butylbenzene	500	100	12	mg/kg	ND		ND		ND		ND		ND	
n-Propylbenzene	500	100	3.9	mg/kg	ND		ND		ND		ND		ND	
o-Chlorotoluene				mg/kg	ND		ND		ND		ND		ND	
o-Xylene				mg/kg	ND		ND		ND		ND		ND	
p/m-Xylene				mg/kg	ND		ND		ND		ND		ND	
p-Chlorotoluene				mg/kg	ND		ND		ND		ND		ND	
p-Diethylbenzene				mg/kg	ND		ND		ND		ND		ND	
p-Ethyltoluene				mg/kg	ND		ND		ND		ND		ND	
p-Isopropyltoluene				mg/kg	ND		ND		ND		ND		ND	
sec-Butylbenzene	500	100	11	mg/kg	ND		ND		ND		ND		ND	
Styrene				mg/kg	ND		ND		ND		ND		ND	
tert-Butylbenzene	500	100	5.9	mg/kg	ND		ND		ND		ND		ND	
Tetrachloroethene	150	19	1.3	mg/kg	3.7		ND		ND		ND		ND	
Toluene	500	100	0.7	mg/kg	ND		ND		ND		ND		ND	
trans-1,2-Dichloroethene	500	100	0.19	mg/kg	ND		0.00046	J	0.0014	J	ND		ND	
trans-1,3-Dichloropropene				mg/kg	ND		ND		ND		ND		ND	
trans-1,4-Dichloro-2-butene				mg/kg	ND		ND		ND		ND		ND	
Trichloroethene	200	21	0.47	mg/kg	1.5		ND		ND		ND		ND	
Trichlorofluoromethane				mg/kg	ND		ND		ND		ND		ND	
Vinyl acetate				mg/kg	ND		ND		ND		ND		ND	
Vinyl chloride	13	0.9	0.02	mg/kg	0.4		0.016		0.088		0.0016	J	ND	
Xylenes, Total	500	100	0.26	mg/kg	ND		ND		ND		ND		ND	

Notes:
NYSDEC = New York State Department of Environmental Conservation
NY-RESC = New York Commercial Soil Standards
NY-RESRR = New York Residential Soil Standards
NY-UNRES = New York Unrestricted Use Soil Standards
ND= Compound not detected above laboritory detection limits
J= Presumptive evidence of compound.
mg/kg = Milligrams per Kilogram
Bold Highlighted = Exceeds standard
_ = sample not applicable

TABLE - 2
SOIL ANALYTICAL SUMMARY VOCs - DECEMBER 19-21, 2017
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION					**SB-13 1.5-2.0**		**SB-14 1.5-2.0**		**SB-15 1.5-2.0**		**SB-15 7.5-8.0**		**SB-16 9.5-10.0**		**SB-17 6.5-7.0**	
SAMPLING DATE					**12/19/2016**		**12/19/2016**		**12/20/2016**		**12/20/2016**		**12/20/2016**		**12/21/2016**	
SAMPLE DEPTH (ft.)					**1.5-2.0 (feet bgs)**		**1.5-2.0 (feet bgs)**		**1.5-2.0 (feet bgs)**		**7.5-8.0 (feet bgs)**		**9.5-10.0 (feet bgs)**		**6.5-7.0 (feet bgs)**	
	NY-RESC	**NY-RESRR**	**NY-UNRES**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Volatile Organics by 8260/5035																
1,1,1,2-Tetrachloroethane				mg/kg	ND		ND		ND		ND		ND		ND	
1,1,1-Trichloroethane	500	100	0.68	mg/kg	ND		ND		ND		ND		ND		ND	
1,1,2,2-Tetrachloroethane				mg/kg	ND		ND		ND		ND		ND		ND	
1,1,2-Trichloroethane				mg/kg	ND		ND		ND		ND		ND		ND	
1,1-Dichloroethane	240	26	0.27	mg/kg	ND		ND		ND		ND		ND		ND	
1,1-Dichloroethene	500	100	0.33	mg/kg	ND		ND		ND		ND		ND		ND	
1,1-Dichloropropene				mg/kg	ND		ND		ND		ND		ND		ND	
1,2,3-Trichlorobenzene				mg/kg	ND		ND		ND		ND		ND		ND	
1,2,3-Trichloropropane				mg/kg	ND		ND		ND		ND		ND		ND	
1,2,4,5-Tetramethylbenzene				mg/kg	ND		ND		ND		10		0.022		4.2	
1,2,4-Trichlorobenzene				mg/kg	ND		ND		ND		ND		ND		ND	
1,2,4-Trimethylbenzene	190	52	3.6	mg/kg	ND		ND		ND		30		0.025		3.2	
1,2-Dibromo-3-chloropropane				mg/kg	ND		ND		ND		ND		ND		ND	
1,2-Dibromoethane				mg/kg	ND		ND		ND		ND		ND		ND	
1,2-Dichlorobenzene	500	100	1.1	mg/kg	ND		ND		ND		ND		ND		ND	
1,2-Dichloroethane	30	3.1	0.02	mg/kg	ND		ND		ND		ND		ND		ND	
1,2-Dichloroethene, Total				mg/kg	0.0087		ND		0.0036		1.9		0.025		5.4	
1,2-Dichloropropane				mg/kg	ND		ND		ND		ND		ND		ND	
1,3,5-Trimethylbenzene	190	52	8.4	mg/kg	ND		ND		ND		9.6		0.0054	J	1.7	J
1,3-Dichlorobenzene	280	49	2.4	mg/kg	ND		ND		ND		ND		ND		ND	
1,3-Dichloropropane				mg/kg	ND		ND		ND		ND		ND		ND	
1,3-Dichloropropene, Total				mg/kg	ND		ND		ND		ND		ND		ND	
1,4-Dichlorobenzene	130	13	1.8	mg/kg	ND		0.0005	J	0.00038	J	ND		ND		ND	
1,4-Dioxane	130	13	0.1	mg/kg	ND		ND		ND		ND		ND		ND	
2,2-Dichloropropane				mg/kg	ND		ND		ND		ND		ND		ND	
2-Butanone	500	100	0.12	mg/kg	ND		ND		ND		ND		ND		ND	
2-Hexanone				mg/kg	ND		ND		ND		ND		ND		ND	
4-Methyl-2-pentanone				mg/kg	ND		ND		ND		ND		ND		ND	
Acetone	500	100	0.05	mg/kg	ND		ND		0.0082	J	ND		0.0047	J	ND	
Acrylonitrile				mg/kg	ND		ND		ND		ND		ND		ND	
Benzene	44	4.8	0.06	mg/kg	ND		ND		ND		ND		ND		ND	
Bromobenzene				mg/kg	ND		ND		ND		ND		ND		ND	
Bromochloromethane				mg/kg	ND		ND		ND		ND		ND		ND	
Bromodichloromethane				mg/kg	ND		ND		ND		ND		ND		ND	
Bromoform				mg/kg	ND		ND		ND		ND		ND		ND	
Bromomethane				mg/kg	ND		ND		ND		ND		ND		ND	
Carbon disulfide				mg/kg	ND		ND		ND		ND		0.0018	J	ND	
Carbon tetrachloride	22	2.4	0.76	mg/kg	ND		ND		ND		ND		ND		ND	
Chlorobenzene	500	100	1.1	mg/kg	ND		ND		ND		ND		ND		ND	
Chloroethane				mg/kg	ND		ND		ND		ND		ND		ND	
Chloroform	350	49	0.37	mg/kg	ND		ND		ND		ND		ND		ND	
Chloromethane				mg/kg	ND		ND		ND		ND		ND		ND	
cis-1,2-Dichloroethene	500	100	0.25	mg/kg	0.0087		ND		0.0036		1.9		0.025		5.4	
cis-1,3-Dichloropropene				mg/kg	ND		ND		ND		ND		ND		ND	
Dibromochloromethane				mg/kg	ND		ND		ND		ND		ND		ND	
Dibromomethane				mg/kg	ND		ND		ND		ND		ND		ND	
Dichlorodifluoromethane				mg/kg	ND		ND		ND		ND		ND		ND	
Ethyl ether				mg/kg	ND		ND		ND		ND		ND		ND	
Ethylbenzene	390	41	1	mg/kg	ND		ND		ND		1.9		0.0012		ND	
Hexachlorobutadiene				mg/kg	ND		ND		ND		ND		ND		ND	
Isopropylbenzene				mg/kg	ND		ND		ND		1.1		0.0018		0.11	J
Methyl tert butyl ether	500	100	0.93	mg/kg	ND		ND		0.0033	UJ	ND		ND		ND	
Methylene chloride	500	100	0.05	mg/kg	ND		ND		ND		ND		ND		ND	
Naphthalene	500	100	12	mg/kg	ND		ND		ND		24		0.029		ND	
n-Butylbenzene	500	100	12	mg/kg	ND		ND		ND		3.1		0.0066		0.51	J
n-Propylbenzene	500	100	3.9	mg/kg	ND		ND		ND		2.3		0.0044		0.32	J
o-Chlorotoluene				mg/kg	ND		ND		ND		ND		ND		ND	
o-Xylene				mg/kg	ND		ND		ND		5.9		0.0014	J	ND	
p/m-Xylene				mg/kg	ND		ND		ND		4.6		0.00045	J	ND	
p-Chlorotoluene				mg/kg	ND		ND		ND		ND		ND		ND	
p-Diethylbenzene				mg/kg	ND		ND		ND		27		0.026		9.5	
p-Ethyltoluene				mg/kg	ND		ND		ND		6.9		0.0036	J	1.4	J
p-Isopropyltoluene				mg/kg	ND		ND		ND		3.1		0.0036		0.7	
sec-Butylbenzene	500	100	11	mg/kg	ND		ND		ND		2.5		0.0044		0.42	J
Styrene				mg/kg	ND		ND		ND		ND		ND		ND	
tert-Butylbenzene	500	100	5.9	mg/kg	ND		ND		ND		ND		0.00071	J	ND	
Tetrachloroethene	150	19	1.3	mg/kg	0.041		0.0019		0.046		ND		0.072		ND	
Toluene	500	100	0.7	mg/kg	ND		ND		ND		1.5		ND		ND	
trans-1,2-Dichloroethene	500	100	0.19	mg/kg	ND		ND		ND		ND		ND		ND	
trans-1,3-Dichloropropene				mg/kg	ND		ND		ND		ND		ND		ND	
trans-1,4-Dichloro-2-butene				mg/kg	ND		ND		ND		ND		ND		ND	
Trichloroethene	200	21	0.47	mg/kg	0.0016		ND		0.0048		ND		0.0033		ND	
Trichlorofluoromethane				mg/kg	ND		ND		ND		ND		ND		ND	
Vinyl acetate				mg/kg	ND		ND		ND		ND		ND		ND	
Vinyl chloride	13	0.9	0.02	mg/kg	ND		ND		0.00036	J	1.3	J	0.0027		ND	
Xylenes, Total	500	100	0.26	mg/kg	ND		ND		ND		11		0.0019	J	ND	

Notes:
NYSDEC = New York State Department of Environmental Conservation
NY-RESC = New York Commercial Soil Standards
NY-RESRR = New York Residential Soil Standards
NY-UNRES = New York Unrestricted Use Soil Standards
ND= Compound not detected above laboritory detection limits
J= Presumptive evidence of compound.
mg/kg = Milligrams per Kilogram
Bold Highlighted = Exceeds standard
_ = sample not applicable

TABLE - 3
SOIL ANALYTICAL SUMMARY SVOCs - DECEMBER 19-21, 2017
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION					**MW-10 8.0-8.5**		**MW-11 14.0-14.5**		**MW-11 14.0-14.5X**		**MW-12 13.5-14.0**		**MW-9 16.5-17**	
SAMPLING DATE					**12/19/2016**		**12/19/2016**		**12/19/2016**		**12/20/2016**		**12/19/2016**	
SAMPLE DEPTH (ft.)					**8.0-8.5 (feet bgs)**		**14.0-14.5 (feet bgs)**		**14.0-14.5 (feet bgs)**		**13.5-14.0 (feet bgs)**		**16.5-17 (feet bgs)**	
	NY-RESC	**NY-RESRR**	**NY-UNRES**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Semivolatile Organics by GC/MS														
1,2,4,5-Tetrachlorobenzene				mg/kg	ND		ND		ND	U	ND		ND	
1,2,4-Trichlorobenzene				mg/kg	ND		ND		ND	U	ND		ND	
1,2-Dichlorobenzene	500	100	1.1	mg/kg	ND		ND		ND	U	ND		ND	
1,3-Dichlorobenzene	280	49	2.4	mg/kg	ND		ND		ND	U	ND		ND	
1,4-Dichlorobenzene	130	13	1.8	mg/kg	ND		ND		ND	U	ND		ND	
2,4,5-Trichlorophenol				mg/kg	ND		ND		ND	U	ND		ND	
2,4,6-Trichlorophenol				mg/kg	ND		ND		ND	U	ND		ND	
2,4-Dichlorophenol				mg/kg	ND		ND		ND	U	ND		ND	
2,4-Dimethylphenol				mg/kg	ND		ND		ND	U	ND		ND	
2,4-Dinitrophenol				mg/kg	ND		ND		ND	U	ND		ND	
2,4-Dinitrotoluene				mg/kg	ND		ND		ND	U	ND		ND	
2,6-Dinitrotoluene				mg/kg	ND		ND		ND	U	ND		ND	
2-Chloronaphthalene				mg/kg	ND		ND		ND	U	ND		ND	
2-Chlorophenol				mg/kg	ND		ND		ND	U	ND		ND	
2-Methylnaphthalene				mg/kg	0.22	J	ND		ND	U	0.048	J	ND	
2-Methylphenol	500	100	0.33	mg/kg	ND		ND		ND	U	ND		ND	
2-Nitroaniline				mg/kg	ND		ND		ND	U	ND		ND	
2-Nitrophenol				mg/kg	ND		ND		ND	U	ND		ND	
3,3'-Dichlorobenzidine				mg/kg	ND		ND		ND	U	ND		ND	
3-Methylphenol/4-Methylphenol	500	100	0.33	mg/kg	ND		ND		ND	U	ND		ND	
3-Nitroaniline				mg/kg	ND		ND		ND	U	ND		ND	
4,6-Dinitro-o-cresol				mg/kg	ND		ND		ND	U	ND		ND	
4-Bromophenyl phenyl ether				mg/kg	ND		ND		ND	U	ND		ND	
4-Chloroaniline				mg/kg	ND		ND		ND	U	ND		ND	
4-Chlorophenyl phenyl ether				mg/kg	ND		ND		ND	U	ND		ND	
4-Nitroaniline				mg/kg	ND		ND		ND	U	ND		ND	
4-Nitrophenol				mg/kg	ND		ND		ND	U	ND		ND	
Acenaphthene	500	100	20	mg/kg	ND		ND		ND	U	0.077	J	ND	
Acenaphthylene	500	100	100	mg/kg	ND		ND		ND	U	ND		ND	
Acetophenone				mg/kg	ND		ND		ND	U	ND		ND	
Anthracene	500	100	100	mg/kg	ND		ND		ND	U	0.15		ND	
Benzo(a)anthracene	5.6	1	1	mg/kg	ND		ND		ND	U	0.54		ND	
Benzo(a)pyrene	1	1	1	mg/kg	ND		ND		ND	U	**1**		ND	
Benzo(b)fluoranthene	5.6	1	1	mg/kg	ND		ND		ND	U	1		ND	
Benzo(ghi)perylene	500	100	100	mg/kg	ND		ND		ND	U	0.64		ND	
Benzo(k)fluoranthene	56	3.9	0.8	mg/kg	ND		ND		ND	U	0.27		ND	
Benzoic Acid				mg/kg	ND		ND		ND	U	ND		ND	
Benzyl Alcohol				mg/kg	ND		ND		ND	U	ND		ND	
Biphenyl				mg/kg	ND		ND		ND	U	ND		ND	
Bis(2-chloroethoxy)methane				mg/kg	ND		ND		ND	U	ND		ND	
Bis(2-chloroethyl)ether				mg/kg	ND		ND		ND	U	ND		ND	
Bis(2-chloroisopropyl)ether				mg/kg	ND		ND		ND	U	ND		ND	
Bis(2-ethylhexyl)phthalate				mg/kg	ND		ND		ND	U	0.2	J	ND	

TABLE - 3
SOIL ANALYTICAL SUMMARY SVOCs - DECEMBER 19-21, 2017
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION					**MW-10 8.0-8.5**		**MW-11 14.0-14.5**		**MW-11 14.0-14.5X**		**MW-12 13.5-14.0**		**MW-9 16.5-17**	
SAMPLING DATE					**12/19/2016**		**12/19/2016**		**12/19/2016**		**12/20/2016**		**12/19/2016**	
SAMPLE DEPTH (ft.)					**8.0-8.5 (feet bgs)**		**14.0-14.5 (feet bgs)**		**14.0-14.5 (feet bgs)**		**13.5-14.0 (feet bgs)**		**16.5-17 (feet bgs)**	
	NY-RESC	**NY-RESRR**	**NY-UNRES**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Butyl benzyl phthalate				mg/kg	ND		ND		ND	U	ND		ND	
Carbazole				mg/kg	ND		ND		ND	U	0.066	J	ND	
Chrysene	56	3.9	1	mg/kg	ND		ND		ND	U	0.56		ND	
Dibenzo(a,h)anthracene	0.56	0.33	0.33	mg/kg	ND		ND		ND	U	0.18		ND	
Dibenzofuran	350	59	7	mg/kg	ND		ND		ND	U	ND		ND	
Diethyl phthalate				mg/kg	ND		ND		ND	U	ND		ND	
Dimethyl phthalate				mg/kg	ND		ND		ND	U	ND		ND	
Di-n-butylphthalate				mg/kg	ND		ND		ND	U	ND		ND	
Di-n-octylphthalate				mg/kg	ND		ND		ND	U	ND		ND	
Fluoranthene	500	100	100	mg/kg	ND		ND		ND	U	0.6		ND	
Fluorene	500	100	30	mg/kg	0.04	J	ND		ND	U	0.052	J	ND	
Hexachlorobenzene	6	1.2	0.33	mg/kg	ND		ND		ND	U	ND		ND	
Hexachlorobutadiene				mg/kg	ND		ND		ND	U	ND		ND	
Hexachlorocyclopentadiene				mg/kg	ND		ND		ND	U	ND		ND	
Hexachloroethane				mg/kg	ND		ND		ND	U	ND		ND	
Indeno(1,2,3-cd)pyrene	5.6	0.5	0.5	mg/kg	ND		ND		ND	U	0.75		ND	
Isophorone				mg/kg	ND		ND		ND	U	ND		ND	
Naphthalene	500	100	12	mg/kg	0.031	J	ND		ND	U	0.2	J	ND	
NDPA/DPA				mg/kg	ND		ND		ND	U	ND		ND	
Nitrobenzene	69	15		mg/kg	ND		ND		ND	U	ND		ND	
n-Nitrosodi-n-propylamine				mg/kg	ND		ND		ND	U	ND		ND	
p-Chloro-m-cresol				mg/kg	ND		ND		ND	U	ND		ND	
Pentachlorophenol	6.7	6.7	0.8	mg/kg	ND		ND		ND	U	ND		ND	
Phenanthrene	500	100	100	mg/kg	0.11	J	ND		ND	U	0.41		ND	
Phenol	500	100	0.33	mg/kg	ND		ND		ND	U	ND		ND	
Pyrene	500	100	100	mg/kg	ND		ND		ND	U	0.58		ND	

Notes:
NYSDEC = New York State Department of Environmental Conservation
NY-RESC = New York Commercial Soil Standards
NY-RESRR = New York Residential Soil Standards
NY-UNRES = New York Unrestricted Use Soil Standards
ND= Compound not detected above laboritory detection limits
J= Presumptive evidence of compound.
mg/kg = Milligrams per Kilogram

TABLE - 3
SOIL ANALYTICAL SUMMARY SVOCs - DECEMBER 19-21, 2017
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION					**SB-13 1.5-2.0**		**SB-14 1.5-2.0**		**SB-15 7.5-8.0**		**SB-15 7.5-8.0**		**SB-16 9.5-10.0**		**SB-17 6.5-7.0**	
SAMPLING DATE					**12/19/2016**		**12/19/2016**		**12/20/2016**		**12/20/2016**		**12/20/2016**		**12/21/2016**	
SAMPLE DEPTH (ft.)					**1.5-2.0 (feet bgs)**		**1.5-2.0 (feet bgs)**		**7.5-8.0 (feet bgs)**		**7.5-8.0 (feet bgs)**		**9.5-10.0 (feet bgs)**		**6.5-7.0 (feet bgs)**	
	NY-RESC	**NY-RESRR**	**NY-UNRES**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Semivolatile Organics by GC/MS																
1,2,4,5-Tetrachlorobenzene				mg/kg	ND		ND		ND		-	-	ND		ND	
1,2,4-Trichlorobenzene				mg/kg	ND		ND		ND		-	-	ND		ND	
1,2-Dichlorobenzene	500	100	1.1	mg/kg	ND		ND		ND		-	-	ND		ND	
1,3-Dichlorobenzene	280	49	2.4	mg/kg	ND		ND		ND		-	-	ND		ND	
1,4-Dichlorobenzene	130	13	1.8	mg/kg	ND		ND		ND		-	-	ND		ND	
2,4,5-Trichlorophenol				mg/kg	ND		ND		ND		-	-	ND		ND	
2,4,6-Trichlorophenol				mg/kg	ND		ND		ND		-	-	ND		ND	
2,4-Dichlorophenol				mg/kg	ND		ND		ND		-	-	ND		ND	
2,4-Dimethylphenol				mg/kg	ND		ND		ND		-	-	ND		ND	
2,4-Dinitrophenol				mg/kg	ND		ND		ND		-	-	ND		ND	
2,4-Dinitrotoluene				mg/kg	ND		ND		ND		-	-	ND		ND	
2,6-Dinitrotoluene				mg/kg	ND		ND		ND		-	-	ND		ND	
2-Chloronaphthalene				mg/kg	ND		ND		ND		-	-	ND		ND	
2-Chlorophenol				mg/kg	ND		ND		ND		-	-	ND		ND	
2-Methylnaphthalene				mg/kg	ND		ND		28	E	32		ND		26	E
2-Methylphenol	500	100	0.33	mg/kg	ND		ND		ND		-	-	ND		ND	
2-Nitroaniline				mg/kg	ND		ND		ND		-	-	ND		ND	
2-Nitrophenol				mg/kg	ND		ND		ND		-	-	ND		ND	
3,3'-Dichlorobenzidine				mg/kg	ND		ND		ND		-	-	ND		ND	
3-Methylphenol/4-Methylphenol	500	100	0.33	mg/kg	ND		ND		ND		-	-	ND		ND	
3-Nitroaniline				mg/kg	ND		ND		ND		-	-	ND		ND	
4,6-Dinitro-o-cresol				mg/kg	ND		ND		ND		-	-	ND		ND	
4-Bromophenyl phenyl ether				mg/kg	ND		ND		ND		-	-	ND		ND	
4-Chloroaniline				mg/kg	ND		ND		ND		-	-	ND		ND	
4-Chlorophenyl phenyl ether				mg/kg	ND		ND		ND		-	-	ND		ND	
4-Nitroaniline				mg/kg	ND		ND		ND		-	-	ND		ND	
4-Nitrophenol				mg/kg	ND		ND		ND		-	-	ND		ND	
Acenaphthene	500	100	20	mg/kg	ND		ND		1.6		-	-	0.15	J	1.1	
Acenaphthylene	500	100	100	mg/kg	ND		ND		ND		-	-	ND		0.44	
Acetophenone				mg/kg	ND		ND		ND		-	-	ND		ND	
Anthracene	500	100	100	mg/kg	ND		ND		1.3		-	-	0.1	J	0.65	
Benzo(a)anthracene	5.6	1	1	mg/kg	0.023	J	ND		ND		-	-	ND		ND	
Benzo(a)pyrene	1	1	1	mg/kg	ND		ND		ND		-	-	ND		ND	
Benzo(b)fluoranthene	5.6	1	1	mg/kg	0.03	J	ND		ND		-	-	ND		ND	
Benzo(ghi)perylene	500	100	100	mg/kg	ND		ND		ND		-	-	ND		ND	
Benzo(k)fluoranthene	56	3.9	0.8	mg/kg	ND		ND		ND		-	-	ND		ND	
Benzoic Acid				mg/kg	ND		ND		ND		-	-	ND		ND	
Benzyl Alcohol				mg/kg	ND		ND		ND		-	-	ND		ND	
Biphenyl				mg/kg	ND		ND		ND		-	-	ND		ND	
Bis(2-chloroethoxy)methane				mg/kg	ND		ND		ND		-	-	ND		ND	
Bis(2-chloroethyl)ether				mg/kg	ND		ND		ND		-	-	ND		ND	
Bis(2-chloroisopropyl)ether				mg/kg	ND		ND		ND		-	-	ND		ND	
Bis(2-ethylhexyl)phthalate				mg/kg	ND		ND		ND		-	-	ND		ND	

TABLE - 3
SOIL ANALYTICAL SUMMARY SVOCs - DECEMBER 19-21, 2017
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION					**SB-13 1.5-2.0**		**SB-14 1.5-2.0**		**SB-15 7.5-8.0**		**SB-15 7.5-8.0**		**SB-16 9.5-10.0**		**SB-17 6.5-7.0**	
SAMPLING DATE					**12/19/2016**		**12/19/2016**		**12/20/2016**		**12/20/2016**		**12/20/2016**		**12/21/2016**	
SAMPLE DEPTH (ft.)					**1.5-2.0 (feet bgs)**		**1.5-2.0 (feet bgs)**		**7.5-8.0 (feet bgs)**		**7.5-8.0 (feet bgs)**		**9.5-10.0 (feet bgs)**		**6.5-7.0 (feet bgs)**	
	NY-RESC	**NY-RESRR**	**NY-UNRES**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Butyl benzyl phthalate				mg/kg	ND		ND		ND		-	-	ND		ND	
Carbazole				mg/kg	ND		ND		ND		-	-	ND		ND	
Chrysene	56	3.9	1	mg/kg	0.023	J	ND		ND		-	-	ND		ND	
Dibenzo(a,h)anthracene	0.56	0.33	0.33	mg/kg	ND		ND		ND		-	-	ND		ND	
Dibenzofuran	350	59	7	mg/kg	ND		ND		1.5		-	-	0.13	J	0.86	
Diethyl phthalate				mg/kg	ND		ND		ND		-	-	ND		ND	
Dimethyl phthalate				mg/kg	ND		ND		ND		-	-	ND		ND	
Di-n-butylphthalate				mg/kg	ND		ND		ND		-	-	ND		ND	
Di-n-octylphthalate				mg/kg	ND		ND		ND		-	-	ND		ND	
Fluoranthene	500	100	100	mg/kg	0.037	J	ND		0.15		-	-	ND		0.076	J
Fluorene	500	100	30	mg/kg	ND		ND		3.6		-	-	0.38		2.3	
Hexachlorobenzene	6	1.2	0.33	mg/kg	ND		ND		ND		-	-	ND		ND	
Hexachlorobutadiene				mg/kg	ND		ND		ND		-	-	ND		ND	
Hexachlorocyclopentadiene				mg/kg	ND		ND		ND		-	-	ND		ND	
Hexachloroethane				mg/kg	ND		ND		ND		-	-	ND		ND	
Indeno(1,2,3-cd)pyrene	5.6	0.5	0.5	mg/kg	ND		ND		ND		-	-	ND		ND	
Isophorone				mg/kg	ND		ND		ND		-	-	ND		ND	
Naphthalene	500	100	12	mg/kg	ND		ND		8.2	E	6.9		0.13	J	2.7	
NDPA/DPA				mg/kg	ND		ND		ND		-	-	ND		ND	
Nitrobenzene	69	15		mg/kg	ND		ND		ND		-	-	ND		ND	
n-Nitrosodi-n-propylamine				mg/kg	ND		ND		ND		-	-	ND		ND	
p-Chloro-m-cresol				mg/kg	ND		ND		ND		-	-	ND		ND	
Pentachlorophenol	6.7	6.7	0.8	mg/kg	ND		ND		ND		-	-	ND		ND	
Phenanthrene	500	100	100	mg/kg	ND		ND		9.8	E	7.4		0.81		5.6	
Phenol	500	100	0.33	mg/kg	ND		ND		ND		-	-	ND		ND	
Pyrene	500	100	100	mg/kg	0.033	J	ND		0.46		-	-	0.026	J	0.17	

Notes:
NYSDEC = New York State Department of Environmental Conservation
NY-RESC = New York Commercial Soil Standards
NY-RESRR = New York Residential Soil Standards
NY-UNRES = New York Unrestricted Use Soil Standards
ND= Compound not detected above laboritory detection limits
J= Presumptive evidence of compound.
mg/kg = Milligrams per Kilogram

TABLE - 4
SOIL ANALYTICAL SUMMARY METALS - DECEMBER 19-21, 2017
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION					**MW-10 8.0-8.5**		**MW-11 14.0-14.5**		**MW-11 14.0-14.5X**		**MW-12 13.5-14.0**		**MW-9 16.5-17**	
SAMPLING DATE					**12/19/2016**		**12/19/2016**		**12/19/2016**		**12/20/2016**		**12/19/2016**	
SAMPLE DEPTH (ft.)					**8.0-8.5 (feet bgs)**		**14.0-14.5 (feet bgs)**		**14.0-14.5 (feet bgs)**		**13.5-14.0 (feet bgs)**		**16.5-17 (feet bgs)**	
	NY-RESC	**NY-RESRR**	**NY-UNRE**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Total Metals														
Aluminum, Total				mg/kg	650		580		1100		450		220	
Antimony, Total				mg/kg	ND	U	ND		ND		ND		ND	U
Arsenic, Total	16	16	13	mg/kg	1.1		0.87	J	1.4		0.66	J	0.51	J
Barium, Total	400	400	350	mg/kg	2.2		2.2		3.5		1.7		0.89	J
Beryllium, Total	590	72	7.2	mg/kg	0.04	J	0.04	J	0.08	J	ND		ND	
Cadmium, Total	9.3	4.3	2.5	mg/kg	ND		ND		ND		ND		ND	
Calcium, Total				mg/kg	490		330		510		250		130	
Chromium, Total				mg/kg	3.3		2.8		4.3		2.1		1.7	
Cobalt, Total				mg/kg	0.54	J	0.52	J	0.86	J	0.36	J	0.22	J
Copper, Total	270	270	50	mg/kg	0.41	J	0.43	J	1		0.31	J	ND	
Iron, Total				mg/kg	1600		1200		2200		1100		510	
Lead, Total	1000	400	63	mg/kg	1.3	J	0.87	J	1.6	J	0.67	J	0.75	J
Magnesium, Total				mg/kg	290		270		480		210		95	
Manganese, Total	10000	2000	1600	mg/kg	18		15		25		12		5.8	
Mercury, Total	2.8	0.81	0.18	mg/kg	ND		ND		ND		ND		ND	
Nickel, Total	310	310	30	mg/kg	0.92	J	0.9	J	1.9	J	0.66	J	0.46	J
Potassium, Total				mg/kg	150	J	150	J	280		120	J	56	J
Selenium, Total	1500	180	3.9	mg/kg	ND		ND		ND		ND		ND	
Silver, Total	1500	180	2	mg/kg	ND		ND		ND		ND		ND	
Sodium, Total				mg/kg	85	J	51	J	120	J	76	J	110	J
Thallium, Total				mg/kg	ND		ND		ND		ND		ND	
Vanadium, Total				mg/kg	3.4		2.9		4.9		2		1.3	
Zinc, Total	10000	10000	109	mg/kg	3.2	J	3.3	J	8.1		2.3	J	1.1	J

Notes:
NYSDEC = New York State Department of Environmental Conservation
NY-RESC = New York Commercial Soil Standards
NY-RESRR = New York Residential Soil Standards
NY-UNRES = New York Unrestricted Use Soil Standards
ND= Compound not detected above laboritory detection limits
J= Presumptive evidence of compound.
mg/kg = Milligrams per Kilogram
Bold Highlighted = Exceeds standard
_ = sample not applicable

TABLE - 4
SOIL ANALYTICAL SUMMARY METALS - DECEMBER 19-21, 2017
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION					**SB-13 1.5-2.0**		**SB-14 1.5-2.0**		**SB-15 7.5-8.0**		**SB-16 9.5-10.0**		**SB-17 6.5-7.0**	
SAMPLING DATE					**12/19/2016**		**12/19/2016**		**12/20/2016**		**12/20/2016**		**12/21/2016**	
SAMPLE DEPTH (ft.)					**1.5-2.0 (feet bgs)**		**1.5-2.0 (feet bgs)**		**7.5-8.0 (feet bgs)**		**9.5-10.0 (feet bgs)**		**6.5-7.0 (feet bgs)**	
	NY-RESC	**NY-RESRR**	**NY-UNRE**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Total Metals														
Aluminum, Total				mg/kg	780		300		2900		340		380	
Antimony, Total				mg/kg	ND		ND		ND		ND		ND	
Arsenic, Total	16	16	13	mg/kg	1.8		0.66	J	4.8		0.73	J	0.42	J
Barium, Total	400	400	350	mg/kg	8.2		1.7		7.9		0.74	J	1.3	
Beryllium, Total	590	72	7.2	mg/kg	0.07	J	0.05	J	0.3	J	0.07	J	ND	
Cadmium, Total	9.3	4.3	2.5	mg/kg	ND		ND		ND		ND		ND	
Calcium, Total				mg/kg	59000		110		700		85		160	
Chromium, Total				mg/kg	2.7		1.5		7.6		0.87	J	1.8	
Cobalt, Total				mg/kg	1	J	0.26	J	8.9		0.26	J	0.25	J
Copper, Total	270	270	50	mg/kg	5.3		0.42	J	2.6		ND		0.42	J
Iron, Total				mg/kg	2800		880		5100		640		530	
Lead, Total	1000	400	63	mg/kg	21		0.56	J	2.2	J	0.27	J	0.66	J
Magnesium, Total				mg/kg	30000		130		820		66		120	
Manganese, Total	10000	2000	1600	mg/kg	79		5.5		35		4		5.5	
Mercury, Total	2.8	0.81	0.18	mg/kg	0.03	J	ND		ND		ND		ND	
Nickel, Total	310	310	30	mg/kg	2.4		0.47	J	14		0.51	J	0.78	J
Potassium, Total				mg/kg	170	J	130	J	420		42	J	57	J
Selenium, Total	1500	180	3.9	mg/kg	ND		ND		ND		ND		ND	
Silver, Total	1500	180	2	mg/kg	ND		ND		ND		ND		ND	
Sodium, Total				mg/kg	19	J	18	J	41	J	19	J	18	J
Thallium, Total				mg/kg	ND		ND		ND		ND		ND	
Vanadium, Total				mg/kg	4.9		1.8		9.3		0.81	J	1.6	
Zinc, Total	10000	10000	109	mg/kg	22		1.2	J	32		1.2	J	2.7	J

Notes:
NYSDEC = New York State Department of Environmental Conservatic
NY-RESC = New York Commercial Soil Standards
NY-RESRR = New York Residential Soil Standards
NY-UNRES = New York Unrestricted Use Soil Standards
ND= Compound not detected above laboritory detection limits
J= Presumptive evidence of compound.
mg/kg = Milligrams per Kilogram
Bold Highlighted = Exceeds standard
_ = sample not applicable

TABLE - 5
SOIL ANALYTICAL SUMMARY PCBs, PESTICIDES, HERBICIDES- DECEMBER 19-21, 2017
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION					**MW-10 8.0-8.5**		**MW-11 14.0-14.5**		**MW-11 14.0-14.5X**		**MW-12 13.5-14.0**		**MW-9 16.5-17**	
SAMPLING DATE					**12/19/2016**		**12/19/2016**		**12/19/2016**		**12/20/2016**		**12/19/2016**	
SAMPLE DEPTH (ft.)					**8.0-8.5 (feet bgs)**		**14.0-14.5 (feet bgs)**		**14.0-14.5 (feet bgs)**		**13.5-14.0 (feet bgs)**		**16.5-17 (feet bgs)**	
	NY-RESC	**NY-RESRR**	**NY-UNRES**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Chlorinated Herbicides by GC														
2,4,5-T				mg/kg	ND		ND		ND		ND		ND	
2,4,5-TP (Silvex)	500	100	3.8	mg/kg	ND		ND		ND		ND		ND	
2,4-D				mg/kg	ND		ND		ND		ND		ND	
General Chemistry														
Solids, Total				%	78.8		82.2		79.2		76.8		81.8	
Organochlorine Pesticides by GC														
4,4'-DDD	92	13	0.0033	mg/kg	ND		ND		ND		ND		ND	
4,4'-DDE	62	8.9	0.0033	mg/kg	ND		ND		ND		ND		ND	
4,4'-DDT	47	7.9	0.0033	mg/kg	ND		ND		ND		ND		ND	
Aldrin	0.68	0.097	0.005	mg/kg	ND		ND		ND		ND		ND	
Alpha-BHC	3.4	0.48	0.02	mg/kg	ND		ND		ND		ND		ND	
Beta-BHC	3	0.36	0.036	mg/kg	ND		ND		ND		ND		ND	
Chlordane				mg/kg	ND		ND		ND		ND		ND	
cis-Chlordane	24	4.2	0.094	mg/kg	ND		ND		ND		ND		ND	
Delta-BHC	500	100	0.04	mg/kg	ND		ND		ND		ND		ND	
Dieldrin	1.4	0.2	0.005	mg/kg	ND		ND		ND		ND		ND	
Endosulfan I	200	24	2.4	mg/kg	ND		ND		ND		ND		ND	
Endosulfan II	200	24	2.4	mg/kg	ND		ND		ND		ND		ND	
Endosulfan sulfate	200	24	2.4	mg/kg	ND		ND		ND		ND		ND	
Endrin	89	11	0.014	mg/kg	ND		ND		ND		ND		ND	
Endrin aldehyde				mg/kg	ND		ND		ND		ND		ND	
Endrin ketone				mg/kg	ND		ND		ND		ND		ND	
Heptachlor	15	2.1	0.042	mg/kg	ND		ND		ND		ND		ND	
Heptachlor epoxide				mg/kg	ND		ND		ND		ND		ND	
Lindane	9.2	1.3	0.1	mg/kg	ND		ND		ND		ND		ND	
Methoxychlor				mg/kg	ND		ND		ND		ND		ND	
Toxaphene				mg/kg	ND		ND		ND		ND		ND	
trans-Chlordane				mg/kg	ND		ND		ND		ND		ND	
Polychlorinated Biphenyls by GC														
Aroclor 1016	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
Aroclor 1221	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
Aroclor 1232	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
Aroclor 1242	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
Aroclor 1248	1	1	0.1	mg/kg	ND		ND		ND		0.0246	J	ND	
Aroclor 1254	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
Aroclor 1260	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
Aroclor 1262	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
Aroclor 1268	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
PCBs, Total				mg/kg	ND		ND		ND		0.0246	J	ND	

Notes:
NYSDEC = New York State Department of Environmental Conservation
NY-RESC = New York Commercial Soil Standards
NY-RESRR = New York Residential Soil Standards
NY-UNRES = New York Unrestricted Use Soil Standards
ND= Compound not detected above laboritory detection limits
J= Presumptive evidence of compound.
mg/kg = Milligrams per Kilogram
Bold Highlighted = Exceeds standard
_ = sample not applicable

TABLE - 5
SOIL ANALYTICAL SUMMARY PCBs, PESTICIDES, HERBICIDES- DECEMBER 19-21, 2017
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION					**SB-13 1.5-2.0**		**SB-14 1.5-2.0**		**SB-15 7.5-8.0**		**SB-16 9.5-10.0**		**SB-17 6.5-7.0**	
SAMPLING DATE					**12/19/2016**		**12/19/2016**		**12/20/2016**		**12/20/2016**		**12/21/2016**	
SAMPLE DEPTH (ft.)					**1.5-2.0 (feet bgs)**		**1.5-2.0 (feet bgs)**		**7.5-8.0 (feet bgs)**		**9.5-10.0 (feet bgs)**		**6.5-7.0 (feet bgs)**	
	NY-RESC	**NY-RESRR**	**NY-UNRES**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Chlorinated Herbicides by GC														
2,4,5-T				mg/kg	ND		ND		ND		ND		ND	
2,4,5-TP (Silvex)	500	100	3.8	mg/kg	ND		ND		ND		ND		ND	
2,4-D				mg/kg	ND		ND		ND		ND		ND	
General Chemistry														
Solids, Total				%	93.7		95.1		81.8		81.5		82.2	
Organochlorine Pesticides by GC														
4,4'-DDD	92	13	0.0033	mg/kg	0.00155	J	ND		ND		ND		ND	
4,4'-DDE	62	8.9	0.0033	mg/kg	0.0526		ND		ND		ND		ND	
4,4'-DDT	47	7.9	0.0033	mg/kg	0.0569		ND		ND		ND		ND	
Aldrin	0.68	0.097	0.005	mg/kg	ND		ND		ND		ND		ND	
Alpha-BHC	3.4	0.48	0.02	mg/kg	ND		ND		ND		ND		ND	
Beta-BHC	3	0.36	0.036	mg/kg	ND		ND		ND		ND		ND	
Chlordane				mg/kg	0.116		ND		ND		ND		ND	
cis-Chlordane	24	4.2	0.094	mg/kg	0.0242		ND		ND		ND		ND	
Delta-BHC	500	100	0.04	mg/kg	ND		ND		ND		ND		ND	
Dieldrin	1.4	0.2	0.005	mg/kg	0.0147		ND		ND		ND		ND	
Endosulfan I	200	24	2.4	mg/kg	ND		ND		ND		ND		ND	
Endosulfan II	200	24	2.4	mg/kg	ND		ND		ND		ND		ND	
Endosulfan sulfate	200	24	2.4	mg/kg	ND		ND		ND		ND		ND	
Endrin	89	11	0.014	mg/kg	ND		ND		ND		ND		ND	
Endrin aldehyde				mg/kg	ND		ND		ND		ND		ND	
Endrin ketone				mg/kg	ND		ND		ND		ND		ND	
Heptachlor	15	2.1	0.042	mg/kg	ND		ND		ND		ND		ND	
Heptachlor epoxide				mg/kg	0.00178	J	ND		ND		ND		ND	
Lindane	9.2	1.3	0.1	mg/kg	ND		ND		ND		ND		ND	
Methoxychlor				mg/kg	ND		ND		ND		ND		ND	
Toxaphene				mg/kg	ND		ND		ND		ND		ND	
trans-Chlordane				mg/kg	0.0158	PI	ND		ND		ND		ND	
Polychlorinated Biphenyls by GC														
Aroclor 1016	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
Aroclor 1221	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
Aroclor 1232	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
Aroclor 1242	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
Aroclor 1248	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
Aroclor 1254	1	1	0.1	mg/kg	ND		0.00876	J	ND		ND		ND	
Aroclor 1260	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
Aroclor 1262	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
Aroclor 1268	1	1	0.1	mg/kg	ND		ND		ND		ND		ND	
PCBs, Total				mg/kg	ND		0.00876	J	ND		ND		ND	

Notes:
NYSDEC = New York State Department of Environmental Conservation
NY-RESC = New York Commercial Soil Standards
NY-RESRR = New York Residential Soil Standards
NY-UNRES = New York Unrestricted Use Soil Standards
ND= Compound not detected above laboritory detection limits
J= Presumptive evidence of compound.
mg/kg = Milligrams per Kilogram
Bold Highlighted = Exceeds standard
_ = sample not applicable

TABLE - 6
GROUNDWATER ANALYTICAL SUMMARY - JANUARY 11, 2017
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION				**DP-1-11117**		**DP-1-11117**		**DP-1-11117-DUP**		**DP-1-11117-DUP**		**MW-10-11117**	
SAMPLING DATE				**1/11/2017**		**1/11/2017**		**1/11/2017**		**1/11/2017**		**1/11/2017**	
	NY-GWQS	**NY-TOGS-GA**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Volatile Organics by GC/MS													
1,1,1,2-Tetrachloroethane	5	5	ug/l	ND		-	-	ND		-	-	ND	
1,1,1-Trichloroethane	5	5	ug/l	ND		-	-	ND		-	-	ND	
1,1,2,2-Tetrachloroethane	5	5	ug/l	ND		-	-	ND		-	-	ND	
1,1,2-Trichloroethane	1	1	ug/l	ND		-	-	ND		-	-	ND	
1,1-Dichloroethane	5	5	ug/l	ND		-	-	ND		-	-	ND	
1,1-Dichloroethene	5	5	ug/l	ND		-	-	ND		-	-	ND	
1,1-Dichloropropene	5	5	ug/l	ND		-	-	ND		-	-	ND	
1,2,3-Trichlorobenzene	5	5	ug/l	ND		-	-	ND		-	-	ND	
1,2,3-Trichloropropane	0.04	0.04	ug/l	ND		-	-	ND		-	-	ND	
1,2,4,5-Tetramethylbenzene	5	5	ug/l	**28**	J	-	-	**26**	J	-	-	**30**	
1,2,4-Trichlorobenzene	5	5	ug/l	ND		-	-	ND		-	-	ND	
1,2,4-Trimethylbenzene	5	5	ug/l	**220**		-	-	**200**		-	-	**120**	
1,2-Dibromo-3-chloropropane	0.04	0.04	ug/l	ND		-	-	ND		-	-	ND	
1,2-Dibromoethane	0.0006	0.0006	ug/l	ND		-	-	ND		-	-	ND	
1,2-Dichlorobenzene	3	3	ug/l	ND		-	-	ND		-	-	ND	
1,2-Dichloroethane	0.6	0.6	ug/l	ND		-	-	ND		-	-	ND	
1,2-Dichloroethene, Total			ug/l	2300	J	-	-	2300	J	-	-	52	J
1,2-Dichloropropane	1	1	ug/l	ND		-	-	ND		-	-	ND	
1,3,5-Trimethylbenzene	5	5	ug/l	**54**	J	-	-	**50**	J	-	-	**33**	
1,3-Dichlorobenzene	3	3	ug/l	ND	UJ	-	-	ND	UJ	-	-	ND	UJ
1,3-Dichloropropane	5	5	ug/l	ND		-	-	ND		-	-	ND	
1,3-Dichloropropene, Total			ug/l	ND		-	-	ND		-	-	ND	
1,4-Dichlorobenzene	3	3	ug/l	ND		-	-	ND		-	-	ND	
1,4-Dioxane			ug/l	ND		-	-	ND		-	-	ND	
2,2-Dichloropropane	5	5	ug/l	ND		-	-	ND		-	-	ND	
2-Butanone	50	50	ug/l	ND		-	-	ND		-	-	ND	
2-Hexanone	50	50	ug/l	ND		-	-	ND		-	-	ND	
4-Methyl-2-pentanone			ug/l	ND		-	-	ND		-	-	ND	
Acetone	50	50	ug/l	ND		-	-	ND		-	-	ND	
Acrylonitrile	5	5	ug/l	ND		-	-	ND		-	-	ND	
Benzene	1	1	ug/l	**38**		-	-	**30**		-	-	ND	
Bromobenzene	5	5	ug/l	ND		-	-	ND		-	-	ND	
Bromochloromethane	5	5	ug/l	ND		-	-	ND		-	-	ND	
Bromodichloromethane	50	50	ug/l	ND		-	-	ND		-	-	ND	
Bromoform	50	50	ug/l	ND		-	-	ND		-	-	ND	
Bromomethane	5	5	ug/l	ND		-	-	ND		-	-	ND	
Carbon disulfide	60	60	ug/l	ND		-	-	ND		-	-	ND	
Carbon tetrachloride	5	5	ug/l	ND		-	-	ND		-	-	ND	
Chlorobenzene	5	5	ug/l	ND		-	-	ND		-	-	ND	
Chloroethane	5	5	ug/l	ND		-	-	ND		-	-	ND	
Chloroform	7	7	ug/l	ND		-	-	ND		-	-	ND	
Chloromethane			ug/l	ND		-	-	ND		-	-	ND	
cis-1,2-Dichloroethene	5	5	ug/l	**2300**		-	-	**2300**		-	-	**50**	
cis-1,3-Dichloropropene	0.4	0.4	ug/l	ND		-	-	ND		-	-	ND	
Dibromochloromethane	50	50	ug/l	ND		-	-	ND		-	-	ND	
Dibromomethane	5	5	ug/l	ND		-	-	ND		-	-	ND	
Dichlorodifluoromethane	5	5	ug/l	ND		-	-	ND		-	-	ND	
Ethyl ether			ug/l	ND		-	-	ND		-	-	ND	
Ethylbenzene	5	5	ug/l	**83**		-	-	**76**		-	-	**82**	
Hexachlorobutadiene	0.5	0.5	ug/l	ND		-	-	ND		-	-	ND	
Isopropylbenzene	5	5	ug/l	ND		-	-	ND		-	-	**18**	
Methyl tert butyl ether	10	10	ug/l	ND		-	-	ND		-	-	ND	
Methylene chloride	5	5	ug/l	ND		-	-	ND		-	-	ND	
Naphthalene	5	10	ug/l	**240**		-	-	**200**		-	-	**330**	
n-Butylbenzene	5	5	ug/l	ND		-	-	ND		-	-	**9.2**	
n-Propylbenzene	10	5	ug/l	**22**	J	-	-	**22**	J	-	-	**27**	
o-Chlorotoluene	5	5	ug/l	ND		-	-	ND		-	-	ND	
o-Xylene	5	5	ug/l	**170**		-	-	**140**		-	-	**12**	
p/m-Xylene	5	5	ug/l	**130**		-	-	**120**		-	-	**82**	
p-Chlorotoluene		5	ug/l	ND		-	-	ND		-	-	ND	
p-Diethylbenzene			ug/l	ND		-	-	ND		-	-	ND	
p-Ethyltoluene	5		ug/l	73		-	-	70		-	-	47	
p-Isopropyltoluene	5	5	ug/l	ND		-	-	ND		-	-	**6.8**	
sec-Butylbenzene	5	5	ug/l	ND		-	-	ND		-	-	**6.3**	
Styrene	5	930	ug/l	ND		-	-	ND		-	-	ND	
tert-Butylbenzene	5	5	ug/l	ND		-	-	ND		-	-	ND	
Tetrachloroethene	5	5	ug/l	**8.7**	J	-	-	**8.5**	J	-	-	ND	
Toluene	5	5	ug/l	**160**		-	-	**130**		-	-	2.1	J
trans-1,2-Dichloroethene	5	5	ug/l	**22**	J	-	-	**21**	J	-	-	2.4	J
trans-1,3-Dichloropropene	0.4	0.4	ug/l	ND		-	-	ND		-	-	ND	
trans-1,4-Dichloro-2-butene	5	5	ug/l	ND		-	-	ND		-	-	ND	
Trichloroethene	5	5	ug/l	ND		-	-	ND		-	-	ND	
Trichlorofluoromethane	5	5	ug/l	ND		-	-	ND		-	-	ND	
Vinyl acetate			ug/l	ND		-	-	ND		-	-	ND	
Vinyl chloride	2	2	ug/l	**6600**	E	**5600**		**6400**	E	**5700**		**85**	
Xylenes, Total			ug/l	300		-	-	260		-	-	94	

Notes:
NYSDEC = New York State Department of Environmental Conservation
NY-AWQS = New York Ambient Water Quality Standards.
NY-TAGM-GW= New York Groundwater Effluent standards.
ND= Compound not detected above laboritory detection limits
J= Presumptive evidence of compound. This represents an estimated concentration
for Tentatively Identified Compounds (TICs)
ug/l= Micro Grams per Liter
Bold Highlighted = Exceeds standard
_ = sample not applicable

TABLE - 6
GROUNDWATER ANALYTICAL SUMMARY - JANUARY 11, 2017
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION				**MW-11-11117**		**MW-12-11117**		**MW-6-11117**		**MW-9-11117**		**TRIP BLANK**		**FIELD BLANK-11117**	
SAMPLING DATE				**1/11/2017**		**1/11/2017**		**1/11/2017**		**1/11/2017**		**1/11/2017**		**1/11/2017**	
	NY-GWQS	**NY-TOGS-GA**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Volatile Organics by GC/MS															
1,1,1,2-Tetrachloroethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,1,1-Trichloroethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,1,2,2-Tetrachloroethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,1,2-Trichloroethane	1	1	ug/l	ND		ND		ND		ND		ND		ND	
1,1-Dichloroethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,1-Dichloroethene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,1-Dichloropropene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,2,3-Trichlorobenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,2,3-Trichloropropane	0.04	0.04	ug/l	ND		ND		ND		ND		ND		ND	
1,2,4,5-Tetramethylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,2,4-Trichlorobenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,2,4-Trimethylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,2-Dibromo-3-chloropropane	0.04	0.04	ug/l	ND		ND		ND		ND		ND		ND	
1,2-Dibromoethane	0.0006	0.0006	ug/l	ND		ND		ND		ND		ND		ND	
1,2-Dichlorobenzene	3	3	ug/l	ND		ND		ND		ND		ND		ND	
1,2-Dichloroethane	0.6	0.6	ug/l	ND		ND		ND		ND		ND		ND	
1,2-Dichloroethene, Total			ug/l	1.9	J	ND		1.4	J	ND		ND		ND	
1,2-Dichloropropane	1	1	ug/l	ND		ND		ND		ND		ND		ND	
1,3,5-Trimethylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,3-Dichlorobenzene	3	3	ug/l	ND		ND		ND		ND		ND		ND	UJ
1,3-Dichloropropane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,3-Dichloropropene, Total			ug/l	ND		ND		ND		ND		ND		ND	
1,4-Dichlorobenzene	3	3	ug/l	ND		ND		ND		ND		ND		ND	
1,4-Dioxane			ug/l	ND		ND		ND		ND		ND		ND	
2,2-Dichloropropane	5	5	ug/l	ND		ND		ND		ND	UJ	ND		ND	
2-Butanone	50	50	ug/l	ND		ND		ND		ND		ND		ND	
2-Hexanone	50	50	ug/l	ND		ND		ND		ND		ND		ND	
4-Methyl-2-pentanone			ug/l	ND		ND		ND		ND		ND		ND	
Acetone	50	50	ug/l	ND		ND		ND		ND		ND		ND	
Acrylonitrile	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Benzene	1	1	ug/l	ND		ND		ND		ND		ND		ND	
Bromobenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Bromochloromethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Bromodichloromethane	50	50	ug/l	ND		ND		ND		ND		ND		ND	
Bromoform	50	50	ug/l	ND		ND		ND		ND		ND		ND	
Bromomethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Carbon disulfide	60	60	ug/l	ND		ND		ND		ND		ND		ND	
Carbon tetrachloride	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Chlorobenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Chloroethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Chloroform	7	7	ug/l	ND		ND		ND		ND		ND		ND	
Chloromethane			ug/l	ND		ND		ND		ND		ND		ND	
cis-1,2-Dichloroethene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
cis-1,3-Dichloropropene	0.4	0.4	ug/l	ND		ND		ND		ND		ND		ND	
Dibromochloromethane	50	50	ug/l	ND		ND		ND		ND		ND		ND	
Dibromomethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Dichlorodifluoromethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Ethyl ether			ug/l	ND		ND		ND		ND		ND		ND	
Ethylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Hexachlorobutadiene	0.5	0.5	ug/l	ND		ND		ND		ND		ND		ND	
Isopropylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Methyl tert butyl ether	10	10	ug/l	ND		ND		ND		ND		ND		ND	
Methylene chloride	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Naphthalene	5	10	ug/l	ND		ND		4.3		ND		ND		ND	
n-Butylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
n-Propylbenzene	10	5	ug/l	ND		ND		ND		ND		ND		ND	
o-Chlorotoluene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
o-Xylene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
p/m-Xylene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
p-Chlorotoluene		5	ug/l	ND		ND		ND		ND		ND		ND	
p-Diethylbenzene			ug/l	ND		ND		ND		ND		ND		ND	
p-Ethyltoluene	5		ug/l	ND		ND		ND		ND		ND		ND	
p-Isopropyltoluene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
sec-Butylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Styrene	5	930	ug/l	ND		ND		ND		ND		ND		ND	
tert-Butylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Tetrachloroethene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Toluene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
trans-1,2-Dichloroethene	5	5	ug/l	1.9	J	ND		1.4	J	ND		ND		ND	
trans-1,3-Dichloropropene	0.4	0.4	ug/l	ND		ND		ND		ND	UJ	ND		ND	
trans-1,4-Dichloro-2-butene	5	5	ug/l	ND		ND		ND		ND	UJ	ND		ND	
Trichloroethene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Trichlorofluoromethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Vinyl acetate			ug/l	ND		ND		ND		ND		ND		ND	
Vinyl chloride	2	2	ug/l	ND		ND		ND		ND		ND		ND	
Xylenes, Total			ug/l	ND		ND		ND		ND		ND		ND	

Notes:
NYSDEC = New York State Department of Environmental Conservatio
NY-AWQS = New York Ambient Water Quality Standards.
NY-TAGM-GW= New York Groundwater Effluent standards.
ND= Compound not detected above laboritory detection limits
J= Presumptive evidence of compound. This represents an estimated
for Tentatively Identified Compounds (TICs)
ug/l= Micro Grams per Liter
Bold Highlighted = Exceeds standard
_ = sample not applicable

TABLE 7
GROUNDWATER ANALYTICAL DATA SUMMARY - JANUARY 11, 2017
AEI PROJECT No. 341998; NU-CLEAR LONG BEACH, NEW YORK

LOCATION				**DP-1-11117**		**DP-1-11117**		**DP-1-11117-DUP**		**DP-1-11117-DUP**		**MW-10-11117**	
SAMPLING DATE				**1/11/2017**		**1/11/2017**		**1/11/2017**		**1/11/2017**		**1/11/2017**	
	NY-AWQS	**NY-TOGS-GA**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Semivolatile Organics by GC/MS													
1,2,4,5-Tetrachlorobenzene	5	5	ug/l	ND		-	-	ND		-	-	ND	
1,2,4-Trichlorobenzene	5	5	ug/l	ND		-	-	ND		-	-	ND	
1,2-Dichlorobenzene	3	3	ug/l	ND		-	-	ND		-	-	ND	
1,3-Dichlorobenzene	3	3	ug/l	ND	UJ	-	-	ND	UJ	-	-	ND	UJ
1,4-Dichlorobenzene	3	3	ug/l	ND		-	-	ND		-	-	ND	
2,4,5-Trichlorophenol			ug/l	ND		-	-	ND		-	-	ND	
2,4,6-Trichlorophenol			ug/l	ND		-	-	ND		-	-	ND	
2,4-Dichlorophenol	1	2	ug/l	ND		-	-	ND		-	-	ND	
2,4-Dimethylphenol	10	2	ug/l	ND		-	-	ND		-	-	ND	
2,4-Dinitrophenol	50	2	ug/l	ND		-	-	ND		-	-	ND	
2,4-Dinitrotoluene	5	5	ug/l	ND		-	-	ND		-	-	ND	
2,6-Dinitrotoluene	5	5	ug/l	ND		-	-	ND		-	-	ND	
2-Chloronaphthalene	10	10	ug/l	ND		-	-	ND		-	-	ND	
2-Chlorophenol			ug/l	ND		-	-	ND		-	-	ND	
2-Methylnaphthalene			ug/l	130	E	180		100	E	120		170	E
2-Methylphenol			ug/l	ND		-	-	ND		-	-	ND	
2-Nitroaniline	5	5	ug/l	ND		-	-	ND		-	-	ND	
2-Nitrophenol			ug/l	ND		-	-	ND		-	-	ND	
3,3'-Dichlorobenzidine	5	5	ug/l	ND		-	-	ND		-	-	ND	
3-Methylphenol/4-Methylphenol			ug/l	ND		-	-	ND		-	-	ND	
3-Nitroaniline	5	5	ug/l	ND		-	-	ND		-	-	ND	
4,6-Dinitro-o-cresol			ug/l	ND		-	-	ND		-	-	ND	
4-Bromophenyl phenyl ether			ug/l	ND		-	-	ND		-	-	ND	
4-Chloroaniline	5	5	ug/l	ND		-	-	ND		-	-	ND	
4-Chlorophenyl phenyl ether			ug/l	ND		-	-	ND		-	-	ND	
4-Nitroaniline	5	5	ug/l	ND		-	-	ND		-	-	ND	
4-Nitrophenol			ug/l	ND		-	-	ND		-	-	ND	
Acenaphthene	20	20	ug/l	9		-	-	6.6		-	-	7.5	
Acenaphthylene			ug/l	0.19	J	-	-	0.94		-	-	1.7	
Acetophenone			ug/l	ND		-	-	ND		-	-	ND	
Anthracene	50	50	ug/l	1.3		-	-	0.7		-	-	1	
Benzo(a)anthracene	0.002	0.002	ug/l	**0.15**	J	-	-	**0.06**	J	-	-	ND	
Benzo(a)pyrene	0.002	0.002	ug/l	**0.09**	J	-	-	ND		-	-	ND	
Benzo(b)fluoranthene	0.002	0.002	ug/l	**0.13**	J	-	-	**0.05**	J	-	-	ND	
Benzo(ghi)perylene			ug/l	0.06	J	-	-	ND		-	-	ND	
Benzo(k)fluoranthene	0.002	0.002	ug/l	ND		-	-	ND		-	-	ND	
Benzoic Acid			ug/l	ND		-	-	ND		-	-	ND	
Benzyl Alcohol			ug/l	ND		-	-	ND		-	-	ND	

TABLE 7
GROUNDWATER ANALYTICAL DATA SUMMARY - JANUARY 11, 2017
AEI PROJECT No. 341998; NU-CLEAR LONG BEACH, NEW YORK

LOCATION				**DP-1-11117**		**DP-1-11117**		**DP-1-11117-DUP**		**DP-1-11117-DUP**		**MW-10-11117**	
SAMPLING DATE				**1/11/2017**		**1/11/2017**		**1/11/2017**		**1/11/2017**		**1/11/2017**	
	NY-AWQS	**NY-TOGS-GA**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Biphenyl			ug/l	4.9		-	-	4		-	-	ND	
Bis(2-chloroethoxy)methane	5	5	ug/l	ND		-	-	ND		-	-	ND	
Bis(2-chloroethyl)ether	1	1	ug/l	ND		-	-	ND		-	-	ND	
Bis(2-chloroisopropyl)ether	5	5	ug/l	ND		-	-	ND		-	-	ND	
Bis(2-ethylhexyl)phthalate	5	5	ug/l	ND		-	-	ND		-	-	**8.9**	J
Butyl benzyl phthalate	50	50	ug/l	ND		-	-	ND		-	-	ND	
Carbazole			ug/l	16		-	-	17		-	-	6.3	J
Chrysene	0.002	0.002	ug/l	**0.23**		-	-	**0.1**	J	-	-	ND	
Dibenzo(a,h)anthracene			ug/l	ND		-	-	ND		-	-	ND	
Dibenzofuran			ug/l	5		-	-	4.7		-	-	ND	
Diethyl phthalate	50	50	ug/l	ND		-	-	ND		-	-	ND	
Dimethyl phthalate	50	50	ug/l	ND		-	-	ND		-	-	ND	
Di-n-butylphthalate	50	50	ug/l	ND		-	-	ND		-	-	ND	
Di-n-octylphthalate	50	50	ug/l	ND		-	-	ND		-	-	ND	
Fluoranthene	50	50	ug/l	0.06	J	-	-	0.26		-	-	ND	
Fluorene	50	50	ug/l	10		-	-	7.7		-	-	9.7	
Hexachlorobenzene	0.04	0.04	ug/l	ND		-	-	ND		-	-	ND	
Hexachlorobutadiene	0.5	0.5	ug/l	ND		-	-	ND		-	-	ND	
Hexachlorocyclopentadiene	5	5	ug/l	ND		-	-	ND		-	-	ND	
Hexachloroethane	5	5	ug/l	ND		-	-	ND		-	-	ND	
Indeno(1,2,3-cd)pyrene	0.002	0.002	ug/l	**0.05**	J	-	-	ND		-	-	ND	
Isophorone	50	50	ug/l	ND		-	-	ND		-	-	ND	
Naphthalene	5	10	ug/l	**110**	E	**160**		**91**	E	**120**		**140**	E
NDPA/DPA	50	50	ug/l	ND		-	-	ND		-	-	ND	
Nitrobenzene	0.4	0.4	ug/l	ND		-	-	ND		-	-	ND	
n-Nitrosodi-n-propylamine			ug/l	ND		-	-	ND		-	-	ND	
p-Chloro-m-cresol			ug/l	ND		-	-	ND		-	-	ND	
Pentachlorophenol	1	2	ug/l	ND		-	-	ND		-	-	ND	
Phenanthrene	50	50	ug/l	16		-	-	9.6		-	-	15	
Phenol	1	2	ug/l	ND		-	-	ND		-	-	ND	
Pyrene	50	50	ug/l	1.9		-	-	0.95		-	-	ND	

Notes:

NYSDEC = New York State Department of Environmental Conservation

NY-AWQS = New York Ambient Water Quality Standards.

NY-TAGM-GW= New York Groundwater Effluent standards.

ND= Compound not detected above laboritory detection limits

J= Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs)

ug/l= Micro Grams per Liter

Bold Highlighted = Exceeds standard

_ = sample not applicable

TABLE 7
GROUNDWATER ANALYTICAL DATA SUMMARY - JANUARY 11, 2017
AEI PROJECT No. 341998; NU-CLEAR LONG BEACH, NEW YORK

LOCATION				MW-10-11117		MW-11-11117		MW-12-11117		MW-6-11117		MW-9-11117	
SAMPLING DATE				1/11/2017		1/11/2017		1/11/2017		1/11/2017		1/11/2017	
	NY-AWQS	NY-TOGS-GA	Units	Results	Qual	Results	Qual	Results	Qual	Results	Qual	Results	Qual
Semivolatile Organics by GC/MS													
1,2,4,5-Tetrachlorobenzene	5	5	ug/l	-	-	ND		ND		ND		ND	
1,2,4-Trichlorobenzene	5	5	ug/l	-	-	ND		ND		ND		ND	
1,2-Dichlorobenzene	3	3	ug/l	-	-	ND		ND		ND		ND	
1,3-Dichlorobenzene	3	3	ug/l	-	-	ND		ND		ND		ND	
1,4-Dichlorobenzene	3	3	ug/l	-	-	ND		ND		ND		ND	
2,4,5-Trichlorophenol			ug/l	-	-	ND		ND		ND		ND	
2,4,6-Trichlorophenol			ug/l	-	-	ND		ND		ND		ND	
2,4-Dichlorophenol	1	2	ug/l	-	-	ND		ND		ND		ND	
2,4-Dimethylphenol	10	2	ug/l	-	-	ND		ND		ND		ND	
2,4-Dinitrophenol	50	2	ug/l	-	-	ND		ND		ND		ND	
2,4-Dinitrotoluene	5	5	ug/l	-	-	ND		ND		ND		ND	
2,6-Dinitrotoluene	5	5	ug/l	-	-	ND		ND		ND		ND	
2-Chloronaphthalene	10	10	ug/l	-	-	ND		ND		ND		ND	
2-Chlorophenol			ug/l	-	-	ND		ND		ND		ND	
2-Methylnaphthalene			ug/l	200		ND		ND		0.34		ND	
2-Methylphenol			ug/l	-	-	ND		ND		ND		ND	
2-Nitroaniline	5	5	ug/l	-	-	ND		ND		ND		ND	
2-Nitrophenol			ug/l	-	-	ND		ND		ND		ND	
3,3'-Dichlorobenzidine	5	5	ug/l	-	-	ND		ND		ND		ND	
3-Methylphenol/4-Methylphenol			ug/l	-	-	ND		ND		ND		ND	
3-Nitroaniline	5	5	ug/l	-	-	ND		ND		ND		ND	
4,6-Dinitro-o-cresol			ug/l	-	-	ND		ND		ND		ND	
4-Bromophenyl phenyl ether			ug/l	-	-	ND		ND		ND		ND	
4-Chloroaniline	5	5	ug/l	-	-	ND		ND		ND		ND	
4-Chlorophenyl phenyl ether			ug/l	-	-	ND		ND		ND		ND	
4-Nitroaniline	5	5	ug/l	-	-	ND		ND		ND		ND	
4-Nitrophenol			ug/l	-	-	ND		ND		ND		ND	
Acenaphthene	20	20	ug/l	-	-	ND		ND		ND		ND	
Acenaphthylene			ug/l	-	-	ND		ND		ND		ND	
Acetophenone			ug/l	-	-	ND		ND		ND		ND	
Anthracene	50	50	ug/l	-	-	ND		ND		ND		ND	
Benzo(a)anthracene	0.002	0.002	ug/l	-	-	**0.02**	J	ND		ND		**0.02**	J
Benzo(a)pyrene	0.002	0.002	ug/l	-	-	ND		ND		ND		ND	
Benzo(b)fluoranthene	0.002	0.002	ug/l	-	-	**0.03**	J	ND		ND		**0.02**	J
Benzo(ghi)perylene			ug/l	-	-	ND		ND		ND		ND	
Benzo(k)fluoranthene	0.002	0.002	ug/l	-	-	ND		ND		ND		ND	
Benzoic Acid			ug/l	-	-	ND		ND		ND		ND	
Benzyl Alcohol			ug/l	-	-	ND		ND		ND		ND	

TABLE 7
GROUNDWATER ANALYTICAL DATA SUMMARY - JANUARY 11, 2017
AEI PROJECT No. 341998; NU-CLEAR LONG BEACH, NEW YORK

LOCATION				**MW-10-11117**		**MW-11-11117**		**MW-12-11117**		**MW-6-11117**		**MW-9-11117**	
SAMPLING DATE				**1/11/2017**		**1/11/2017**		**1/11/2017**		**1/11/2017**		**1/11/2017**	
	NY-AWQS	**NY-TOGS-GA**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Biphenyl			ug/l	-	-	ND		ND		ND		ND	
Bis(2-chloroethoxy)methane	5	5	ug/l	-	-	ND		ND		ND		ND	
Bis(2-chloroethyl)ether	1	1	ug/l	-	-	ND		ND		ND		ND	
Bis(2-chloroisopropyl)ether	5	5	ug/l	-	-	ND		ND		ND		ND	
Bis(2-ethylhexyl)phthalate	5	5	ug/l	-	-	ND		ND		ND		ND	
Butyl benzyl phthalate	50	50	ug/l	-	-	ND		ND		ND		ND	
Carbazole			ug/l	-	-	ND		ND		ND		ND	
Chrysene	0.002	0.002	ug/l	-	-	ND		ND		ND		ND	
Dibenzo(a,h)anthracene			ug/l	-	-	0.04	J	ND		ND		ND	
Dibenzofuran			ug/l	-	-	ND		ND		ND		ND	
Diethyl phthalate	50	50	ug/l	-	-	ND		ND		ND		ND	
Dimethyl phthalate	50	50	ug/l	-	-	ND		ND		ND		ND	
Di-n-butylphthalate	50	50	ug/l	-	-	ND		ND		ND		ND	
Di-n-octylphthalate	50	50	ug/l	-	-	ND		ND		ND		ND	
Fluoranthene	50	50	ug/l	-	-	0.07	J	ND		ND		ND	
Fluorene	50	50	ug/l	-	-	ND		ND		ND		ND	
Hexachlorobenzene	0.04	0.04	ug/l	-	-	ND		ND		ND		ND	
Hexachlorobutadiene	0.5	0.5	ug/l	-	-	ND		0.06	J	ND		ND	
Hexachlorocyclopentadiene	5	5	ug/l	-	-	ND		ND		ND		ND	
Hexachloroethane	5	5	ug/l	-	-	ND		0.06		ND		ND	
Indeno(1,2,3-cd)pyrene	0.002	0.002	ug/l	-	-	ND		ND		ND		ND	
Isophorone	50	50	ug/l	-	-	ND		ND		ND		ND	
Naphthalene	5	10	ug/l	**170**		ND		0.12	J	0.12	J	0.15	J
NDPA/DPA	50	50	ug/l	-	-	ND		ND		ND		ND	
Nitrobenzene	0.4	0.4	ug/l	-	-	ND		ND		ND		ND	
n-Nitrosodi-n-propylamine			ug/l	-	-	ND		ND		ND		ND	
p-Chloro-m-cresol			ug/l	-	-	ND		ND		ND		ND	
Pentachlorophenol	1	2	ug/l	-	-	ND		ND		ND		ND	
Phenanthrene	50	50	ug/l	-	-	ND		ND		0.06	J	0.03	J
Phenol	1	2	ug/l	-	-	ND		ND		ND		ND	
Pyrene	50	50	ug/l	-	-	ND		ND		ND		ND	

Notes:

NYSDEC = New York State Department of Environmental Cc

NY-AWQS = New York Ambient Water Quality Standards.

NY-TAGM-GW= New York Groundwater Effluent standards.

ND= Compound not detected above laboritory detection lim

J= Presumptive evidence of compound. This represents an

Tentatively Identified Compounds (TICs)

ug/l= Micro Grams per Liter

Bold Highlighted = Exceeds standard

_ = sample not applicable

TABLE 7
GROUNDWATER ANALYTICAL DATA SUMMARY - JANUARY 11, 2017
AEI PROJECT No. 341998; NU-CLEAR LONG BEACH, NEW YORK

LOCATION				**TRIP BLANK**		**FIELD BLANK-11117**	
SAMPLING DATE				**1/11/2017**		**1/11/2017**	
	NY-AWQS	**NY-TOGS-GA**	**Units**	**Results**	**Qual**	**Results**	**Qual**
Semivolatile Organics by GC/MS							
1,2,4,5-Tetrachlorobenzene	5	5	ug/l	-	-	ND	
1,2,4-Trichlorobenzene	5	5	ug/l	-	-	ND	
1,2-Dichlorobenzene	3	3	ug/l	-	-	ND	
1,3-Dichlorobenzene	3	3	ug/l	-	-	ND	UJ
1,4-Dichlorobenzene	3	3	ug/l	-	-	ND	
2,4,5-Trichlorophenol			ug/l	-	-	ND	
2,4,6-Trichlorophenol			ug/l	-	-	ND	
2,4-Dichlorophenol	1	2	ug/l	-	-	ND	
2,4-Dimethylphenol	10	2	ug/l	-	-	ND	
2,4-Dinitrophenol	50	2	ug/l	-	-	ND	
2,4-Dinitrotoluene	5	5	ug/l	-	-	ND	
2,6-Dinitrotoluene	5	5	ug/l	-	-	ND	
2-Chloronaphthalene	10	10	ug/l	-	-	ND	
2-Chlorophenol			ug/l	-	-	ND	
2-Methylnaphthalene			ug/l	-	-	ND	
2-Methylphenol			ug/l	-	-	ND	
2-Nitroaniline	5	5	ug/l	-	-	ND	
2-Nitrophenol			ug/l	-	-	ND	
3,3'-Dichlorobenzidine	5	5	ug/l	-	-	ND	
3-Methylphenol/4-Methylphenol			ug/l	-	-	ND	
3-Nitroaniline	5	5	ug/l	-	-	ND	
4,6-Dinitro-o-cresol			ug/l	-	-	ND	
4-Bromophenyl phenyl ether			ug/l	-	-	ND	
4-Chloroaniline	5	5	ug/l	-	-	ND	
4-Chlorophenyl phenyl ether			ug/l	-	-	ND	
4-Nitroaniline	5	5	ug/l	-	-	ND	
4-Nitrophenol			ug/l	-	-	ND	
Acenaphthene	20	20	ug/l	-	-	ND	
Acenaphthylene			ug/l	-	-	ND	
Acetophenone			ug/l	-	-	ND	
Anthracene	50	50	ug/l	-	-	ND	
Benzo(a)anthracene	0.002	0.002	ug/l	-	-	ND	
Benzo(a)pyrene	0.002	0.002	ug/l	-	-	ND	
Benzo(b)fluoranthene	0.002	0.002	ug/l	-	-	ND	
Benzo(ghi)perylene			ug/l	-	-	ND	
Benzo(k)fluoranthene	0.002	0.002	ug/l	-	-	ND	
Benzoic Acid			ug/l	-	-	ND	
Benzyl Alcohol			ug/l	-	-	ND	

TABLE 7
GROUNDWATER ANALYTICAL DATA SUMMARY - JANUARY 11, 2017
AEI PROJECT No. 341998; NU-CLEAR LONG BEACH, NEW YORK

LOCATION				**TRIP BLANK**		**FIELD BLANK-11117**	
SAMPLING DATE				**1/11/2017**		**1/11/2017**	
	NY-AWQS	**NY-TOGS-GA**	**Units**	**Results**	**Qual**	**Results**	**Qual**
Biphenyl			ug/l	-	-	ND	
Bis(2-chloroethoxy)methane	5	5	ug/l	-	-	ND	
Bis(2-chloroethyl)ether	1	1	ug/l	-	-	ND	
Bis(2-chloroisopropyl)ether	5	5	ug/l	-	-	ND	
Bis(2-ethylhexyl)phthalate	5	5	ug/l	-	-	ND	
Butyl benzyl phthalate	50	50	ug/l	-	-	ND	
Carbazole			ug/l	-	-	ND	
Chrysene	0.002	0.002	ug/l	-	-	ND	
Dibenzo(a,h)anthracene			ug/l	-	-	ND	
Dibenzofuran			ug/l	-	-	ND	
Diethyl phthalate	50	50	ug/l	-	-	ND	
Dimethyl phthalate	50	50	ug/l	-	-	ND	
Di-n-butylphthalate	50	50	ug/l	-	-	ND	
Di-n-octylphthalate	50	50	ug/l	-	-	ND	
Fluoranthene	50	50	ug/l	-	-	ND	
Fluorene	50	50	ug/l	-	-	ND	
Hexachlorobenzene	0.04	0.04	ug/l	-	-	ND	
Hexachlorobutadiene	0.5	0.5	ug/l	-	-	ND	
Hexachlorocyclopentadiene	5	5	ug/l	-	-	ND	
Hexachloroethane	5	5	ug/l	-	-	ND	
Indeno(1,2,3-cd)pyrene	0.002	0.002	ug/l	-	-	ND	
Isophorone	50	50	ug/l	-	-	ND	
Naphthalene	5	10	ug/l	-	-	ND	
NDPA/DPA	50	50	ug/l	-	-	ND	
Nitrobenzene	0.4	0.4	ug/l	-	-	ND	
n-Nitrosodi-n-propylamine			ug/l	-	-	ND	
p-Chloro-m-cresol			ug/l	-	-	ND	
Pentachlorophenol	1	2	ug/l	-	-	ND	
Phenanthrene	50	50	ug/l	-	-	ND	
Phenol	1	2	ug/l	-	-	ND	
Pyrene	50	50	ug/l	-	-	ND	

Notes:

NYSDEC = New York State Department of Environmental Cc

NY-AWQS = New York Ambient Water Quality Standards.

NY-TAGM-GW= New York Groundwater Effluent standards.

ND= Compound not detected above laboritory detection lim

J= Presumptive evidence of compound. This represents an

Tentatively Identified Compounds (TICs)

ug/l= Micro Grams per Liter

Bold Highlighted = Exceeds standard

_ = sample not applicable

TABLE 8
GROUNDWATER ANALYTICAL DATA SUMMARY - JANUARY 11, 2017
AEI PROJECT No. 341998; NU-CLEAR LONG BEACH. NEW YORK

LOCATION				**DP-1-11117**		**DP-1-11117-DUP**		**MW-10-11117**		**MW-11-1111**
SAMPLING DATE				**1/11/2017**		**1/11/2017**		**1/11/2017**		**1/11/2017**
	NY-AWQS	**NY-TOGS-GA**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**
Total Metals										
Aluminum, Total		2000	ug/l	666	J	**11500**	J	104		452
Antimony, Total	3	6	ug/l	ND		0.9	J	0.5	J	0.9
Arsenic, Total	25	50	ug/l	2.4	J	24.3	J	3.3		2
Barium, Total	1000	2000	ug/l	20.9	J	131.8	J	7.3	J	3.3
Beryllium, Total	3	3	ug/l	ND		0.7		ND		ND
Cadmium, Total	5	10	ug/l	0.1	J	0.9		ND		ND
Calcium, Total			ug/l	50200		55500		49600		25000
Chromium, Total	50	100	ug/l	6.4	J	**102.6**	J	3.7	J	2.8
Cobalt, Total			ug/l	4.2	J	71.1	J	0.3	J	0.6
Copper, Total	200	1000	ug/l	3.9	J	66	J	1.2		7.4
Iron, Total	300	600	ug/l	**3400**	J	**27100**	J	262		**627**
Lead, Total	25	50	ug/l	10.7	J	**208.6**	J	0.5	J	0.9
Magnesium, Total	35000	35000	ug/l	7250	J	10600	J	17700		6000
Manganese, Total	300	600	ug/l	70.1	J	221.4	J	46.5		20.2
Mercury, Total	0.7	1.4	ug/l	ND		0.36		ND		ND
Nickel, Total	100	200	ug/l	2.7	J	41.2	J	4.2		3.1
Potassium, Total			ug/l	5060		6760		18700		5620
Selenium, Total	10	20	ug/l	ND		9		2	J	ND
Silver, Total	50	100	ug/l	ND		0.2	J	ND		ND
Sodium, Total	20000		ug/l	18700		19700		226000		80200
Thallium, Total	0.5	0.5	ug/l	ND		0.3	J	ND		ND
Vanadium, Total			ug/l	5.2	J	46.6	J	14		4.5
Zinc, Total	2000	5000	ug/l	12.3	J	231.9	J	3.4	J	28

Notes:
NYSDEC = New York State Department of Environmental Conservation
NY-AWQS = New York Ambient Water Quality Standards.
NY-TAGM-GW= New York Groundwater Effluent standards.
ND= Compound not detected above laboritory detection limits
J= Presumptive evidence of compound.
ug/l= Micro Grams per Liter
Bold Highlighted = Exceeds standard
_ = sample not applicable

TABLE 8
GROUNDWATER ANALYTICAL DATA SUMMARY - JANUARY 11, 2017
AEI PROJECT No. 341998; NU-CLEAR LONG BEACH. NEW YORK

LOCATION			**17**
SAMPLING DATE			
	NY-AWQS	**NY-TOGS-GA**	**Qual**
Total Metals			
Aluminum, Total		2000	
Antimony, Total	3	6	J
Arsenic, Total	25	50	
Barium, Total	1000	2000	J
Beryllium, Total	3	3	
Cadmium, Total	5	10	
Calcium, Total			
Chromium, Total	50	100	J
Cobalt, Total			
Copper, Total	200	1000	
Iron, Total	300	600	
Lead, Total	25	50	J
Magnesium, Total	35000	35000	
Manganese, Total	300	600	
Mercury, Total	0.7	1.4	
Nickel, Total	100	200	
Potassium, Total			
Selenium, Total	10	20	
Silver, Total	50	100	
Sodium, Total	20000		
Thallium, Total	0.5	0.5	
Vanadium, Total			J
Zinc, Total	2000	5000	

Notes:
NYSDEC = New York State Department of Environmer
NY-AWQS = New York Ambient Water Quality Standa
NY-TAGM-GW= New York Groundwater Effluent stanc
ND= Compound not detected above laboritory detecti
J= Presumptive evidence of compound.
ug/l= Micro Grams per Liter
Bold Highlighted = Exceeds standard
_ = sample not applicable

TABLE 8
GROUNDWATER ANALYTICAL DATA SUMMARY - JANUARY 11, 2017
AEI PROJECT No. 341998; NU-CLEAR LONG BEACH. NEW YORK

LOCATION			**MW-12-11117**		**MW-6-11117**		**MW-9-11117**		**FIELD BLANK-11117**	
SAMPLING DATE			**1/11/2017**		**1/11/2017**		**1/11/2017**		**1/11/2017**	
	NY-AWQS	**NY-TOGS-GA**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Total Metals										
Aluminum, Total		2000	204		5	J	9	J	ND	
Antimony, Total	3	6	1.1	J	ND		2.9	J	ND	
Arsenic, Total	25	50	2.8		0.2	J	1.4		ND	
Barium, Total	1000	2000	8.1	J	2.7	J	4.9		1.8	J
Beryllium, Total	3	3	ND		ND		ND		ND	
Cadmium, Total	5	10	0.1	J	ND		ND		ND	
Calcium, Total			15400		42700		48400		ND	
Chromium, Total	50	100	1.3	J	0.8	U	0.7	U	0.5	J
Cobalt, Total			0.3	J	ND		0.7		ND	
Copper, Total	200	1000	9.5		ND		0.4	J	ND	
Iron, Total	300	600	560		19	U	425		45	J
Lead, Total	25	50	0.9	J	ND		ND		ND	
Magnesium, Total	35000	35000	3760		12700		7100		ND	
Manganese, Total	300	600	10.9		15.9		51.3		0.6	J
Mercury, Total	0.7	1.4	ND		ND		ND		ND	
Nickel, Total	100	200	1.8	J	ND		3.4		ND	
Potassium, Total			6900		9010		4680		ND	
Selenium, Total	10	20	ND		ND		ND		ND	
Silver, Total	50	100	ND		ND		ND		ND	
Sodium, Total	20000		35100		105000		82100		ND	
Thallium, Total	0.5	0.5	ND		ND		ND		ND	
Vanadium, Total			2.2	J	ND		1.9	J	ND	
Zinc, Total	2000	5000	44.2		ND		ND		ND	

Notes:
NYSDEC = New York State Department of Environmer
NY-AWQS = New York Ambient Water Quality Standa
NY-TAGM-GW= New York Groundwater Effluent stanc
ND= Compound not detected above laboritory detecti
J= Presumptive evidence of compound.
ug/l= Micro Grams per Liter
Bold Highlighted = Exceeds standard
_ = sample not applicable

TABLE - 10
GROUNDWATER ANALYTICAL SUMMARY - JANUARY 26, 2017 - VOCs
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION				**DP-1 012617**		**MW-1 012617**		**MW-10 012617**		**MW-11 012517**		**MW-12 012517**		**MW-2 012617**	
SAMPLING DATE				**1/26/2017**		**1/26/2017**		**1/26/2017**		**1/25/2017**		**1/25/2017**		**1/26/2017**	
	NY-AWQS	**NY-TOGS-GA**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Volatile Organics by GC/MS															
1,1,1,2-Tetrachloroethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,1,1-Trichloroethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,1,2,2-Tetrachloroethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,1,2-Trichloroethane	1	1	ug/l	ND		ND		ND		ND		ND		ND	
1,1-Dichloroethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,1-Dichloroethene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,1-Dichloropropene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,2,3-Trichlorobenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,2,3-Trichloropropane	0.04	0.04	ug/l	ND		ND		ND		ND		ND		ND	
1,2,4,5-Tetramethylbenzene	5	5	ug/l	ND		4.6		**24**		ND		ND		ND	
1,2,4-Trichlorobenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,2,4-Trimethylbenzene	5	5	ug/l	**180**		1.4	J	**100**		ND		ND		ND	
1,2-Dibromo-3-chloropropane	0.04	0.04	ug/l	ND		ND		ND		ND		ND		ND	
1,2-Dibromoethane	0.0006	0.0006	ug/l	ND		ND		ND		ND		ND		ND	
1,2-Dichlorobenzene	3	3	ug/l	ND		ND		ND		ND		ND		ND	
1,2-Dichloroethane	0.6	0.6	ug/l	ND		ND		ND		ND		ND		ND	
1,2-Dichloroethene, Total			ug/l	2600		1.9	J	57		ND		ND		6.6	
1,2-Dichloropropane	1	1	ug/l	ND		ND		ND		ND		ND		ND	
1,3,5-Trimethylbenzene	5	5	ug/l	**42**	J	0.92	J	**28**		ND		ND		ND	
1,3-Dichlorobenzene	3	3	ug/l	ND		ND		ND		ND		ND		ND	
1,3-Dichloropropane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,3-Dichloropropene, Total			ug/l	25		ND		ND		ND		ND		ND	
1,4-Dichlorobenzene	3	3	ug/l	ND		ND		ND		ND		ND		ND	
1,4-Dioxane			ug/l	12000		ND		ND		ND		ND		ND	
2,2-Dichloropropane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
2-Butanone	50	50	ug/l	ND		ND		ND		ND		ND		ND	
2-Hexanone	50	50	ug/l	ND		ND		ND		ND		ND		ND	
4-Methyl-2-pentanone			ug/l	250		ND		ND		ND		ND		ND	
Acetone	50	50	ug/l	**78**	J	ND		9.4	J	ND		ND		ND	
Acrylonitrile	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Benzene	1	1	ug/l	**37**		**2.9**		**1.4**	J	ND		ND		ND	
Bromobenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Bromochloromethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Bromodichloromethane	50	50	ug/l	ND		ND		ND		ND		ND		ND	
Bromoform	50	50	ug/l	ND		ND		ND		ND		ND		ND	
Bromomethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Carbon disulfide	60	60	ug/l	ND		ND		ND		ND		ND		ND	
Carbon tetrachloride	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Chlorobenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	

TABLE - 10
GROUNDWATER ANALYTICAL SUMMARY - JANUARY 26, 2017 - VOCs
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION				DP-1 012617		MW-1 012617		MW-10 012617		MW-11 012517		MW-12 012517		MW-2 012617	
SAMPLING DATE				**1/26/2017**		**1/26/2017**		**1/26/2017**		**1/25/2017**		**1/25/2017**		**1/26/2017**	
	NY-AWQS	**NY-TOGS-GA**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Chloroethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Chloroform	7	7	ug/l	ND		ND		ND		ND		ND		ND	
Chloromethane			ug/l	ND		ND		ND		ND		ND		ND	
cis-1,2-Dichloroethene	5	5	ug/l	**2600**		ND		**57**		ND		ND		**6.6**	
cis-1,3-Dichloropropene	0.4	0.4	ug/l	ND		ND		ND		ND		ND		ND	
Dibromochloromethane	50	50	ug/l	ND		ND		ND		ND		ND		ND	
Dibromomethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Dichlorodifluoromethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Ethyl ether			ug/l	ND		ND		ND		ND		ND		ND	
Ethylbenzene	5	5	ug/l	**66**	J	**12**		**71**		ND		ND		ND	
Hexachlorobutadiene	0.5	0.5	ug/l	ND		ND		ND		ND		ND		ND	
Isopropylbenzene	5	5	ug/l	ND		3.3		**18**		ND		ND		ND	
Methyl tert butyl ether	10	10	ug/l	ND		ND		ND		ND		ND		ND	
Methylene chloride	5	5	ug/l	ND		ND		ND		ND		ND		ND	
n-Butylbenzene	5	5	ug/l	ND		0.85	J	4.2	J	ND		ND		ND	
n-Propylbenzene	5	5	ug/l	ND		4.4		**24**		ND		ND		ND	
Naphthalene	10	10	ug/l	**700**		**13**		**410**		1.4	J	ND		ND	
o-Chlorotoluene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
o-Xylene	5	5	ug/l	**130**		1.2	J	**9.7**	J	ND		ND		ND	
p-Chlorotoluene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
p-Diethylbenzene			ug/l	ND		ND		28		ND		ND		ND	
p-Ethyltoluene			ug/l	51	J	1.6	J	40		ND		ND		ND	
p-Isopropyltoluene	5	5	ug/l	ND		0.82	J	**6.3**	J	ND		ND		ND	
p/m-Xylene	5	5	ug/l	**92**	J	4.1		**69**		ND		ND		ND	
sec-Butylbenzene	5	5	ug/l	ND		1.1	J	**5.9**	J	ND		ND		ND	
Styrene	5	930	ug/l	ND		ND		ND		ND		ND		ND	
tert-Butylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Tetrachloroethene	5	5	ug/l	ND		ND		ND		ND		ND		0.96	
Toluene	5	5	ug/l	**150**		0.75	J	ND		ND		ND		ND	
trans-1,2-Dichloroethene	5	5	ug/l	ND		1.9	J	ND		ND		ND		ND	
trans-1,3-Dichloropropene	0.4	0.4	ug/l	ND		ND		ND		ND		ND		ND	
trans-1,4-Dichloro-2-butene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Trichloroethene	5	5	ug/l	ND		ND		ND		ND		ND		1.3	
Trichlorofluoromethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Vinyl acetate			ug/l	250		ND		ND		ND		ND		ND	
Vinyl chloride	2	2	ug/l	**5300**		1.2		**99**		ND		ND		ND	
Xylenes, Total			ug/l	220	J	5.3	J	79	J	ND		ND		ND	

Notes:
NYSDEC = New York State Department of Environmental Conservation
NY-AWQS = New York Ambient Water Quality Standards.
NY-TAGM-GW= New York Groundwater Effluent standards.
ND= Compound not detected above laboritory detection limits
J= Presumptive evidence of compound.
ug/l= Micro Grams per Liter
Bold Highlighted = Exceeds standard
_ = sample not applicable

TABLE - 10
GROUNDWATER ANALYTICAL SUMMARY - JANUARY 26, 2017 - VOCs
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION				**MW-3 012517**		**MW-3 DUP**		**MW-4D 012617**		**MW-5 012617**		**MW-6 012617**		**MW-7 012517**	
SAMPLING DATE				**1/25/2017**		**1/25/2017**		**1/26/2017**		**1/26/2017**		**1/26/2017**		**1/25/2017**	
	NY-AWQS	**NY-TOGS-GA**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Volatile Organics by GC/MS															
1,1,1,2-Tetrachloroethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,1,1-Trichloroethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,1,2,2-Tetrachloroethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,1,2-Trichloroethane	1	1	ug/l	ND		ND		ND		ND		ND		ND	
1,1-Dichloroethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,1-Dichloroethene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,1-Dichloropropene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,2,3-Trichlorobenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,2,3-Trichloropropane	0.04	0.04	ug/l	ND		ND		ND		ND		ND		ND	
1,2,4,5-Tetramethylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,2,4-Trichlorobenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,2,4-Trimethylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,2-Dibromo-3-chloropropane	0.04	0.04	ug/l	ND		ND		ND		ND		ND		ND	
1,2-Dibromoethane	0.0006	0.0006	ug/l	ND		ND		ND		ND		ND		ND	
1,2-Dichlorobenzene	3	3	ug/l	ND		ND		ND		ND		ND		ND	
1,2-Dichloroethane	0.6	0.6	ug/l	ND		ND		ND		ND		ND		ND	
1,2-Dichloroethene, Total			ug/l	1	J	0.99	J	28		1.2	J	ND		ND	
1,2-Dichloropropane	1	1	ug/l	ND		ND		ND		ND		ND		ND	
1,3,5-Trimethylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,3-Dichlorobenzene	3	3	ug/l	ND		ND		ND		ND		ND		ND	
1,3-Dichloropropane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
1,3-Dichloropropene, Total			ug/l	ND		ND		ND		ND		ND		ND	
1,4-Dichlorobenzene	3	3	ug/l	ND		ND		ND		ND		ND		ND	
1,4-Dioxane			ug/l	ND		ND		ND		ND		ND		ND	
2,2-Dichloropropane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
2-Butanone	50	50	ug/l	ND		ND		ND		ND		ND		ND	
2-Hexanone	50	50	ug/l	ND		ND		ND		ND		ND		ND	
4-Methyl-2-pentanone			ug/l	ND		ND		ND		ND		ND		ND	
Acetone	50	50	ug/l	ND		ND		ND		ND		1.9	J	ND	
Acrylonitrile	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Benzene	1	1	ug/l	0.28	J	0.28	J	0.59		0.39	J	ND		ND	
Bromobenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Bromochloromethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Bromodichloromethane	50	50	ug/l	ND		ND		ND		ND		ND		ND	
Bromoform	50	50	ug/l	ND		ND		ND		ND		ND		ND	
Bromomethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Carbon disulfide	60	60	ug/l	ND		ND		ND		ND		ND		ND	
Carbon tetrachloride	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Chlorobenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	

TABLE - 10
GROUNDWATER ANALYTICAL SUMMARY - JANUARY 26, 2017 - VOCs
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION				**MW-3 012517**		**MW-3 DUP**		**MW-4D 012617**		**MW-5 012617**		**MW-6 012617**		**MW-7 012517**	
SAMPLING DATE				**1/25/2017**		**1/25/2017**		**1/26/2017**		**1/26/2017**		**1/26/2017**		**1/25/2017**	
	NY-AWQS	**NY-TOGS-GA**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Chloroethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Chloroform	7	7	ug/l	ND		ND		ND		ND		ND		ND	
Chloromethane			ug/l	ND		ND		ND		ND		ND		ND	
cis-1,2-Dichloroethene	5	5	ug/l	1	J	0.99	J	**28**		1.2	J	ND		ND	
cis-1,3-Dichloropropene	0.4	0.4	ug/l	ND		ND		ND		ND		ND		ND	
Dibromochloromethane	50	50	ug/l	ND		ND		ND		ND		ND		ND	
Dibromomethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Dichlorodifluoromethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Ethyl ether			ug/l	ND		ND		ND		ND		ND		ND	
Ethylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Hexachlorobutadiene	0.5	0.5	ug/l	ND		ND		ND		ND		ND		ND	
Isopropylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Methyl tert butyl ether	10	10	ug/l	ND		ND		ND		ND		ND		ND	
Methylene chloride	5	5	ug/l	ND		ND		ND		ND		ND		ND	
n-Butylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
n-Propylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Naphthalene	10	10	ug/l	ND		ND		ND		1.1	J	ND		ND	
o-Chlorotoluene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
o-Xylene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
p-Chlorotoluene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
p-Diethylbenzene			ug/l	ND		ND		ND		ND		ND		ND	
p-Ethyltoluene			ug/l	ND		ND		ND		ND		ND		ND	
p-Isopropyltoluene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
p/m-Xylene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
sec-Butylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Styrene	5	930	ug/l	ND		ND		ND		ND		ND		ND	
tert-Butylbenzene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Tetrachloroethene	5	5	ug/l	ND		ND		**6.2**		0.62		ND		ND	
Toluene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
trans-1,2-Dichloroethene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
trans-1,3-Dichloropropene	0.4	0.4	ug/l	ND		ND		ND		ND		ND		ND	
trans-1,4-Dichloro-2-butene	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Trichloroethene	5	5	ug/l	ND		ND		2.1		ND		ND		ND	
Trichlorofluoromethane	5	5	ug/l	ND		ND		ND		ND		ND		ND	
Vinyl acetate			ug/l	ND		ND		ND		ND		ND		ND	
Vinyl chloride	2	2	ug/l	ND		ND		ND		ND		ND		0.82	J
Xylenes, Total			ug/l	ND		ND		ND		ND		ND		ND	

Notes:
NYSDEC = New York State Department of Environmental Conserva
NY-AWQS = New York Ambient Water Quality Standards.
NY-TAGM-GW= New York Groundwater Effluent standards.
ND= Compound not detected above laboritory detection limits
J= Presumptive evidence of compound.
ug/l= Micro Grams per Liter
Bold Highlighted = Exceeds standard
_ = sample not applicable

TABLE - 10
GROUNDWATER ANALYTICAL SUMMARY - JANUARY 26, 2017 - VOCs
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION				**MW-8 012517**		**MW-9 012517**		**TRIP BLANK**		**FIELD BLANK 012617**	
SAMPLING DATE				**1/25/2017**		**1/25/2017**		**1/23/2017**		**1/26/2017**	
	NY-AWQS	**NY-TOGS-GA**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Volatile Organics by GC/MS											
1,1,1,2-Tetrachloroethane	5	5	ug/l	ND		ND		ND		ND	
1,1,1-Trichloroethane	5	5	ug/l	ND		ND		ND		ND	
1,1,2,2-Tetrachloroethane	5	5	ug/l	ND		ND		ND		ND	
1,1,2-Trichloroethane	1	1	ug/l	ND		ND		ND		ND	
1,1-Dichloroethane	5	5	ug/l	ND		ND		ND		ND	
1,1-Dichloroethene	5	5	ug/l	ND		ND		ND		ND	
1,1-Dichloropropene	5	5	ug/l	ND		ND		ND		ND	
1,2,3-Trichlorobenzene	5	5	ug/l	ND		ND		ND		ND	
1,2,3-Trichloropropane	0.04	0.04	ug/l	ND		ND		ND		ND	
1,2,4,5-Tetramethylbenzene	5	5	ug/l	ND		ND		ND		ND	
1,2,4-Trichlorobenzene	5	5	ug/l	ND		ND		ND		ND	
1,2,4-Trimethylbenzene	5	5	ug/l	ND		ND		ND		ND	
1,2-Dibromo-3-chloropropane	0.04	0.04	ug/l	ND		ND		ND		ND	
1,2-Dibromoethane	0.0006	0.0006	ug/l	ND		ND		ND		ND	
1,2-Dichlorobenzene	3	3	ug/l	ND		ND		ND		ND	
1,2-Dichloroethane	0.6	0.6	ug/l	ND		ND		ND		ND	
1,2-Dichloroethene, Total			ug/l	1.9	J	ND		ND		ND	
1,2-Dichloropropane	1	1	ug/l	ND		ND		ND		ND	
1,3,5-Trimethylbenzene	5	5	ug/l	ND		ND		ND		ND	
1,3-Dichlorobenzene	3	3	ug/l	ND		ND		ND		ND	
1,3-Dichloropropane	5	5	ug/l	ND		ND		ND		ND	
1,3-Dichloropropene, Total			ug/l	ND		ND		ND		ND	
1,4-Dichlorobenzene	3	3	ug/l	ND		ND		ND		ND	
1,4-Dioxane			ug/l	ND		ND		ND		ND	
2,2-Dichloropropane	5	5	ug/l	ND		ND		ND		ND	
2-Butanone	50	50	ug/l	ND		ND		ND		ND	
2-Hexanone	50	50	ug/l	ND		ND		ND		ND	
4-Methyl-2-pentanone			ug/l	ND		ND		ND		ND	
Acetone	50	50	ug/l	ND		ND		ND		ND	
Acrylonitrile	5	5	ug/l	ND		ND		ND		ND	
Benzene	1	1	ug/l	ND		ND		ND		ND	
Bromobenzene	5	5	ug/l	ND		ND		ND		ND	
Bromochloromethane	5	5	ug/l	ND		ND		ND		ND	
Bromodichloromethane	50	50	ug/l	ND		ND		ND		ND	
Bromoform	50	50	ug/l	ND		ND		ND		ND	
Bromomethane	5	5	ug/l	ND		ND		ND		ND	
Carbon disulfide	60	60	ug/l	ND		ND		ND		ND	
Carbon tetrachloride	5	5	ug/l	ND		ND		ND		ND	
Chlorobenzene	5	5	ug/l	ND		ND		ND		ND	

TABLE - 10
GROUNDWATER ANALYTICAL SUMMARY - JANUARY 26, 2017 - VOCs
AEI PROJECT No. 341998; NU-CLEAR, LONG BEACH, NEW YORK

LOCATION				**MW-8 012517**		**MW-9 012517**		**TRIP BLANK**		**FIELD BLANK 012617**	
SAMPLING DATE				**1/25/2017**		**1/25/2017**		**1/23/2017**		**1/26/2017**	
	NY-AWQS	**NY-TOGS-GA**	**Units**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**	**Results**	**Qual**
Chloroethane	5	5	ug/l	ND		ND		ND		ND	
Chloroform	7	7	ug/l	ND		ND		ND		ND	
Chloromethane			ug/l	ND		ND		ND		ND	
cis-1,2-Dichloroethene	5	5	ug/l	1.9	J	ND		ND		ND	
cis-1,3-Dichloropropene	0.4	0.4	ug/l	ND		ND		ND		ND	
Dibromochloromethane	50	50	ug/l	ND		ND		ND		ND	
Dibromomethane	5	5	ug/l	ND		ND		ND		ND	
Dichlorodifluoromethane	5	5	ug/l	ND		ND		ND		ND	
Ethyl ether			ug/l	ND		ND		ND		ND	
Ethylbenzene	5	5	ug/l	ND		ND		ND		ND	
Hexachlorobutadiene	0.5	0.5	ug/l	ND		ND		ND		ND	
Isopropylbenzene	5	5	ug/l	ND		ND		ND		ND	
Methyl tert butyl ether	10	10	ug/l	ND		ND		ND		ND	
Methylene chloride	5	5	ug/l	ND		ND		ND		ND	
n-Butylbenzene	5	5	ug/l	ND		ND		ND		ND	
n-Propylbenzene	5	5	ug/l	ND		ND		ND		ND	
Naphthalene	10	10	ug/l	ND		ND		ND		ND	
o-Chlorotoluene	5	5	ug/l	ND		ND		ND		ND	
o-Xylene	5	5	ug/l	ND		ND		ND		ND	
p-Chlorotoluene	5	5	ug/l	ND		ND		ND		ND	
p-Diethylbenzene			ug/l	ND		ND		ND		ND	
p-Ethyltoluene			ug/l	ND		ND		ND		ND	
p-Isopropyltoluene	5	5	ug/l	ND		ND		ND		ND	
p/m-Xylene	5	5	ug/l	ND		ND		ND		ND	
sec-Butylbenzene	5	5	ug/l	ND		ND		ND		ND	
Styrene	5	930	ug/l	ND		ND		ND		ND	
tert-Butylbenzene	5	5	ug/l	ND		ND		ND		ND	
Tetrachloroethene	5	5	ug/l	ND		ND		ND		ND	
Toluene	5	5	ug/l	ND		ND		ND		ND	
trans-1,2-Dichloroethene	5	5	ug/l	ND		ND		ND		ND	
trans-1,3-Dichloropropene	0.4	0.4	ug/l	ND		ND		ND		ND	
trans-1,4-Dichloro-2-butene	5	5	ug/l	ND		ND		ND		ND	
Trichloroethene	5	5	ug/l	ND		ND		ND		ND	
Trichlorofluoromethane	5	5	ug/l	ND		ND		ND		ND	
Vinyl acetate			ug/l	ND		ND		ND		ND	
Vinyl chloride	2	2	ug/l	2.6		ND		ND		ND	
Xylenes, Total			ug/l	ND		ND		ND		ND	

Notes:
NYSDEC = New York State Department of Environmental Conserva
NY-AWQS = New York Ambient Water Quality Standards.
NY-TAGM-GW= New York Groundwater Effluent standards.
ND= Compound not detected above laboritory detection limits
J= Presumptive evidence of compound.
ug/l= Micro Grams per Liter
Bold Highlighted = Exceeds standard
_ = sample not applicable

TABLE 11
Project Permit Listing
To Be Updated as Project Progresses

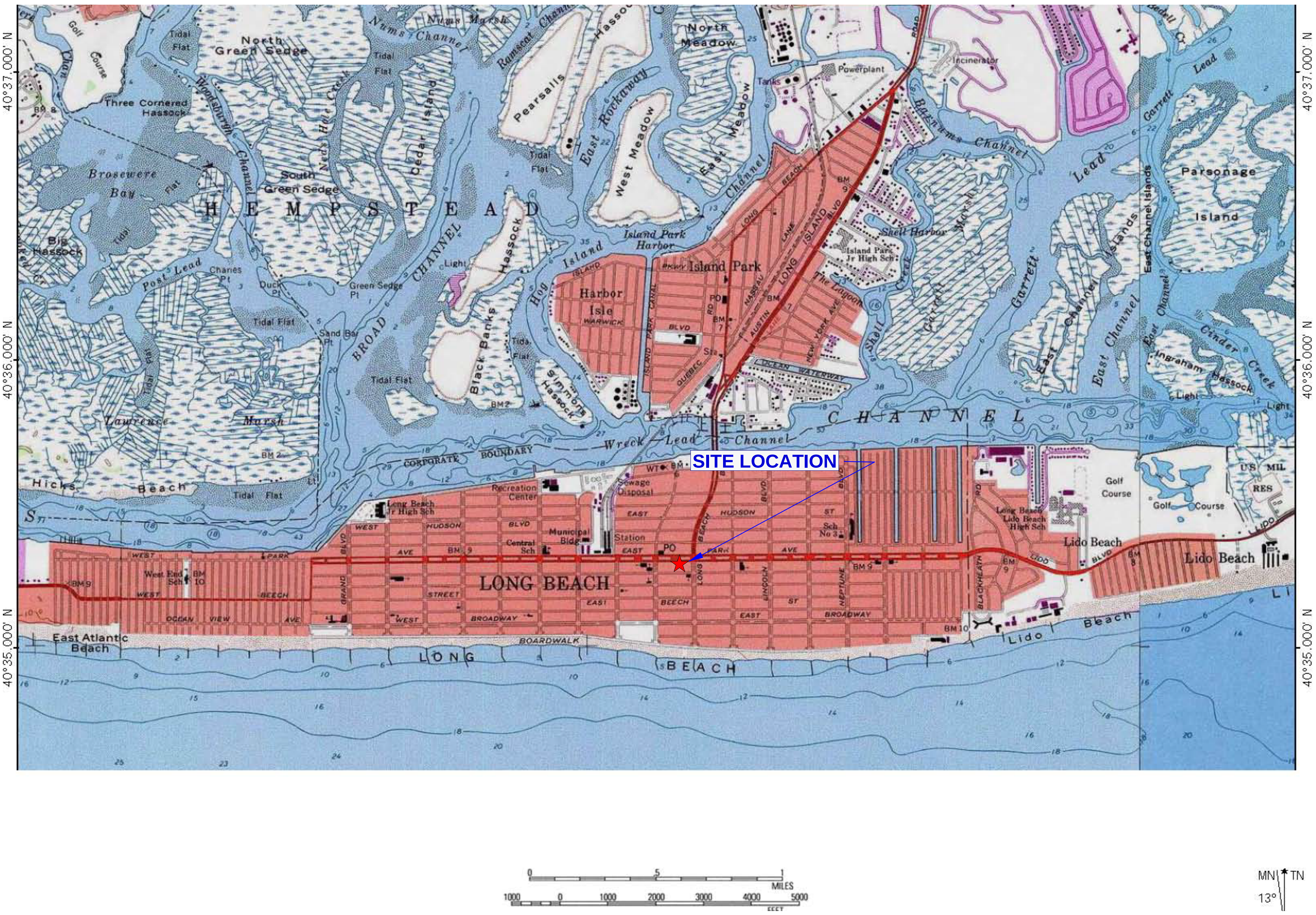
Permit	***Permit Number***	***Originating Agency***	***Pursuant to***	***Issued***	***Expires***	***Contact Phone***

Note: This list will be updated as the project progresses

Table 12
Emergency Contact List

General Emergencies		911
Police		911
Fire Department		911
Mount Sinai South Nassau Emergency Room		(516) 870-1010
NYSDEC Spills Hotline		1-800-457-7362
NYSDEC Project Manager	John Sheehan	(631) 444-0244
Nassau County Dept. of Health		(516) 227-9697
National Response Center		1-800-424-8802
Poison Control		1-800-222-1222
EBC Project Manager	Keith Butler	(631) 504-6000
EBC BCP Program Manager	Charles Sosik	(631) 504-6000
EBC Site Safety Officer	Tom Gallo	(631) 504-6000
Remedial Engineer	Ariel Czemerinski	(516) 987-1662
Construction Manager	Alex Liechtung	(516)779-5455

FIGURES



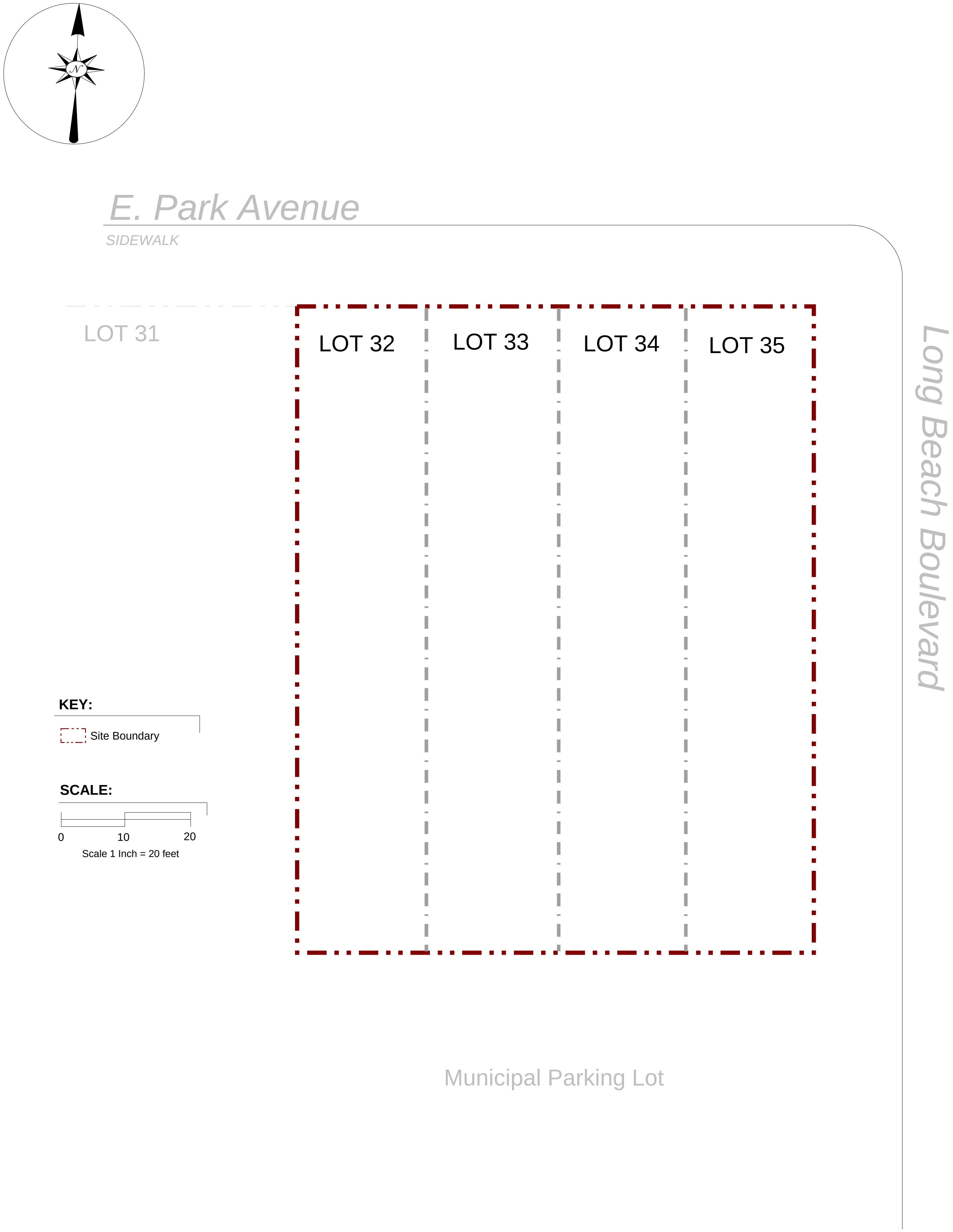
EBC

Phone 631.504.6000
Fax 631. 924 .2870

ENVIRONMENTAL BUSINESS CONSULTANTS

Figure No.
1

Site Name:	FORMER NU-CLEAR CLEANERS
Site Address:	180 E. PARK AVENUE, LONG BEACH, NY
Drawing Title:	SITE LOCATION MAP



EBC
ENVIRONMENTAL BUSINESS CONSULTANTS

Phone 631.504.6000
Fax 631. 924 .2870

Figure No.
2

Site Name:	FORMER NU-CLEAR CLEANERS
Site Address:	180 E. PARK AVENUE, LONG BEACH, NY
Drawing Title:	SITE PLAN

EBC

ENVIRONMENTAL BUSINESS CONSULTANTS

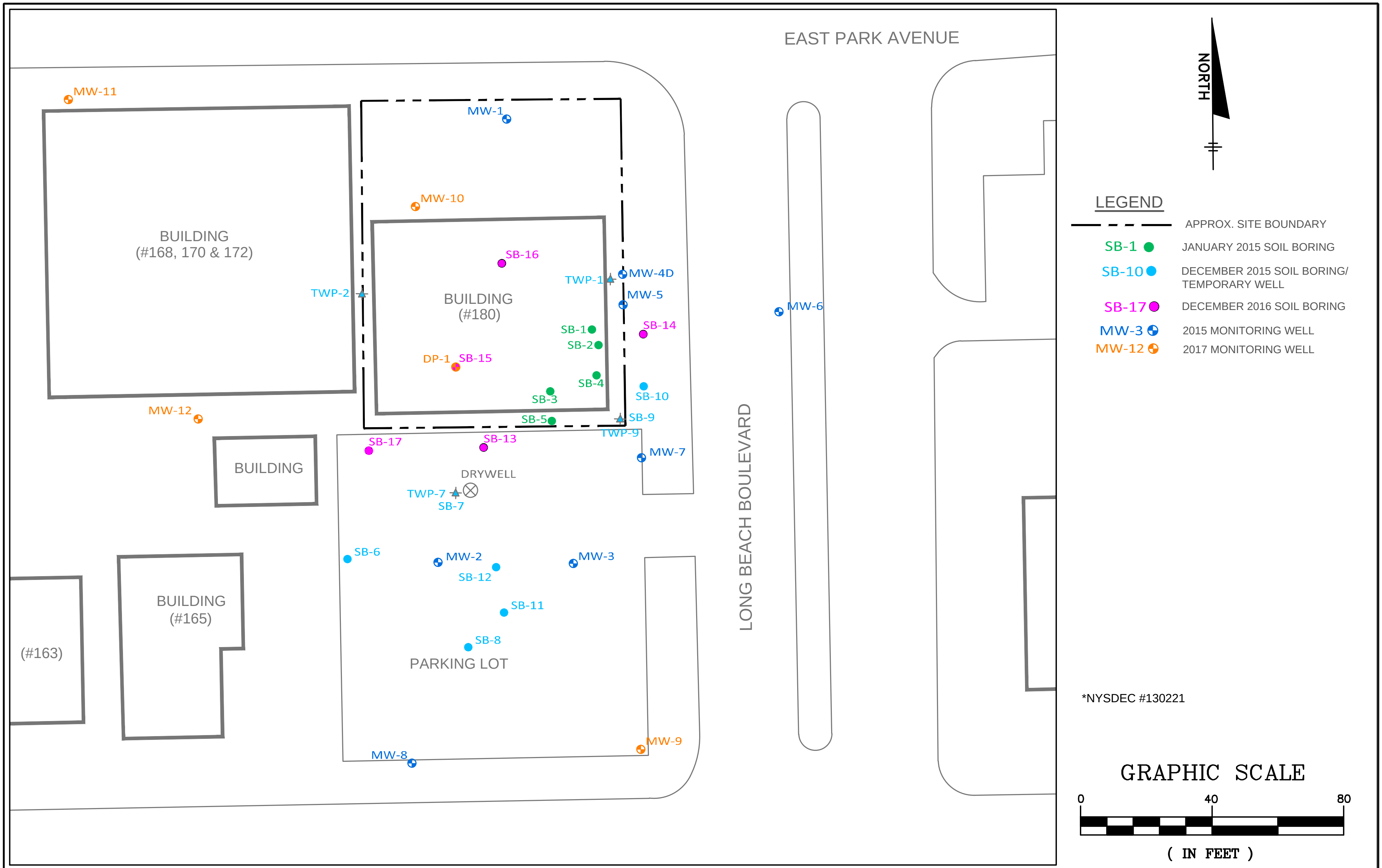
Phone 631.504.6000
Fax 631. 924 .2870

Figure No.
3

Site Name: FOORMER NU-CLEAR CLEANERS

Site Address: 180 E. PARK AVENUE, LONG BEACH, NY

Drawing Title: SURROUNDING LAND USE



AEI Consultants

Environmental & Engineering Services

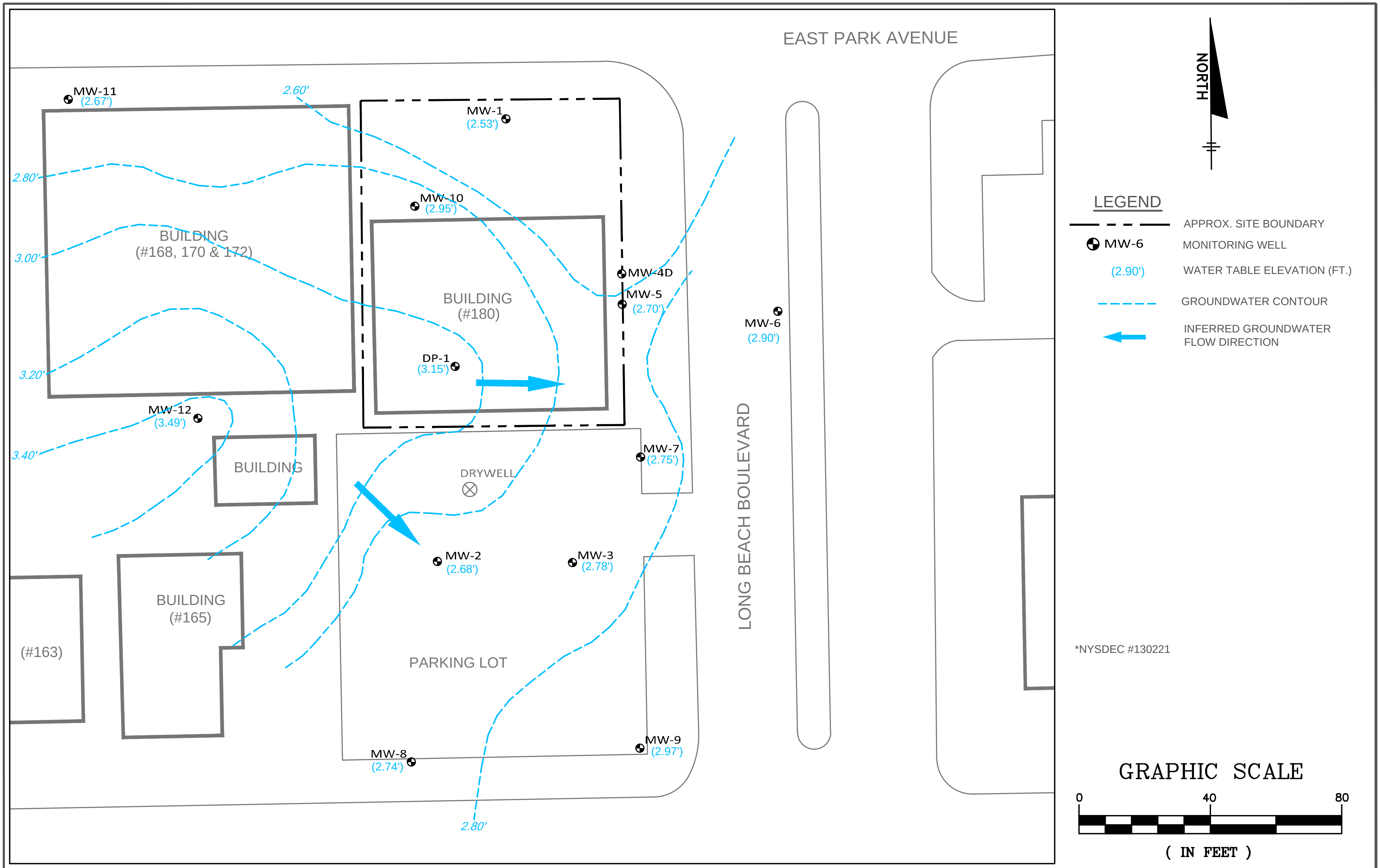
DRAWN BY: AVC	REVIEWED BY: DKO	
APPROVED BY: RK	Date: 3/9/17	

SAMPLE LOCATION MAP

NU-CLEAR CLEANERS
180 EAST PARK AVENUE
LONG BEACH, NEW YORK

AEI Project #341998

FIGURE
4



AEI Consultants

Environmental & Engineering Services

DRAWN BY:
AVC

REVIEWED BY:
DKO

APPROVED BY:
RK

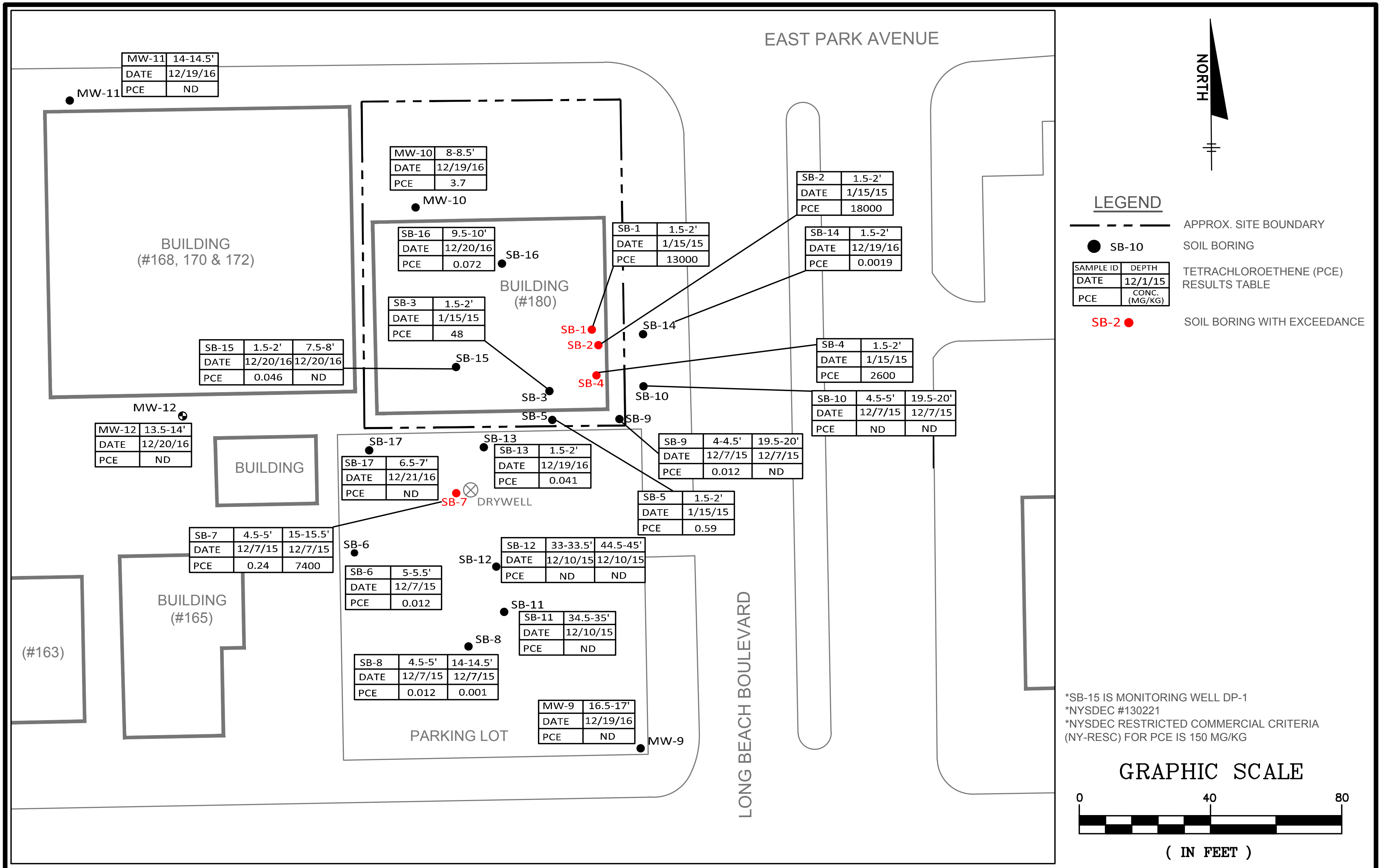
Date:
3/6/17

SHALLOW GROUNDWATER ELEVATION CONTOUR MAP
FOR JANUARY 25, 2017

NU-CLEAR CLEANERS
180 EAST PARK AVENUE
LONG BEACH, NEW YORK

AEI Project #341998

FIGURE
5



*SB-15 IS MONITORING WELL DP-1
*NYSDEC #130221
*NYSDEC RESTRICTED COMMERCIAL CRITERIA (NY-RESC) FOR PCE IS 150 MG/KG

AEI Consultants
Environmental & Engineering Services

DRAWN BY:
AVC

REVIEWED BY:
DKO

APPROVED BY:
RK

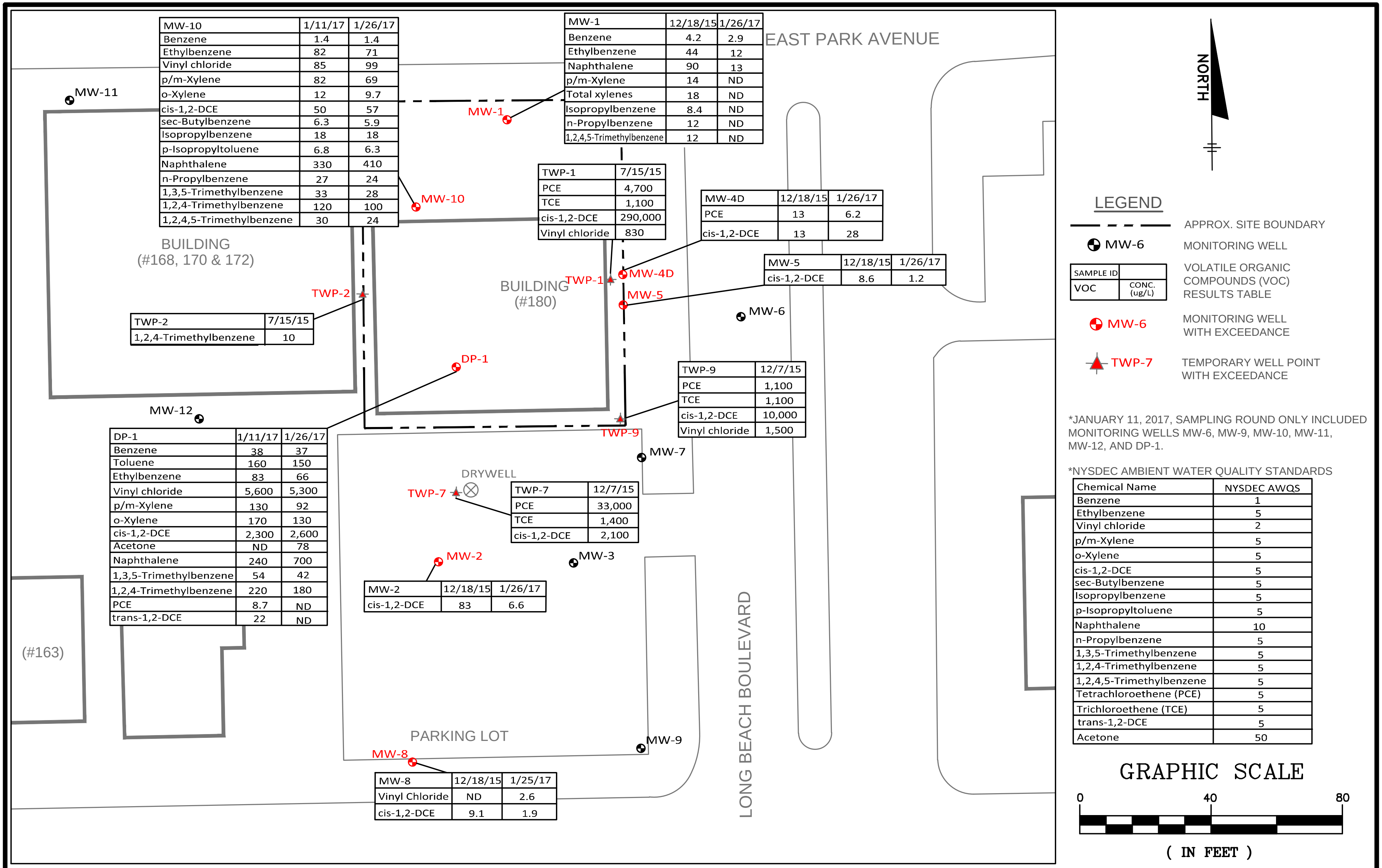
Date:
3/6/2017

VOC CONCENTRATIONS IN SOIL

NU-CLEAR CLEANERS
180 EAST PARK AVENUE
LONG BEACH, NEW YORK

AEI Project #341998

FIGURE
6



MW-10	1/11/17	1/26/17
Benzene	1.4	1.4
Ethylbenzene	82	71
Vinyl chloride	85	99
p/m-Xylene	82	69
o-Xylene	12	9.7
cis-1,2-DCE	50	57
sec-Butylbenzene	6.3	5.9
Isopropylbenzene	18	18
p-Isopropyltoluene	6.8	6.3
Naphthalene	330	410
n-Propylbenzene	27	24
1,3,5-Trimethylbenzene	33	28
1,2,4-Trimethylbenzene	120	100
1,2,4,5-Trimethylbenzene	30	24

MW-1	12/18/15	1/26/17
Benzene	4.2	2.9
Ethylbenzene	44	12
Naphthalene	90	13
p/m-Xylene	14	ND
Total xylenes	18	ND
Isopropylbenzene	8.4	ND
n-Propylbenzene	12	ND
1,2,4,5-Trimethylbenzene	12	ND

TWP-1	7/15/15
PCE	4,700
TCE	1,100
cis-1,2-DCE	290,000
Vinyl chloride	830

MW-4D	12/18/15	1/26/17
PCE	13	6.2
cis-1,2-DCE	13	28

MW-5	12/18/15	1/26/17
cis-1,2-DCE	8.6	1.2

TWP-2	7/15/15
1,2,4-Trimethylbenzene	10

TWP-9	12/7/15
PCE	1,100
TCE	1,100
cis-1,2-DCE	10,000
Vinyl chloride	1,500

DP-1	1/11/17	1/26/17
Benzene	38	37
Toluene	160	150
Ethylbenzene	83	66
Vinyl chloride	5,600	5,300
p/m-Xylene	130	92
o-Xylene	170	130
cis-1,2-DCE	2,300	2,600
Acetone	ND	78
Naphthalene	240	700
1,3,5-Trimethylbenzene	54	42
1,2,4-Trimethylbenzene	220	180
PCE	8.7	ND
trans-1,2-DCE	22	ND

TWP-7	12/7/15
PCE	33,000
TCE	1,400
cis-1,2-DCE	2,100

MW-2	12/18/15	1/26/17
cis-1,2-DCE	83	6.6

MW-8	12/18/15	1/25/17
Vinyl Chloride	ND	2.6
cis-1,2-DCE	9.1	1.9

LEGEND

— — —	APPROX. SITE BOUNDARY
MW-6	MONITORING WELL
SAMPLE ID VOC CONC. (ug/L)	VOLATILE ORGANIC COMPOUNDS (VOC) RESULTS TABLE
MW-6	MONITORING WELL WITH EXCEEDANCE
▲ TWP-7	TEMPORARY WELL POINT WITH EXCEEDANCE

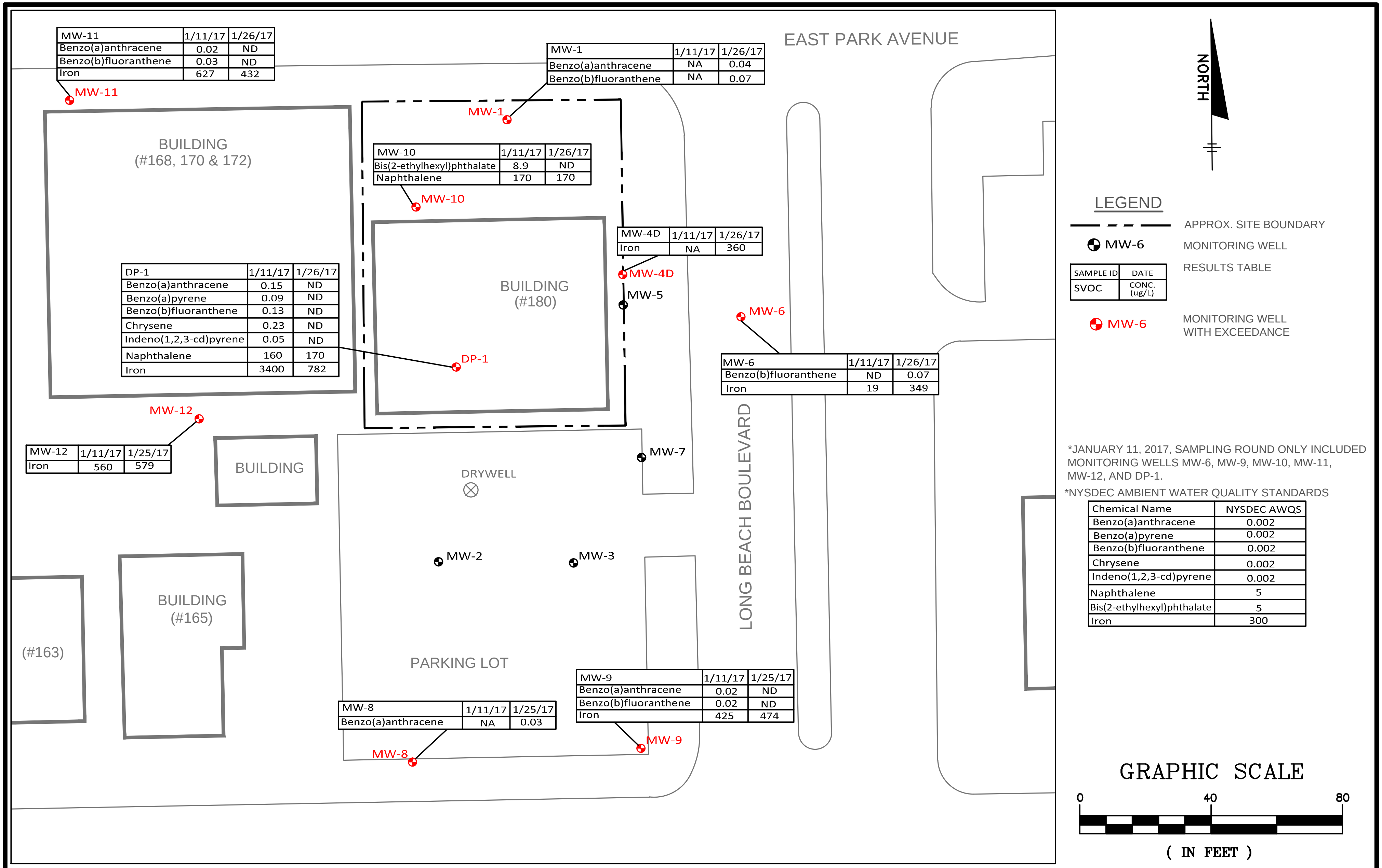
*JANUARY 11, 2017, SAMPLING ROUND ONLY INCLUDED MONITORING WELLS MW-6, MW-9, MW-10, MW-11, MW-12, AND DP-1.

*NYSDEC AMBIENT WATER QUALITY STANDARDS

Chemical Name	NYSDEC AWQS
Benzene	1
Ethylbenzene	5
Vinyl chloride	2
p/m-Xylene	5
o-Xylene	5
cis-1,2-DCE	5
sec-Butylbenzene	5
Isopropylbenzene	5
p-Isopropyltoluene	5
Naphthalene	10
n-Propylbenzene	5
1,3,5-Trimethylbenzene	5
1,2,4-Trimethylbenzene	5
1,2,4,5-Trimethylbenzene	5
Tetrachloroethene (PCE)	5
Trichloroethene (TCE)	5
trans-1,2-DCE	5
Acetone	50

AEI Consultants
Environmental & Engineering Services

DRAWN BY: AVC	REVIEWED BY: DKO	VOC EXCEEDANCES OF NYSDEC AMBIENT WATER QUALITY STANDARDS NU-CLEAR CLEANERS 180 EAST PARK AVENUE LONG BEACH, NEW YORK	AEI Project #341998	FIGURE 7
APPROVED BY: RK	Date: 3/6/17			



MW-11	1/11/17	1/26/17
Benzo(a)anthracene	0.02	ND
Benzo(b)fluoranthene	0.03	ND
Iron	627	432

MW-1	1/11/17	1/26/17
Benzo(a)anthracene	NA	0.04
Benzo(b)fluoranthene	NA	0.07

MW-10	1/11/17	1/26/17
Bis(2-ethylhexyl)phthalate	8.9	ND
Naphthalene	170	170

MW-4D	1/11/17	1/26/17
Iron	NA	360

DP-1	1/11/17	1/26/17
Benzo(a)anthracene	0.15	ND
Benzo(a)pyrene	0.09	ND
Benzo(b)fluoranthene	0.13	ND
Chrysene	0.23	ND
Indeno(1,2,3-cd)pyrene	0.05	ND
Naphthalene	160	170
Iron	3400	782

MW-6	1/11/17	1/26/17
Benzo(b)fluoranthene	ND	0.07
Iron	19	349

MW-12	1/11/17	1/25/17
Iron	560	579

MW-9	1/11/17	1/25/17
Benzo(a)anthracene	0.02	ND
Benzo(b)fluoranthene	0.02	ND
Iron	425	474

MW-8	1/11/17	1/25/17
Benzo(a)anthracene	NA	0.03

*JANUARY 11, 2017, SAMPLING ROUND ONLY INCLUDED MONITORING WELLS MW-6, MW-9, MW-10, MW-11, MW-12, AND DP-1.

*NYSDEC AMBIENT WATER QUALITY STANDARDS

Chemical Name	NYSDEC AWQS
Benzo(a)anthracene	0.002
Benzo(a)pyrene	0.002
Benzo(b)fluoranthene	0.002
Chrysene	0.002
Indeno(1,2,3-cd)pyrene	0.002
Naphthalene	5
Bis(2-ethylhexyl)phthalate	5
Iron	300

AEI Consultants
Environmental & Engineering Services

DRAWN BY:
AVC

REVIEWED BY:
DKO

APPROVED BY:
RK

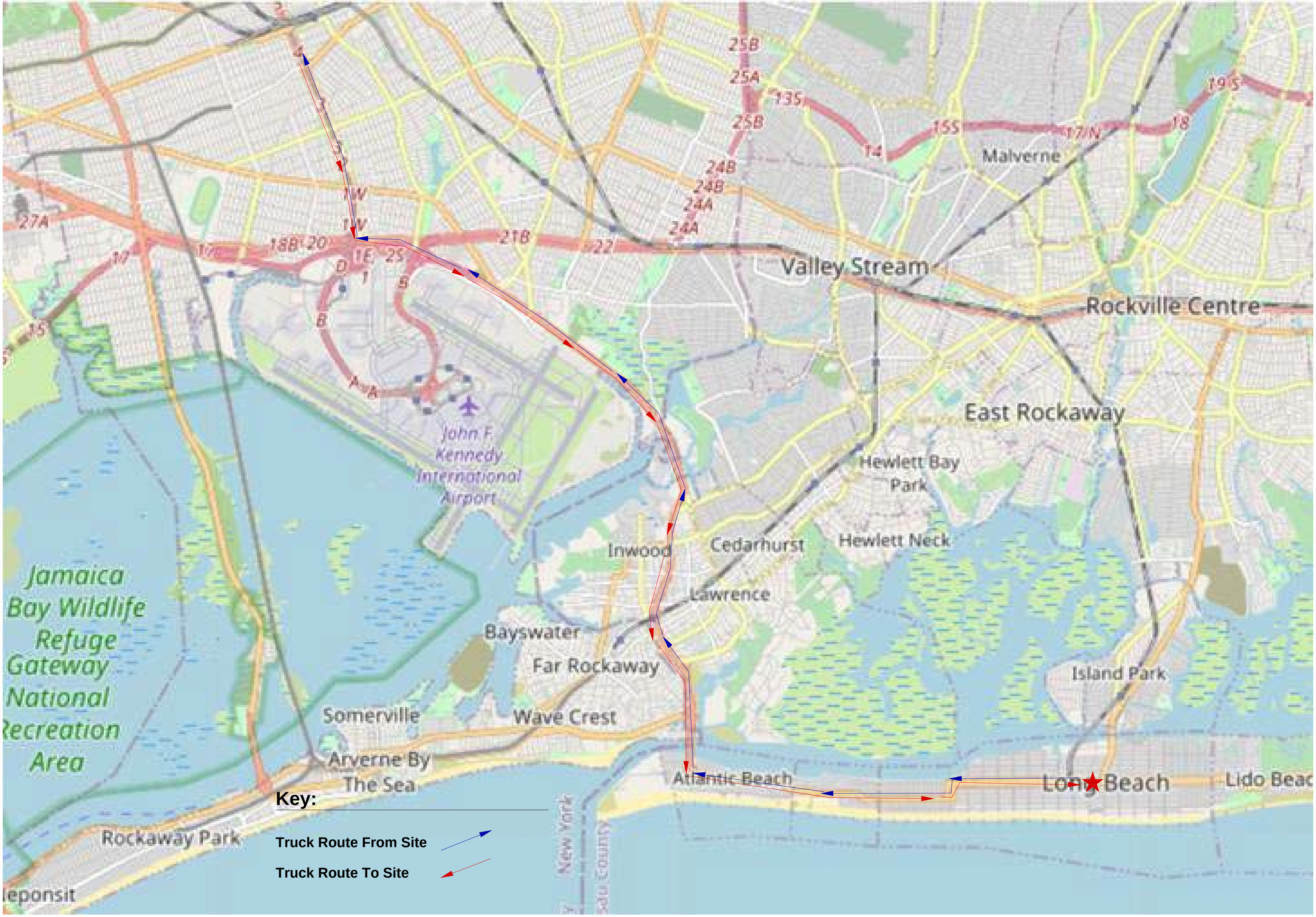
Date:
3/6/17

PESTICIDE/HERBICIDE/PCB/METALS/SVOC EXCEEDANCES OF NYSDEC AMBIENT WATER QUALITY STANDARDS

NU-CLEAR CLEANERS
180 EAST PARK AVENUE
LONG BEACH, NEW YORK

AEI Project #341998

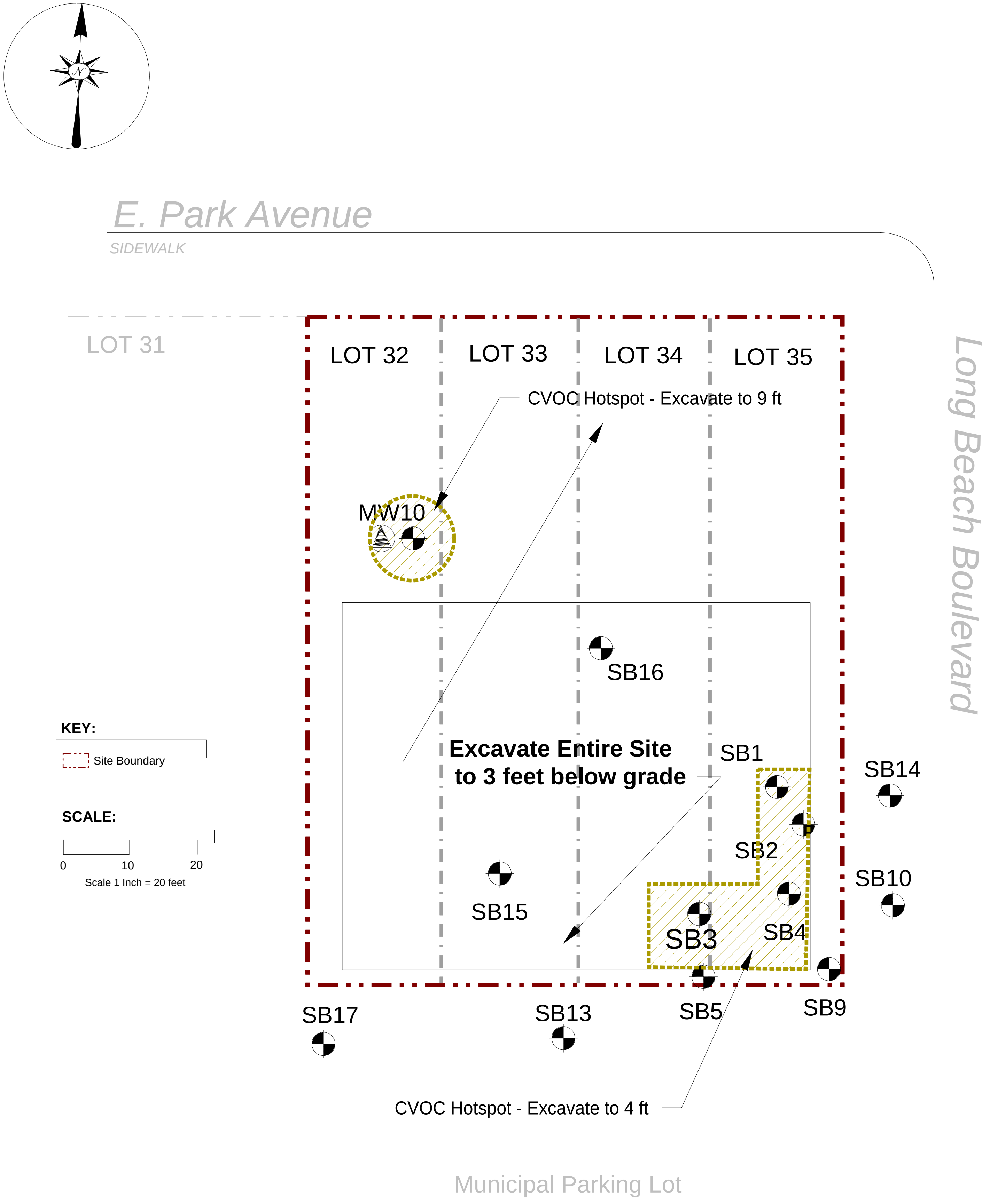
FIGURE
8



AMC Engineering, PLLC
18-36 42nd Street
Astoria, NY 11105

Figure No.
9
6/20/20

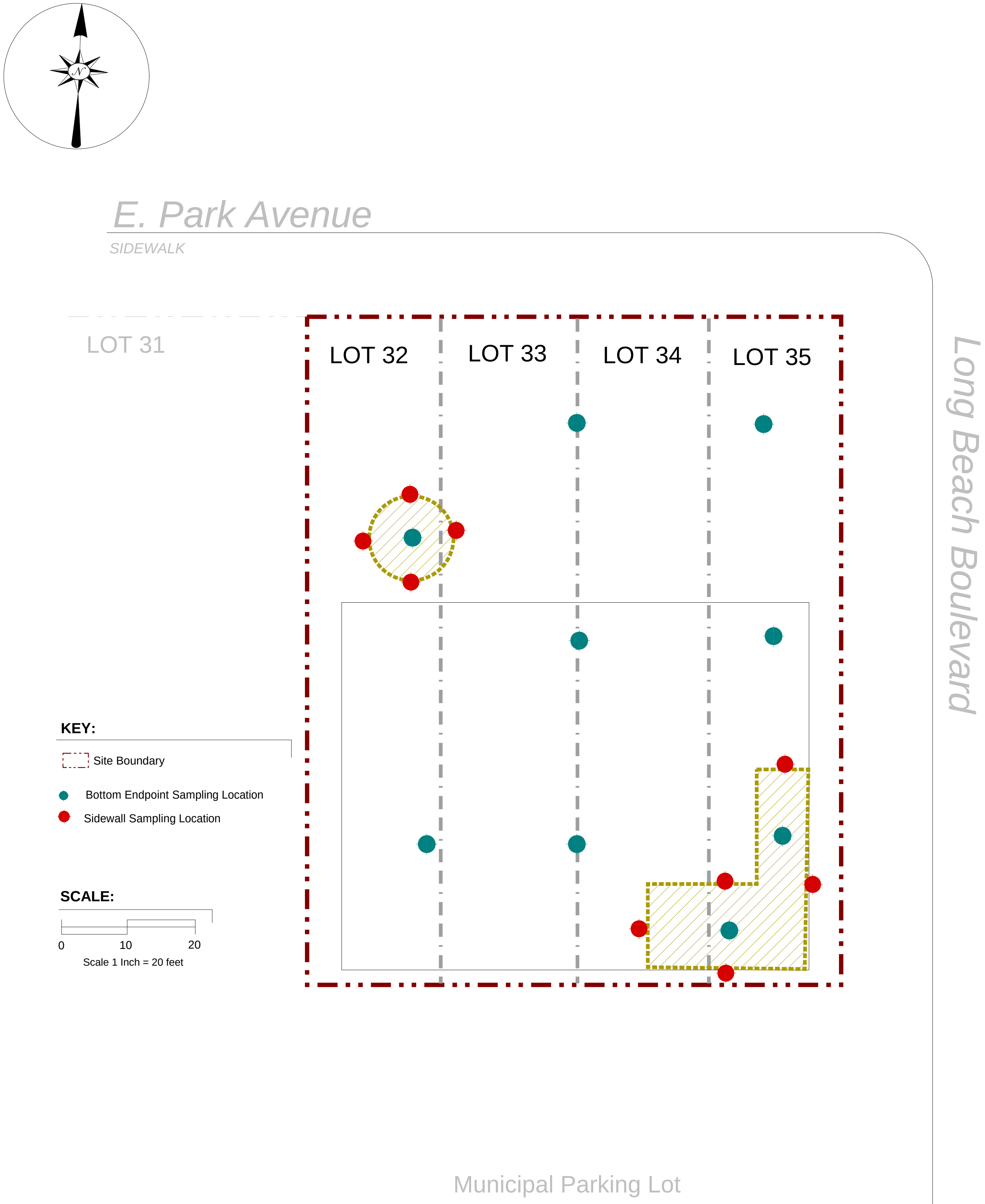
Site Name: 69-02 Queens Boulevard
Site Address: 180 E. Park Avenue, Long Beach, NY
Drawing Title: Truck Route



AMC Engineering, PLLC
18-36 42nd Street
Astoria, NY 11105

Figure No.
10

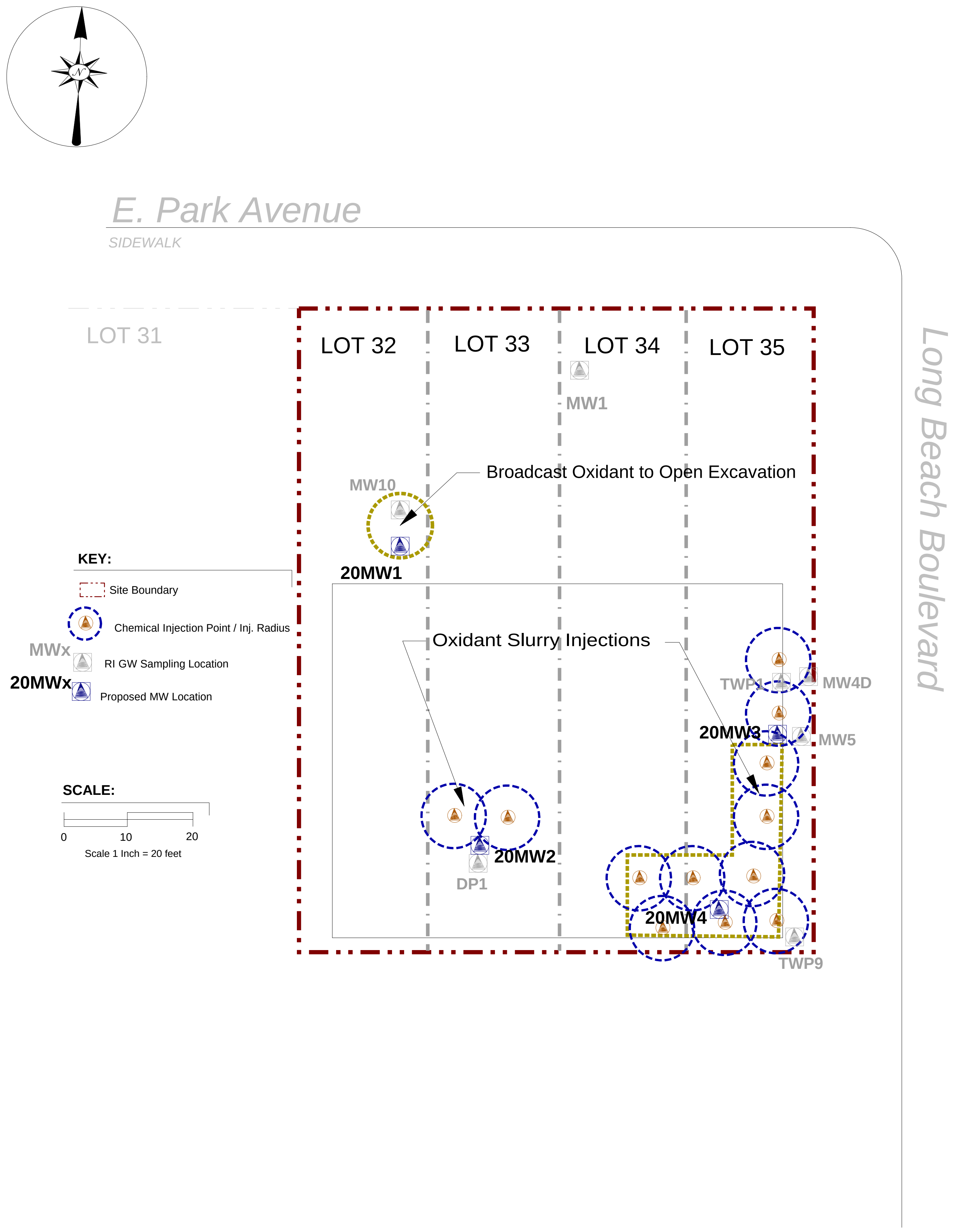
Site Name: FORMER NU-CLEAR CLEANERS
Site Address: 180 E. PARK AVENUE, LONG BEACH, NY
Drawing Title: EXCAVATION PLAN



AMC Engineering, PLLC
18-36 42nd Street
Astoria, NY 11105

Figure No.
11

Site Name: **Former Nu-Clear Cleaners**
Site Address: 180 E. Park Avenue, Long Beach, NY
Drawing Title: Endpoint Sampling Plan



AMC Engineeting, PLLC
18-36 42nd Street
Astoria, NY 11105

Figure No.
12

Site Name: FORMER NU-CLEAR CLEANERS
Site Address: 180 E. PARK AVENUE, LONG BEACH, NY
Drawing Title: ISCO TREATMENT PLAN

ATTACHMENT A

Metes and Bounds Description of Property

METES AND BOUNDS DESCRIPION

All that certain plot piece or parcel of land, situate, lying and being in the City of Long Beach, Town of Hempstead, County of Nassau and State of New York, known and designated as and by the lot numbers 32, 33, 34, and 35 in Block 110 on a certain map entitled Estates of Long Beach, Long Beach, L.I., Map No.1, William H. Reynolds, President, Chas. W. Leavitt, Jr., Landscape Engineer, New York City, and filed in the Nassau County Clerk's office April 20, 1911 as Map No. 31, Ca e No. 231, which said lots when taken together are more particularly bounded and described according to said map as follows:

BEGINNING at the corner formed by the intersection of the southerly side of Park Street and the westerly side of long Beach Boulevard;

RUNNING THENCE southerly along the westerly said of Long Beach Boulevard, 100 feet to the center line of the block between Park Street and Walnut Street as laid down on said map;

THENCE westerly along the center line of the block and parallel with Park Street, 80 feet;

THENCE northerly parallel with Long Beach Boulevard, 100 feet to the southerly side of Park Street;

THENCE easterly along the southerly side of Park Street, 80 feet to the corner, aforesaid, the point or place of BEGINNING.

ATTACHMENT B
Health and Safety Plan

FORMER NU-CLEAR CLEANERS SITE
180 E. Park Avenue
Lido Beach, NY
Block 59 Lots 32-35

CONSTRUCTION HEALTH AND SAFETY PLAN

Prepared for:
180 Park Avenue LLC
54 Regent Drive
Lido Beach, NY 11561

Prepared by:

ENVIRONMENTAL BUSINESS CONSULTANTS
1808 Middle Country Road
Ridge, NY 11961

TABLE OF CONTENTS
CONSTRUCTION HEALTH AND SAFETY PLAN

1.0 INTRODUCTION AND SITE ENTRY REQUIREMENTS 1
1.1 Training Requirements 1
1.2 Medical Monitoring Requirements 2
1.3 Site Safety Plan Acceptance, Acknowledgment and Amendments 2
1.4 Key Personnel - Roles and Responsibilities 2

2.0 SITE BACKGROUND AND SCOPE OF WORK 4
2.1 Summary of Remedial Investigation 4
2.3 Description of Remedial Action 4

3.0 HAZARD ASSESSMENT 6
3.1 Physical Hazards 6
3.1.1 Tripping Hazards 6
3.1.2 Climbing Hazards 6
3.1.3 Cuts and Lacerations 6
3.1.4 Lifting Hazards 6
3.1.5 Utility Hazards 6
3.1.6 Traffic Hazards 6
3.2 Work in Extreme Temperatures 6
3.2.1 Heat Stress 6
3.2.2 Cold Exposure 8
3.3 Chemical Hazards 8
3.3.1 Respirable Dust 8
3.3.2 Dust Control and Monitoring During Earthwork 9
3.3.3 Organic Vapors 9

4.0 PERSONAL PROTECTIVE EQUIPMENT 10
4.1 Level D 10
4.2 Level C 10
4.3 Activity-Specific Levels of Personal Protection 11

5.0 AIR MONITORING AND ACTION LEVELS 12
5.1 Air Monitoring Requirements 12
5.2 Work Stoppage Responses 12
5.3 Action Levels During Excavation Activities 12

6.0 SITE CONTROL 14
6.1 Work Zones 14
6.2 General Site Work 14

TABLE OF CONTENTS
CONSTRUCTION HEALTH AND SAFETY PLAN

7.0 CONTINGENCY PLAN/EMERGENCY RESPONSE PLAN 15
7.1 Emergency Equipment On-site 15
7.2 Emergency Telephone Numbers 15
7.3 Personnel Responsibilities During an Emergency 15
7.4 Medical Emergencies 16
7.5 Fire or Explosion 16
7.6 Evacuation Routes 16
7.7 Spill Control Procedures 17
7.8 Vapor Release Plan 17

STATEMENT OF COMMITMENT

This Construction Health and Safety Plan (CHASP) has been prepared to ensure that workers are not exposed to risks from hazardous materials during the Remedial Actions at the Site.

This CHASP, which applies to persons present at the site actually or potentially exposed to hazardous materials, describes emergency response procedures for actual and potential chemical hazards. This CHASP is also intended to inform and guide personnel entering the work area or exclusion zone. Persons are to acknowledge that they understand the potential hazards and the contents of this Health and Safety policy by signing off on receipt of their individual copy of the document. Contractors and suppliers are retained as independent contractors and are responsible for ensuring the health and safety of their own employees.

1.0 INTRODUCTION AND SITE ENTRY REQUIREMENTS

This document describes the health and safety guidelines developed by Environmental Business Consultants (EBC) for the planned Remedial Action at the Site to protect on-site personnel, visitors, and the public from physical harm and exposure to hazardous materials or wastes during remedial activities. In accordance with the Occupational Safety and Health Administration (OSHA) 29 CFR Part 1910.120 Hazardous Waste Operations and Emergency Response Final rule, this CHASP, including the attachments, addresses safety and health hazards related to excavation, loading and other soil disturbance activities and is based on the best information available. The CHASP may be revised by EBC at the request of the owner and/or a regulatory agency upon receipt of new information regarding site conditions. Changes will be documented by written amendments signed by EBC's project manager, site safety officer and/or the EBC health and safety consultant.

Work performed under the remedial action will not involve confined space entry since the excavations will be large and sloped back in accordance with NYCDOB shoring requirements and will not have a limited or restricted means for entry or exit.

1.1 Training Requirements

Personnel entering the exclusion zone or decontamination zone are required to be certified in health and safety practices for hazardous waste site operations as specified in the Federal OSHA Regulations CFR 1910.120e (revised 3/6/90).

Paragraph (e - 3) of the above referenced regulations requires that all on-site management personnel directly responsible for or who supervise employees engaged in hazardous waste operations, must initially receive 8 hours of supervisor training related to managing hazardous waste work.

Paragraph (e - 8) of the above referenced regulations requires that workers and supervisors receive 8 hours of refresher training annually on the items specified in Paragraph (e-1) and/or (e-3).

Additionally, all on-site personnel must receive adequate site-specific training in the form of an on-site Health and Safety briefing prior to participating in field work with emphasis on the following:

- Protection of the adjacent community from hazardous vapors and / or dust which may be released during intrusive activities.
- Identification of chemicals known or suspected to be present on-site and the health effects and hazards of those substances.
- The need for vigilance in personnel protection, and the importance of attention to proper use, fit and care of personnel protective equipment.
- Decontamination procedures.
- Site control including work zones, access and security.
- Hazards and protection against heat or cold.
- The proper observance of daily health and safety practices, such as entry and exit of work zones and site. Proper hygiene during lunch, break, etc.

- Emergency procedures to be followed in case of fire, explosion and sudden release of hazardous gases.

Health and Safety meetings will be conducted on a daily basis and will cover protective clothing and other equipment to be used that day, potential and chemical and physical hazards, emergency procedures, and conditions and activities from the previous day.

1.2 Medical Monitoring Requirements

Field personnel and visitors entering the exclusion zone or decontamination zone must have completed appropriate medical monitoring required under OSHA 29 CFR 1910.120(f) if respirators or other breathing related PPE is needed. Medical monitoring enables a physician to monitor each employee's health, physical condition, and his fitness to wear respiratory protective equipment and carry out on-site tasks.

1.3 Site Safety Plan Acceptance, Acknowledgment and Amendments

The project superintendent and the site safety officer are responsible for informing personnel (EBC employees and/or owner or owners representatives) entering the work area of the contents of this plan and ensuring that each person signs the safety plan acknowledging the on-site hazards and procedures required to minimize exposure to adverse effects of these hazards. A copy of the Acknowledgement Form is included in **Appendix A**.

Site conditions may warrant an amendment to the CHASP. Amendments to the CHASP are acknowledged by completing forms included in **Appendix B**.

1.4 Key Personnel - Roles and Responsibilities

Personnel responsible for implementing this Health and Safety Plan are:

Name	Title	Address	Contact Numbers
Keith Butler	Project Manager	1808 Middle Country Rd Ridge, NY 11961	(631) 504-6000
Ms. Chawinie Miller	Health & Safety Manager	1808 Middle Country Rd Ridge, NY 11961	(631) 504-6000
Mr. Thomas Gallo	Site Safety Officer	1808 Middle Country Rd Ridge, NY 11961	(631) 504-6000

The project manager is responsible for overall project administration and, with guidance from the site safety officer, for supervising the implementation of this CHASP. The site safety officer will conduct daily (tail gate or tool box) safety meetings at the project site and oversee daily safety issues. Each subcontractor and supplier (defined as an OSHA employer) is also responsible for the health and safety of its employees. If there is any dispute about health and safety or project activities, on-site personnel will attempt to resolve the issue. If the issue cannot be resolved at the site, then the project manager will be consulted.

The site safety officer is also responsible for coordinating health and safety activities related to hazardous material exposure on-site. The site safety officer is responsible for the following:

1. Educating personnel about information in this CHASP and other safety requirements to be observed during site operations, including, but not limited to, decontamination procedures, designation of work zones and levels of protection, air monitoring, fit testing, and emergency procedures dealing with fire and first aid.
2. Coordinating site safety decisions with the project manager.
3. Designating exclusion, decontamination and support zones on a daily basis.
4. Monitoring the condition and status of known on-site hazards and maintaining and implementing the air quality monitoring program specified in this CHASP.
5. Maintaining the work zone entry/exit log and site entry/exit log.
6. Maintaining records of safety problems, corrective measures and documentation of chemical exposures or physical injuries (the site safety officer will document these conditions in a bound notebook and maintain a copy of the notebook on-site).

The person who observes safety concerns and potential hazards that have not been addressed in the daily safety meetings should immediately report their observations/concerns to the site safety officer or appropriate key personnel.

2.0 SITE BACKGROUND AND SCOPE OF WORK

The Site is located in the City of Long Beach in Nassau County and is comprised of four rectangular shaped tax parcels identified as Section 59, Block 119, Lots 32, 33, 34 and 35. The Site is located in a commercial strip along the E. Park Avenue retail corridor. The Site has 80 feet of street frontage along E. Park Avenue and 100 feet of frontage along Long Beach Boulevard for a total area of 8,000 sf (0.18 acres).

2.1 Summary of Remedial Investigation

A Remedial Investigation was completed at the Site by AEI consultants from December 2016 through January 2017 and documented in a Remedial Investigation Report dated August 22, 2017. The goals of the Remedial Investigation were to define the nature and extent of contamination in soil, groundwater and any other impacted media; to identify the source(s) of the contamination; to assess the impact of the contamination on public health and/or the environment; and to provide information to support the development of a Remedial Action Work Plan to address the contamination.

Activities completed under the RI:

- Sampling for non-petroleum contaminants such as pesticides, PCBs and metals in soil and groundwater including the analysis of soil and groundwater samples;
- Soil sampling and analysis in soil samples from 9 soil boring locations;
- The installation of 5 groundwater monitoring wells;
- The collection and analysis of groundwater samples for petroleum compounds; and,
- The collection of analysis of soil gas samples for VOCs from 2 soil gas sampling locations.

The sampling performed during the RI identified residual chlorinated VOC contamination “Hotspots” present at two locations including shallow soil (3 ft) in the southeast corner of the Site within the former storage area, and in the northwest area of the Site to a depth of 8.5 feet below grade.

Hotspot 1 in the northwest area of the Site had a tetrachloroethylene (PCE) concentration of 3,700 ug/kg. PCE contamination at Hotspot 2 in the southeast area of the Site ranged from 48,000 to 1,3000,000 ug/kg. PCE in an off-site drywell located in the municipal parking lot behind the building was reported at a concentration of 7,400,000 ug/kg. No other chlorinated or petroleum VOCs were reported in soil at the Site.

Petroleum related VOCs and chlorinated VOCs were reported in the northwest corner of the Site above NYSDEC Ambient Water Quality Standards (AWQS) at a single location (MW10). Total petroleum VOCs in groundwater at this location was reported as 796 µg/L. Total CVOCs were reported at 156 µg/L. DP1 located south of MW10 also contained a mixed plume of petroleum VOCs and chlorinated VOCs. Petroleum VOCs at this location totaled 1,095 µg/L. Chlorinated VOCs totaled 8,230. The highest concentration of chlorinated VOCs were reported in the southeast former storage area (TWP1) at a 296,630 µg/L. Chlorinated VOCs south of this area at TWP9 were reported at 13,700 µg/L. There were no petroleum VOCs reported in this area of the Site.

Off-site chlorinated VOCs were reported adjacent to a former drywell at a concentration of 35,500 µg/L. The drywell has since been remediated.

2.2 Description of Remedial Action

Site activities included within the Remedial Action that are included within the scope of this CHASP include the following:

1. Excavation of soil/fill exceeding Track 1 unrestricted use SCOs as listed in **Table 1** to a minimum depth of 3 feet across the Site with additional excavation to 4 feet and 9 feet in two CVOC residual soil hotspot areas;
2. ISCO treatment of groundwater in the three groundwater hotspot areas;
3. Screening for indications of contamination (by visual means, odor, and monitoring with PID) of all excavated soil during any intrusive Site work;
4. Shoring and SOE work as required to facilitate excavation;
5. Collection and analysis of end-point samples to evaluate the performance of the remedy with respect to attainment of Track 1;
6. Appropriate off-Site disposal of all material removed from the Site in accordance with all Federal, State and local rules and regulations for handling, transport, and disposal;
7. Import of materials to be used for backfill and cover in compliance with: (1) chemical limits and other specifications included in **Table 1**, (2) all Federal, State and local rules and regulations for handling and transport of material;
8. If Track 1 is not achieved, an Environmental Easement will be filed to restrict the land use to commercial.

3.0 HAZARD ASSESSMENT

This section identifies the hazards associated with the proposed scope of work, general physical hazards that can be expected at most sites; and presents a summary of documented or potential chemical hazards at the site. Every effort must be made to reduce or eliminate these hazards. Those that cannot be eliminated must be guarded against using engineering controls and/or personal protective equipment.

3.1 Physical Hazards

3.1.1 Tripping Hazards

An area of risk associated with on-site activities are presented by uneven ground, concrete, curbstones or equipment which may be present at the site thereby creating a potential tripping hazard. During intrusive work, care should be taken to mark or remove any obstacles within the exclusion zone.

3.1.2 Climbing Hazards

During site activities, workers may have to work on excavating equipment by climbing. The excavating contractor will conform with any applicable NIOSH and OSHA requirements or climbing activities.

3.1.3 Cuts and Lacerations

Field activities that involve excavating activities usually involve contact with various types of machinery. A first aid kit approved by the American Red Cross will be available during all intrusive activities.

3.1.4 Lifting Hazards

Improper lifting by workers is one of the leading causes of industrial injuries. Field workers in the excavation program may be required to lift heavy objects. Therefore, all members of the field crew should be trained in the proper methods of lifting heavy objects. All workers should be cautioned against lifting objects too heavy for one person.

3.1.5 Utility Hazards

Before conducting any excavation, the excavation contractor will be responsible for locating and verifying all existing utilities at each excavation.

3.1.6 Traffic Hazards

All traffic, vehicular and pedestrian, shall be maintained and protected at all times consistent with local, state and federal agency regulations regarding such traffic and in accordance with NYCDOT guidelines. The excavation contractor shall carry on his operations without undue interference or delays to traffic. The excavation contractor shall furnish all labor, materials, guards, barricades, signs, lights, and anything else necessary to maintain traffic and to protect his work and the public, during operations.

3.2 Work in Extreme Temperatures

Work under extremely hot or cold weather conditions requires special protocols to minimize the chance that employees will be affected by heat or cold stress.

3.2.1 Heat Stress

The combination of high ambient temperature, high humidity, physical exertion, and personal protective apparel, which limits the dissipation of body heat and moisture, can cause heat stress.

The following prevention, recognition and treatment strategies will be implemented to protect personnel from heat stress. Personnel will be trained to recognize the symptoms of heat stress and to apply the appropriate treatment.

1. Prevention
    a. Provide plenty of fluids. Available in the support zone will be a 50% solution of fruit punch and water or plain water.
    b. Work in Pairs. Individuals should avoid undertaking any activity alone.
    c. Provide cooling devices. A spray hose and a source of water will be provided to reduce body temperature, cool protective clothing and/or act as a quick-drench shower in case of an exposure incident.
    d. Adjustment of the work schedule. As is practical, the most labor-intensive tasks should be carried out during the coolest part of the day.

2. Recognition and Treatment
    a Heat Rash (or prickly heat):

Cause:	Continuous exposure to hot and humid air, aggravated by chafing clothing.
Symptoms:	Eruption of red pimples around sweat ducts accompanied by intense itching and tingling.
Treatment:	Remove source or irritation and cool skin with water or wet cloths.

    b. Heat Cramps (or heat prostration)

Cause:	Profuse perspiration accompanied by inadequate replenishment of body water and electrolytes.
Symptoms:	Muscular weakness, staggering gait, nausea, dizziness, shallow breathing, pale and clammy skin, approximately normal body temperature.
Treatment:	Perform the following while making arrangement for transport to a medical facility. Remove the worker to a contamination reduction zone. Remove protective clothing. Lie worker down on back in a cool place and raise feet 6 to 12 inches. Keep warm, but loosen all clothing. If conscious, provide sips of salt-water solution, using one teaspoon of salt in 12 ounces of water. Transport to a medical facility.

    c. Heat Stroke

Cause:	Same as heat exhaustion. This is also an extremely serious condition.
Symptoms:	Dry hot skin, dry mouth, dizziness, nausea, headache, rapid pulse.
Treatment:	Cool worker immediately by immersing or spraying with cool water or sponge bare skin after removing protective clothing. Transport to hospital.

3.2.2 Cold Exposure

Exposure to cold weather, wet conditions and extreme wind-chill factors may result in excessive loss of body heat (hypothermia) and /or frostbite. To guard against cold exposure and to prevent cold injuries, appropriate warm clothing should be worn, warm shelter must be readily available, rest periods should be adjusted as needed, and the physical conditions of on-site field personnel should be closely monitored. Personnel and supervisors working on-site will be made aware of the signs and symptoms of frost bite and hypothermia such as:

- Shivering;
- reduced blood pressure;
- reduced coordination;
- drowsiness;
- impaired judgment;
- fatigue;
- pupils dilated but reactive to light; and,
- numbing of the toes and fingers.

3.3 Chemical Hazards

"Urban fill" materials, present throughout the New York City area typically contain elevated levels of semi-volatile organic compounds and metals. These "contaminants" are not related to a chemical release occurring on the site, but are inherent in the reworked fill material in the area which contains ash and bits of tar and asphalt. Considering the previous sampling results and the past and present use of the site, the following compounds are considered for the site as potential contaminants: volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyl's (PCBs), and heavy metals such as arsenic, chromium, lead and mercury.

Based on the findings of the Remedial Investigation and the inherent properties of urban fill, the following compounds are considered for the site as potential contaminants: volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, and heavy metals.

Volatile organic compounds reported to be present in soil, soil gas and/or groundwater include the following:

1,2,4-trimethylbenzene	1,3,5-trimethylbenzene	1,2,4,5-trimethylbenzene	Acetone
Benzene	Ethylbenzene	Toluene	m&p-Xylenes
Naphthalene	n-Propylbenzene	o-Xylene	sec-Butylbenzene
Tetrachloroethene	Trichloroethene	Cis/trans-1,2-Dichloroethene	Vinyl Chloride

The primary routes of exposure to these contaminants are inhalation, ingestion and absorption. **Appendix C** includes information sheets for suspected chemicals that may be encountered at the site.

3.3.1 Respirable Dust

Dust may be generated from vehicular traffic and/or excavation activities. If visible observation detects elevated levels of dust, a program of wetting will be employed by the site safety officer. If elevated dust levels persist, the site safety office will employ dust monitoring using a particulate monitor (Miniram or equivalent). If monitoring detects concentrations greater than 150 µg/m3 over daily background, the site safety officer will take corrective actions as defined herein, including the use of water for dust suppression and if this is not effective, requiring workers to wear APRs with efficiency particulate air (HEPA) cartridges.

Absorption pathways for dust and direct contact with soils or groundwater will be mitigated with the implementation of latex gloves, hand washing and decontamination exercises when necessary.

3.3.2 Dust Control and Monitoring During Earthwork

Dust generated during excavation activities or other earthwork may contain contaminants identified in soils at the site. Dust will be controlled by wetting the working surface with water. Calcium chloride may be used if the problem cannot be controlled with water. Air monitoring and dust control techniques are specified in a site specific Dust Control Plan (if applicable). Site workers will not be required to wear APR's unless dust concentrations are consistently over 150 $\mu g/m^3$ over site-specific background in the breathing zone as measured by a dust monitor unless the site safety officer directs workers to wear APRs. The site safety officer will use visible dust as an indicator to implement the dust control plan.

3.3.3 Organic Vapors

Elevated levels of pet VOCs were detected in soil and groundwater samples collected during previous investigations at the site. Therefore, excavation activities may cause the release of organic vapors to the atmosphere. The site safety officer will periodically monitor organic vapors with a Photoionization Detector (PID) during excavation activities to determine whether organic vapor concentrations exceed action levels shown in Section 5 and/or the Community Air Monitoring Plan.

4.0 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) shall be selected in accordance with the site air monitoring program, OSHA 29 CFR 1910.120(c), (g), and 1910.132. Protective equipment shall be NIOSH approved and respiratory protection shall conform to OSHA 29 CFR Part 1910.133 and 1910.134 specifications; head protection shall conform to 1910.135; eye and face protection shall conform to 1910.133; and foot protection shall conform to 1910.136. The only true difference among the levels of protection from D thru B is the addition of the type of respiratory protection. **It is anticipated that work will be performed in Level D PPE.**

4.1 Level D

Level D PPE shall be donned when the atmosphere contains no known hazards and work functions preclude splashes, immersion, or the potential for inhalation of, or contact with, hazardous concentrations of harmful chemicals. Level D PPE consists of:

- standard work uniform, coveralls, or tyvek, as needed;
- steel toe and steel shank work boots;
- hard hat;
- gloves, as needed;
- safety glasses;
- hearing protection;
- equipment replacements are available as needed.

4.2 Level C

Level C PPE shall be donned when the concentrations of measured total organic vapors in the breathing zone exceed background concentrations (using a portable OVA, or equivalent), but are less than 5 ppm. The specifications on the APR filters used must be appropriate for contaminants identified or expected to be encountered. Level C PPE shall be donned when the identified contaminants have adequate warning properties and criteria for using APR have been met. Level C PPE consists of:

- chemical resistant or coated tyvek coveralls;
- steel-toe and steel-shank workboots;
- chemical resistant overboots or disposable boot covers;
- disposable inner gloves (surgical gloves);
- disposable outer gloves;
- full face APR fitted with organic vapor/dust and mist filters or filters appropriate for the identified or expected contaminants;
- hard hat;
- splash shield, as needed; and,
- ankles/wrists taped with duct tape.

The site safety officer will verify if Level C is appropriate by checking organic vapor concentrations using compound and/or class-specific detector tubes.

- chemical resistant coveralls;
- steel-toe and steel-shank workboots;
- chemical resistant overboots or disposable boot covers;
- disposable inner gloves;
- disposable outer gloves;
- hard hat; and,
- ankles/wrists taped.

The exact PPE ensemble is decided on a site-by-site basis by the Site Safety Officer with the intent to provide the most protective and efficient worker PPE.

4.3 Activity-Specific Levels of Personal Protection

The required level of PPE is activity-specific and is based on air monitoring results (Section 4.0) and properties of identified or expected contaminants. **It is expected that site work will be performed in Level D.** If air monitoring results indicate the necessity to upgrade the level of protection engineering controls (i.e. Facing equipment away from the wind and placing site personnel upwind of drilling locations, active venting, etc.) will be implemented before requiring the use of respiratory protection.

5.0 AIR MONITORING AND ACTION LEVELS

29 CFR 1910.120(h) specifies that monitoring shall be performed where there may be a question of employee exposure to hazardous concentrations of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment so that employees are not exposed to levels which exceed permissible exposure limits, or published exposure levels if there are no permissible exposure limits, for hazardous substances.

5.1 Air Monitoring Requirements

If excavation work is performed, air will be monitored for VOCs with a portable ION Science 3000EX photoionization detector, or the equivalent. If necessary, Lower Explosive Limit (LEL) and oxygen will be monitored with a Combustible Gas Indicator (CGI). If appropriate, fugitive dust will be monitored using a MiniRam Model PDM-3 aerosol monitor. Air will be monitored when any of the following conditions apply:

- initial site entry;
- during any work where a potential IDLH condition or flammable atmosphere could develop;
- excavation work begins on another portion of the site;
- contaminants, other than those previously identified, have been discovered;
- each time a different task or activity is initiated;
- during trenching and/or excavation work.

The designated site safety officer will record air monitoring data and ensure that air monitoring instruments are calibrated and maintained in accordance with manufacturer's specifications. Instruments will be zeroed daily and checked for accuracy. Monitoring results will be recorded in a field notebook and will be transferred to instrument reading logs.

5.2 Work Stoppage Responses

The following responses will be initiated whenever one or more of the action levels necessitating a work stoppage are exceeded:

1 The SSO will be consulted immediately
2 All personnel (except as necessary for continued monitoring and contaminant migration, if applicable) will be cleared from the work area (eg from the exclusion zone).
3 Monitoring will be continued until intrusive work resumes.

5.3 Action Levels During Excavation Activities

Instrument readings will be taken in the breathing zone above the excavation pit unless otherwise noted. Each action level is independent of all other action levels in determining responses.

Organic Vapors (PID)	LEL %	Responses
0-1 ppm above background	0%	• Continue excavating • Level D protection • Continue monitoring every 10 minutes
1-5 ppm Above Background, Sustained Reading	1-10%	• Continue excavating • Go to Level C protection or employ engineering controls • Continue monitoring every 10 minutes
5-25 ppm Above Background, Sustained Reading	10-20%	• Discontinue excavating, unless PID is only action level exceeded. • Level C protection or employ engineering controls • Continue monitoring for organic vapors 200 ft downwind • Continuous monitoring for LEL at excavation pit
>25 ppm Above Background, Sustained Reading	>20%	• Discontinue excavating • Withdraw from area, shut off all engine ignition sources. • Allow pit to vent • Continuous monitoring for organic vapors 200 ft downwind.

Notes: Air monitoring will occur in the breathing zone 30 inches above the excavation pit. Readings may also be taken in the excavation pit but will not be used for action levels.

If action levels for any one of the monitoring parameters are exceeded, the appropriate responses listed in the right hand column should be taken. If instrument readings do not return to acceptable levels after the excavation pit has been vented for a period of greater than one-half hour, a decision will then be made whether or not to seal the pit with suppressant foam.

If, during excavation activities, downwind monitoring PID readings are greater than 5 ppm above background for more than one-half hour, excavation will stop until sustained levels are less then 5 ppm (see Community Air Monitoring Plan).

6.0 SITE CONTROL

6.1 Work Zones

The primary purpose of site controls is to establish the perimeter of a hazardous area, to reduce the migration of contaminants into clean areas, and to prevent access or exposure to hazardous materials by unauthorized persons. When operations are to take place involving hazardous materials, the site safety officer will establish an exclusion zone, a decontamination zone, and a support zone. These zones "float" (move around the site) depending on the tasks being performed on any given day. The site safety officer will outline these locations before work begins and when zones change. The site safety officer records this information in the site log book. **It is expected that the entire fenced in area of the Site will be the exclusion zone, with the decontamination zone the Site entrance.** The support zone will be the office trailer.

Tasks requiring OSHA 40-hour Hazardous Waste Operations and Emergency Response Operations training are carried out in the exclusion zone. The exclusion zone is defined by the site safety officer but will typically be a 50-foot area around work activities. Gross decontamination (as determined by the site Health and Safety Officer) is conducted in the exclusion zone; all other decontamination is performed in the decontamination zone or trailer.

Protective equipment is removed in the decontamination zone. Disposable protective equipment is stored in receptacles staged in the decontamination zone, and non-disposable equipment is decontaminated. All personnel and equipment exit the exclusion zone through the decontamination zone. If a decontamination trailer is provided the first aid equipment, an eye wash unit, and drinking water are kept in the decontamination trailer.

The support zone is used for vehicle parking, daily safety meetings, and supply storage. Eating, drinking, and smoking are permitted only in the support zone. When a decontamination trailer is not provided, the eye wash unit, first aid equipment, and drinking water are kept at a central location designated by the site safety officer.

6.2 General Site Work

An excavation contractor with appropriate experience, personnel and training (40 hr OSHA Hazardous Waste Operations and Emergency Response Operations - HAZWOPER) is required to perform the removal of the lead hazardous soil. After this material is removed the contractor will remove historic fill and uncontaminated soil. The excavation contractor’s on-site personnel engaged in historic fill and native soil removal will have a minimum of 24 hour HAZWOPER training.

7.0 CONTINGENCY PLAN/EMERGENCY RESPONSE PLAN

Site personnel must be prepared in the event of an emergency. Emergencies can take many forms: illnesses, injuries, chemical exposure, fires, explosions, spills, leaks, releases of harmful contaminants, or sudden changes in the weather.

Emergency telephone numbers and a map to the hospital will be posted in the command post. Site personnel should be familiar with the emergency procedures, and the locations of site safety, first aid, and communication equipment.

7.1 Emergency Equipment On-site

Private telephones:	Site personnel.
Two-way radios:	Site personnel where necessary.
Emergency Alarms:	On-site vehicle horns*.
First aid kits:	On-site, in vehicles or office.
Fire extinguisher:	On-site, in office or on equipment.

* Horns: Air horns will be supplied to personnel at the discretion of the project superintendent or site safety officer.

7.2 Emergency Telephone Numbers

General Emergencies	911
Police	911
Fire Department	911
Mount Sinai South Nassau Emergency Room	(516) 870-1010
NYSDEC Spills Division	1-800-457-7362
NYSDEC Division of Env. Remediation	(631) 444-0244
NC Department of Health	(516) 227-9697
National Response Center	1-800-424-8802
Poison Control	1-212-340-4494
Site Safety Officer	1-631-504-6000
Alternate Site Safety Officer	1-631-504-6000

7.3 Personnel Responsibilities During an Emergency

The project manager is primarily responsible for responding to and correcting any emergency situations. However, in the absence of the project manager, the site safety officer shall act as the project manager’s on-site designee and perform the following tasks:

- Take appropriate measures to protect personnel including: withdrawal from the exclusion zone, evacuate and secure the site, or upgrade/downgrade the level of protective clothing and respiratory protection;

- Ensure that appropriate federal, state, and local agencies are informed and emergency response plans are coordinated. In the event of fire or explosion, the local fire department should be summoned immediately. If toxic materials are released to the air, the local authorities should be informed in order to assess the need for evacuation;

- Ensure appropriate decontamination, treatment, or testing for exposed or injured personnel;

- Determine the cause of incidents and make recommendations to prevent recurrence; and,

- Ensure that all required reports have been prepared.

The following key personnel are planned for this project:

• Project Manager	Keith Butler (631) 504-6000
• Construction Superintendent	Alex Liechtung (516)779-5455
• Site Safety Officer	Tom Gallo (631) 504-6000

7.4 Medical Emergencies

A person who becomes ill or injured in the exclusion zone will be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination will be completed and first aid administered prior to transport. First aid will be administered while waiting for an ambulance or paramedics. A Field Accident Report (**Appendix D**) must be filled out for any injury.

A person transporting an injured/exposed person to a clinic or hospital for treatment will take the directions to the hospital (**Appendix D**).and information on the chemical(s) to which they may have been exposed (**Appendix C**).

7.5 Fire or Explosion

In the event of a fire or explosion, the local fire department will be summoned immediately. The site safety officer or his designated alternate will advise the fire commander of the location, nature and identification of the hazardous materials on-site. If it is safe to do so, site personnel may:

- use fire fighting equipment available on site; or,
- remove or isolate flammable or other hazardous materials that may contribute to the fire.

7.6 Evacuation Routes

Evacuation routes established by work area locations for each site will be reviewed prior to commencing site operations. As the work areas change, the evacuation routes will be altered accordingly, and the new route will be reviewed.

Under extreme emergency conditions, evacuation is to be immediate without regard for equipment. The evacuation signal will be a continuous blast of a vehicle horn, if possible, and/or by verbal/radio communication. When evacuating the site, personnel will follow these instructions:

- Keep upwind of smoke, vapors, or spill location.

- Exit through the decontamination corridor if possible.

- If evacuation through the decontamination corridor is not possible, personnel should remove contaminated clothing once they are in a safe location and leave it near the exclusion zone or in a safe place.

- The site safety officer will conduct a head count to ensure that all personnel have been evacuated safely. The head count will be correlated to the site and/or exclusion zone entry/exit log.

- If emergency site evacuation is necessary, all personnel are to escape the emergency situation and decontaminate to the maximum extent practical.

7.7 Spill Control Procedures

Spills associated with site activities may be attributed to project equipment and include gasoline, diesel and hydraulic oil. In the event of a leak or a release, site personnel will inform their supervisor immediately, locate the source of spillage and stop the flow if it can be done safely. A spill containment kit including absorbent pads, booms and/or granulated speedy dry absorbent material will be available to site personnel to facilitate the immediate recovery of the spilled material. Daily inspections of site equipment components including hydraulic lines, fuel tanks, etc. will be performed by their respective operators as a preventative measure for equipment leaks and to ensure equipment soundness. In the event of a spill, site personnel will immediately notify the NYSDEC (1-800-457-7362), and a spill number will be generated.

7.8 Vapor Release Plan

If work zone organic vapor (excluding methane) exceeds 5 ppm, then a downwind reading will be made either 200 feet from the work zone or at the property line, whichever is closer. If readings at this location exceed 5 ppm over background, the work will be stopped.

If 5 ppm of VOCs are recorded over background on a PID at the property line, then an off-site reading will be taken within 20 feet of the nearest residential or commercial property, whichever is closer. If efforts to mitigate the emission source are unsuccessful for 30 minutes, then the designated site safety officer will:

- contact the local police;
- continue to monitor air every 30 minutes, 20 feet from the closest off-site property. If two successive readings are below 5 ppm (non-methane), off-site air monitoring will be halted.
- All property line and off site air monitoring locations and results associated with vapor releases will be recorded in the site safety log book.

APPENDIX A

SITE SAFETY ACKNOWLEDGEMENT FORM

DAILY BREIFING SIGN-IN SHEET

Date:______________________________ Person Conducting Briefing:_______________________

Project Name and Location:____

1. AWARENESS (topics discussed, special safety concerns, recent incidents, etc…):

____

____

____

____

2. OTHER ISSUES (HASP changes, attendee comments, etc…):

____

____

____

3. ATTENDEES (Print Name):

1.	11.
2.	12.
3.	13.
4.	14.
5.	15.
6.	16.
7.	17.
8.	18.
9.	19.
10.	20.

APPENDIX B

SITE SAFETY PLAN AMENDMENTS

SITE SAFETY PLAN AMENDMENT FORM

Site Safety Plan Amendment #:____

Site Name: ____

Reason for Amendment:____

____

____

____

Alternative Procedures:____

____

____

____

Required Changes in PPE:____

____

____

____

____________________________	________________
Project Superintendent (signature)	**Date**
____________________________	________________
Health and Safety Consultant (signature)	**Date**
____________________________	________________
Site Safety Officer (signature)	**Date**

APPENDIX C

CHEMICAL HAZARDS

CHEMICAL HAZARDS

The attached International Chemical Safety Cards are provided for contaminants of concern that have been identified in soils and/or groundwater at the site.

International Chemical Safety Cards

1,2,4-TRIMETHYLBENZENE

ICSC: 1433

Pseudocumene
C_9H_{12}
Molecular mass: 120,2

ICSC # 1433
CAS # 95-63-6
RTECS # DC3325000
UN # 1993
EC # 601-043-00-3
March 06, 2002 Peer reviewed

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable.	NO open flames, NO sparks, and NO smoking.	Alcohol-resistant foam, dry powder, carbon dioxide.
EXPLOSION	Above 44°C explosive vapour/air mixtures may be formed.	Above 44°C use a closed system, ventilation, and explosion-proof electrical equipment. Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT GENERATION OF MISTS!	
•INHALATION	Confusion. Cough. Dizziness. Drowsiness. Headache. Sore throat. Vomiting.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Redness. Dry skin.	Protective gloves.	Rinse skin with plenty of water or shower.
•EYES	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	(See Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. Do NOT let this chemical enter the environment. Personal protection: filter respirator for organic gases and vapours.	Fireproof. Separated from strong oxidants. Well closed. Keep in a well-ventilated room.	Xn symbol N symbol R: 10-20-36/37/38-51/53 S: 2-26-61 UN Hazard Class: 3 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 1433

International Chemical Safety Cards

1,2,4-TRIMETHYLBENZENE

ICSC: 1433

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:

CHEMICAL DANGERS:
The substance decomposes on burning producing toxic and irritating fumes Reacts violently with strong oxidants causing fire and explosion hazard.

OCCUPATIONAL EXPOSURE LIMITS:
TLV: (as mixed isomers) 25 ppm as TWA (ACGIH 2004).
MAK: (as mixed isomers) 20 ppm 100 mg/m^3
Peak limitation category: II(2) Pregnancy risk group: C (DFG 2004).
OSHA PEL†: none
NIOSH REL: TWA 25 ppm (125 mg/m^3)
NIOSH IDLH: N.D. See: IDLH INDEX

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation.

INHALATION RISK:
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C; on spraying or dispersing, however, much faster.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is irritating to the eyes the skin and the respiratory tract If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis. The substance may cause effects on the central nervous system

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The liquid defats the skin. Lungs may be affected by repeated or prolonged exposure , resulting in chronic bronchitis The substance may have effects on the central nervous system blood See Notes.

PHYSICAL PROPERTIES

Boiling point: 169°C
Melting point: -44°C
Relative density (water = 1): 0.88
Solubility in water:
very poor
Relative vapour density (air = 1): 4.1
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.01
Flash point: 44°C c.c.
Auto-ignition temperature: 500°C
Explosive limits, vol% in air: 0.9-6.4
Octanol/water partition coefficient as log Pow: 3.8

ENVIRONMENTAL DATA

The substance is toxic to aquatic organisms. Bioaccumulation of this chemical may occur in fish.

NOTES

Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is suggested. See also ICSC 1155 1,3,5-Trimethylbenzene (Mesitylene), ICSC 1362 1,2,3-Trimethylbenzene (Hemimellitene), ICSC 1389 Trimethyl benzene (mixed isomers). 1,3,5-Trimethylbenzene (Mesitylene) is classified as a marine pollutant.

Transport Emergency Card: TEC (R)-30GF1-III
NFPA Code: H0; F2; R0;

ADDITIONAL INFORMATION

ICSC: 1433 **1,2,4-TRIMETHYLBENZENE**

IMPORTANT LEGAL NOTICE:

Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, 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. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

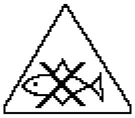
International Chemical Safety Cards

1,3,5-TRIMETHYLBENZENE

ICSC: 1155

Mesitylene
C_9H_{12}
Molecular mass: 120.2

ICSC # 1155
CAS # 108-67-8
RTECS # OX6825000
UN # 2325
EC # 601-025-00-5
March 06, 2002 Peer reviewed



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable.	NO open flames, NO sparks, and NO smoking.	Alcohol-resistant foam, dry powder, carbon dioxide.
EXPLOSION	Above 50°C explosive vapour/air mixtures may be formed.	Above 50°C use a closed system, ventilation, and explosion-proof electrical equipment. Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT GENERATION OF MISTS!	
•INHALATION	Confusion. Cough. Dizziness. Drowsiness. Headache. Sore throat. Vomiting.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Redness. Dry skin.	Protective gloves.	Remove contaminated clothes. Rinse skin with plenty of water or shower.
•EYES	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	(See Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. Do NOT let this chemical enter the environment. (Extra personal protection: filter respirator for organic gases and vapours.)	Fireproof. Separated from strong oxidants. Well closed. Keep in a well-ventilated room.	Marine pollutant. Xi symbol N symbol R: 10-37-51/53 S: 2-61 UN Hazard Class: 3 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 1155

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

1,3,5-TRIMETHYLBENZENE

ICSC: 1155

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:

CHEMICAL DANGERS:
The substance decomposes on burning producing toxic and irritating fumes. Reacts violently with strong oxidants causing fire and explosion hazard.

OCCUPATIONAL EXPOSURE LIMITS:
TLV (as mixed isomers): 25 ppm; (ACGIH 2001).
MAK (all isomers): 20 ppm; 100 mg/m^3; class II 1 © (2001)
OSHA PEL†: none
NIOSH REL: TWA 25 ppm (125 mg/m^3)
NIOSH IDLH: N.D. See: IDLH INDEX

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation.

INHALATION RISK:
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C; on spraying or dispersing, however, much faster.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is irritating to the eyes the skin and the respiratory tract If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis. The substance may cause effects on the central nervous system.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The liquid defats the skin. Lungs may be affected by repeated or prolonged exposure, resulting in chronic bronchitis. The substance may have effects on the central nervous system blood See Notes.

PHYSICAL PROPERTIES

Boiling point: 165°C
Melting point: -45°C
Relative density (water = 1): 0.86
Solubility in water:
very poor
Vapour pressure, kPa at 20°C: 0.25
Relative vapour density (air = 1): 4.1
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.01
Flash point: 50°C (c.c.)
Auto-ignition temperature: 550°C
Octanol/water partition coefficient as log Pow: 3.42

ENVIRONMENTAL DATA

The substance is harmful to aquatic organisms. Bioaccumulation of this chemical may occur in fish.

NOTES

Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. See ICSC 1433 1,2,4-Trimethylbenzene (Pseudocumene), ICSC 1362 1,2,3-Trimethylbenzene (Hemimellitene), ICSC 1389 Trimethyl benzene (mixed isomers).

Transport Emergency Card: TEC (R)-30S2325
NFPA Code: H0; F2; R0

ADDITIONAL INFORMATION

ICSC: 1155 **1,3,5-TRIMETHYLBENZENE**

IMPORTANT LEGAL NOTICE:

Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, 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. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

BENZENE

ICSC: 0015

Cyclohexatriene
Benzol
C_6H_6
Molecular mass: 78.1

ICSC # 0015
CAS # 71-43-2
RTECS # CY1400000
UN # 1114
EC # 601-020-00-8
May 06, 2003 Peer reviewed

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Highly flammable.	NO open flames, NO sparks, and NO smoking.	Powder, AFFF, foam, carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive. Risk of fire and explosion: see Chemical Dangers.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT use compressed air for filling, discharging, or handling. Use non-sparking handtools. Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		AVOID ALL CONTACT!	
•INHALATION	Dizziness. Drowsiness. Headache. Nausea. Shortness of breath. Convulsions. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	MAY BE ABSORBED! Dry skin. Redness. Pain. (Further see Inhalation).	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
•EYES	Redness. Pain.	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	Abdominal pain. Sore throat. Vomiting. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Remove all ignition sources. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. Do NOT let this chemical enter the environment. Personal protection: complete protective clothing including self-contained breathing apparatus.	Fireproof. Separated from food and feedstuffs oxidants halogens	Do not transport with food and feedstuffs. Note: E F symbol T symbol R: 45-46-11-36/38-48/23/24/25-65 S: 53-45 UN Hazard Class: 3 UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0015

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

BENZENE

ICSC: 0015

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air and may travel along the ground; distant ignition possible. As a result of flow, agitation, etc., electrostatic charges can be generated.

CHEMICAL DANGERS:
Reacts violently with oxidants, nitric acid, sulfuric acid and halogens causing fire and explosion hazard. Attacks plastic and rubber.

OCCUPATIONAL EXPOSURE LIMITS:
TLV: 0.5 ppm as TWA 2.5 ppm as STEL (skin) A1 BEI (ACGIH 2004).
MAK: H
Carcinogen category: 1 Germ cell mutagen group: 3A (DFG 2004).
OSHA PEL: 1910.1028 TWA 1 ppm ST 5 ppm See Appendix F
NIOSH REL: Ca TWA 0.1 ppm ST 1 ppm See Appendix A
NIOSH IDLH: Ca 500 ppm See: 71432

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation through the skin and by ingestion

INHALATION RISK:
A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is irritating to the eyes the skin and the respiratory tract Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system , resulting in lowering of consciousness Exposure far above the occupational exposure limit value may result in unconsciousness death

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The liquid defats the skin. The substance may have effects on the bone marrow immune system , resulting in a decrease of blood cells. This substance is carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 80°C
Melting point: 6°C
Relative density (water = 1): 0.88
Solubility in water, g/100 ml at 25°C: 0.18
Vapour pressure, kPa at 20°C: 10
Relative vapour density (air = 1): 2.7
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.2
Flash point:
-11°C c.c.
Auto-ignition temperature: 498°C
Explosive limits, vol% in air: 1.2-8.0
Octanol/water partition coefficient as log Pow: 2.13

ENVIRONMENTAL DATA

The substance is very toxic to aquatic organisms.

NOTES

Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient.

Transport Emergency Card: TEC (R)-30S1114 / 30GF1-II
NFPA Code: H2; F3; R0

ADDITIONAL INFORMATION

ICSC: 0015 **BENZENE**

IMPORTANT LEGAL NOTICE:

Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, 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. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

ACETONE

ICSC: 0087

2-Propanone
Dimethyl ketone
Methyl ketone
C_3H_6O / CH_3COCH_3
Molecular mass: 58.1

ICSC # 0087
CAS # 67-64-1
RTECS # AL3150000
UN # 1090
EC # 606-001-00-8
April 22, 1994 Validated
Fi, review at IHE: 10/09/89

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Highly flammable.	NO open flames, NO sparks, and NO smoking.	Powder, alcohol-resistant foam, water in large amounts, carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT use compressed air for filling, discharging, or handling.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE			
•INHALATION	Sore throat. Cough. Confusion. Headache. Dizziness. Drowsiness. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Dry skin.	Protective gloves.	Remove contaminated clothes. Rinse skin with plenty of water or shower.
•EYES	Redness. Pain. Blurred vision. Possible corneal damage.	Safety spectacles or face shield . Contact lenses should not be worn.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Nausea. Vomiting. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Personal protection: self-contained breathing apparatus. Ventilation. Collect leaking liquid in sealable containers. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. Then wash away with plenty of water.	Fireproof. Separated from strong oxidants. Store in an area without drain or sewer access.	F symbol Xi symbol R: 11-36-66-67 S: 2-9-16-26 UN Hazard Class: 3 UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0087

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

ACETONE

ICSC: 0087

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air and may travel along the ground; distant ignition possible.

CHEMICAL DANGERS:
The substance can form explosive peroxides on contact with strong oxidants such as acetic acid, nitric acid, hydrogen peroxide. Reacts with chloroform and bromoform under basic conditions, causing fire and explosion hazard. Attacks plastic.

OCCUPATIONAL EXPOSURE LIMITS:
TLV: 500 ppm as TWA, 750 ppm as STEL; A4 (not classifiable as a human carcinogen); BEI issued; (ACGIH 2004).
MAK: 500 ppm 1200 mg/m^3
Peak limitation category: I(2); Pregnancy risk group: D; (DFG 2006).
OSHA PEL†: TWA 1000 ppm (2400 mg/m^3)
NIOSH REL: TWA 250 ppm (590 mg/m^3)
NIOSH IDLH: 2500 ppm 10%LEL See: 67641

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation and through the skin.

INHALATION RISK:
A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C; on spraying or dispersing, however, much faster.

EFFECTS OF SHORT-TERM EXPOSURE:
The vapour irritates the eyes and the respiratory tract. The substance may cause effects on the central nervous system , liver , kidneys and gastrointestinal tract .

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the blood and bone marrow .

PHYSICAL PROPERTIES

Boiling point: 56°C
Melting point: -95°C
Relative density (water = 1): 0.8
Solubility in water:
miscible
Vapour pressure, kPa at 20°C: 24

Relative vapour density (air = 1): 2.0
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.2
Flash point: -18°C c.c.
Auto-ignition temperature: 465°C
Explosive limits, vol% in air: 2.2-13
Octanol/water partition coefficient as log Pow: -0.24

ENVIRONMENTAL DATA

NOTES

Use of alcoholic beverages enhances the harmful effect.

Transport Emergency Card: TEC (R)-30S1090

NFPA Code: H 1; F 3; R 0;
Card has been partially updated in July 2007: see Occupational Exposure Limits.
Card has been partially updated in January 2008: see Storage.

ADDITIONAL INFORMATION

ICSC: 0087 **ACETONE**

Material Safety Data Sheet
cis-1,2-Dichloroethylene, 97%

ACC# 97773

Section 1 - Chemical Product and Company Identification

MSDS Name: cis-1,2-Dichloroethylene, 97%
Catalog Numbers: AC113380000, AC113380025, AC113380100
Synonyms: cis-Acetylene dichloride.
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
156-59-2	cis-1,2-Dichloroethylene	97	205-859-7

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: Clear liquid. Flash Point: 6 deg C.
Warning! **Flammable liquid and vapor.** Harmful if inhaled. Unstabilized substance may polymerize. Causes eye and skin irritation. May be harmful if swallowed. May cause respiratory tract irritation.
Target Organs: Central nervous system, respiratory system, eyes, skin.

Potential Health Effects
Eye: Causes moderate eye irritation.
Skin: Causes moderate skin irritation. May cause dermatitis.
Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea. May be harmful if swallowed. May cause central nervous system depression.
Inhalation: May cause respiratory tract irritation. May cause narcotic effects in high concentration. Eye irritation, vertigo, and nausea were reported in humans exposed at 2200 ppm.
Chronic: Not available. Some German investigators reported fatty degeneration of the liver upon repeated narcotic doses in rats and

Section 4 - First Aid Measures

Eyes: In case of contact, immediately flush eyes with plenty of water for a t least 15 minutes. Get medical aid.
Skin: In case of contact, flush skin with plenty of water. Remove contaminated clothing and shoes. Get medical aid if irritation develops and persists. Wash clothing before reuse.
Ingestion: If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical aid.
Inhalation: If inhaled, remove to fresh air. 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. Vapors may form an explosive mixture with air. Use water spray to keep fire-exposed containers cool. Flammable liquid and vapor. Fire or excessive heat may result in violent rupture of the container due to bulk polymerization. Vapors are heavier than air and may travel to a source of ignition and flash back. Vapors can spread along the ground and collect in low or confined areas. Hazardous polymerization may occur under fire conditions.
Extinguishing Media: Use water fog, dry chemical, carbon dioxide, or regular foam.
Flash Point: 6 deg C (42.80 deg F)
Autoignition Temperature: 440 deg C (824.00 deg F)
Explosion Limits, Lower:9.70 vol %
Upper: 12.80 vol %
NFPA Rating: (estimated) Health: 2; Flammability: 3; Instability: 2

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Remove all sources of ignition. Use a spark-proof tool. Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Ground and bond containers when transferring material. Use spark-proof tools and explosion proof equipment. Avoid contact with eyes, skin, and clothing. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Avoid ingestion and inhalation. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames. Use only with adequate ventilation. Pure vapor will be uninhibited and may polymerize in vents or other confined spaces.
Storage: Keep away from sources of ignition. Store in a tightly closed container. Flammables-area. Store protected from light and air.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Use process enclosure, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
cis-1,2-Dichloroethylene	200 ppm TWA	none listed	none listed

OSHA Vacated PELs: cis-1,2-Dichloroethylene: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear chemical splash goggles.
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: Liquid
Appearance: Clear
Odor: Pleasant odor
pH: Not available.
Vapor Pressure: 201 mm Hg @ 25 deg C
Vapor Density: 3.34 (air=1)
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 60 deg C @ 760 mm Hg
Freezing/Melting Point:-80 deg C
Decomposition Temperature: Not available.
Solubility: Insoluble.
Specific Gravity/Density:1.2800
Molecular Formula:$C_2H_2Cl_2$
Molecular Weight:96.94

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures. This material is a monomer and may polymerize under certain conditions if the stabilizer is lost.
Conditions to Avoid: Light, ignition sources, exposure to air, excess heat.
Incompatibilities with Other Materials: Strong oxidizing agents, strong bases, copper.
Hazardous Decomposition Products: Hydrogen chloride, phosgene, carbon monoxide, carbon dioxide.
Hazardous Polymerization: May occur.

Section 11 - Toxicological Information

RTECS#:
CAS# 156-59-2: KV9420000
LD50/LC50:
CAS# 156-59-2:
Inhalation, rat: LC50 = 13700 ppm;
.

Carcinogenicity:
CAS# 156-59-2: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

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:	DOT regulated - small quantity provisions apply (see 49CFR173.4)	1,2-DICHLOROETHYLENE
Hazard Class:		3
UN Number:		UN1150
Packing Group:		II

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 156-59-2 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
None of the chemicals in this material have an RQ.
SARA Section 302 Extremely Hazardous Substances
None of the chemicals in this product have a TPQ.
Section 313 No chemicals are reportable under Section 313.
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.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
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# 156-59-2 can be found on the following state right to know lists: 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 F
Risk Phrases:

R 11 Highly flammable.
R 20 Harmful by inhalation.
R 52/53 Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Safety Phrases:
S 16 Keep away from sources of ignition - No smoking.
S 29 Do not empty into drains.
S 7 Keep container tightly closed.
S 61 Avoid release to the environment. Refer to special instructions /safety data sheets.

WGK (Water Danger/Protection)
CAS# 156-59-2: No information available.

Canada - DSL/NDSL
CAS# 156-59-2 is listed on Canada's NDSL List.

Canada - WHMIS
WHMIS: Not available.

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

Section 16 - Additional Information

MSDS Creation Date: 2/09/1998
Revision #5 Date: 3/16/2007

International Chemical Safety Cards

ETHYLBENZENE

ICSC: 0268

Ethylbenzol
Phenylethane
EB
C_8H_{10} / $C_6H_5C_2H_5$
Molecular mass: 106.2

ICSC # 0268
CAS # 100-41-4
RTECS # DA0700000
UN # 1175
EC # 601-023-00-4
March 13, 1995 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Highly flammable.	NO open flames, NO sparks, and NO smoking.	Powder, AFFF, foam, carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT use compressed air for filling, discharging, or handling.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT GENERATION OF MISTS!	
•INHALATION	Cough. Dizziness. Drowsiness. Headache.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain. Blurred vision.	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	(Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Give a slurry of activated charcoal in water to drink. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Ventilation. Collect leaking liquid in covered containers. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. Personal protection: A filter respirator for organic gases and vapours.	Fireproof. Separated from strong oxidants.	F symbol Xn symbol R: 11-20 S: 2-16-24/25-29 UN Hazard Class: 3 UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0268

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

ETHYLBENZENE

ICSC: 0268

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH AROMATIC ODOUR.

PHYSICAL DANGERS:
The vapour mixes well with air, explosive mixtures are easily formed.

CHEMICAL DANGERS:
Reacts with strong oxidants. Attacks plastic and rubber.

OCCUPATIONAL EXPOSURE LIMITS:
TLV: 100 ppm as TWA 125 ppm as STEL A3 (confirmed animal carcinogen with unknown relevance to humans); BEI issued (ACGIH 2005).
MAK: skin absorption (H);
Carcinogen category: 3A;
(DFG 2004).
OSHA PEL†: TWA 100 ppm (435 mg/m^3)
NIOSH REL: TWA 100 ppm (435 mg/m^3) ST 125 ppm (545 mg/m^3)
NIOSH IDLH: 800 ppm 10%LEL See: 100414

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation of its vapour, through the skin and by ingestion.

INHALATION RISK:
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is irritating to the eyes the skin and the respiratory tract Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system Exposure far above the OEL could cause lowering of consciousness.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis.

PHYSICAL PROPERTIES

Boiling point: 136°C
Melting point: -95°C
Relative density (water = 1): 0.9
Solubility in water, g/100 ml at 20°C: 0.015
Vapour pressure, kPa at 20°C: 0.9
Relative vapour density (air = 1): 3.7
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.02
Flash point: 18°C c.c.
Auto-ignition temperature: 432°C
Explosive limits, vol% in air: 1.0-6.7
Octanol/water partition coefficient as log Pow: 3.2

ENVIRONMENTAL DATA

The substance is harmful to aquatic organisms.

NOTES

The odour warning when the exposure limit value is exceeded is insufficient.

Transport Emergency Card: TEC (R)-30S1175 or 30GF1-I+II
NFPA Code: H2; F3; R0

ADDITIONAL INFORMATION

ICSC: 0268 **ETHYLBENZENE**

IMPORTANT LEGAL NOTICE:

Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, 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. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

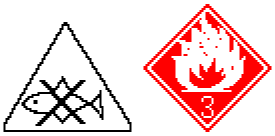
International Chemical Safety Cards

CUMENE

ICSC: 0170

(1-Methylethyl)benzene
2-Phenylpropane
Isopropylbenzene
C_9H_{12} / $C_6H_5CH(CH_3)_2$
Molecular mass: 120.2

ICSC # 0170
CAS # 98-82-8
RTECS # GR8575000
UN # 1918
EC # 601-024-00-X
April 13, 2000 Peer reviewed



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable.	NO open flames, NO sparks, and NO smoking.	Powder, AFFF, foam, carbon dioxide.
EXPLOSION	Above 31°C explosive vapour/air mixtures may be formed.	Above 31°C use a closed system, ventilation, and explosion-proof electrical equipment. Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT GENERATION OF MISTS!	
•INHALATION	Dizziness. Ataxia. Drowsiness. Headache. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Dry skin.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	(See Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment. Personal protection: filter respirator for organic gases and vapours.	Fireproof. Separated from strong oxidants, acids. Cool. Keep in the dark. Store only if stabilized.	Marine pollutant. Note: C Xn symbol N symbol R: 10-37-51/53-65 S: 2-24-37-61-62 UN Hazard Class: 3 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0170

International Chemical Safety Cards

CUMENE

ICSC: 0170

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
As a result of flow, agitation, etc., electrostatic charges can be generated.

CHEMICAL DANGERS:
Reacts violently with acids and strong oxidants causing fire and explosion hazard. The substance can form explosive peroxides.

OCCUPATIONAL EXPOSURE LIMITS:
TLV: 50 ppm as TWA (ACGIH 2004).
MAK: 50 ppm 250 mg/m³
Peak limitation category: II(4);
skin absorption (H);
Pregnancy risk group: C;
(DFG 2004).
OSHA PEL: TWA 50 ppm (245 mg/m^3) skin
NIOSH REL: TWA 50 ppm (245 mg/m^3) skin
NIOSH IDLH: 900 ppm 10%LEL See: 98828

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation and through the skin.

INHALATION RISK:
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is irritating to the eyes and the skin Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system Exposure far above the OEL may result in unconsciousness.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis.

PHYSICAL PROPERTIES

Boiling point: 152°C
Melting point: -96°C
Relative density (water = 1): 0.90
Solubility in water:
none
Vapour pressure, Pa at 20°C: 427
Relative vapour density (air = 1): 4.2
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.01
Flash point:
31°C c.c.
Auto-ignition temperature: 420°C
Explosive limits, vol% in air: 0.9-6.5
Octanol/water partition coefficient as log Pow: 3.66

ENVIRONMENTAL DATA

The substance is toxic to aquatic organisms.

NOTES

Check for peroxides prior to distillation; eliminate if found.

Transport Emergency Card: TEC (R)-30S1918 or 30GF1-III
NFPA Code: H2; F3; R1

ADDITIONAL INFORMATION

ICSC: 0170 **CUMENE**

IMPORTANT LEGAL NOTICE:

Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, 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. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

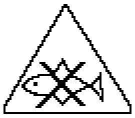
International Chemical Safety Cards

NAPHTHALENE

ICSC: 0667

Naphthene
$C_{10}H_8$
Molecular mass: 128.18

ICSC # 0667
CAS # 91-20-3
RTECS # QJ0525000
UN # 1334 (solid); 2304 (molten)
EC # 601-052-00-2
April 21, 2005 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Above 80°C explosive vapour/air mixtures may be formed. Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		PREVENT DISPERSION OF DUST!	
•INHALATION	Headache. Weakness. Nausea. Vomiting. Sweating. Confusion. Jaundice. Dark urine.	Ventilation (not if powder), local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	MAY BE ABSORBED! (Further see Inhalation).	Protective gloves.	Rinse skin with plenty of water or shower.
•EYES		Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Abdominal pain. Diarrhoea. Convulsions. Unconsciousness. (Further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Rest. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Personal protection: filter respirator for organic gases and vapours. Do NOT let this chemical enter the environment. Sweep spilled substance into covered containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place.	Separated from strong oxidants, food and feedstuffs . Store in an area without drain or sewer access.	Do not transport with food and feedstuffs. Marine pollutant. Xn symbol N symbol R: 22-40-50/53 S: 2-36/37-46-60-61 UN Hazard Class: 4.1 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0667

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

NAPHTHALENE

ICSC: 0667

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
WHITE SOLID IN VARIOUS FORMS , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
Dust explosion possible if in powder or granular form, mixed with air.

CHEMICAL DANGERS:
On combustion, forms irritating and toxic gases. Reacts with strong oxidants .

OCCUPATIONAL EXPOSURE LIMITS:
TLV: 10 ppm as TWA; 15 ppm as STEL; (skin); A4 (not classifiable as a human carcinogen); (ACGIH 2005).
MAK: skin absorption (H);
Carcinogen category: 2; Germ cell mutagen group: 3B; (DFG 2004).
OSHA PEL†: TWA 10 ppm (50 mg/m^3)
NIOSH REL: TWA 10 ppm (50 mg/m^3) ST 15 ppm (75 mg/m^3)
NIOSH IDLH: 250 ppm See: 91203

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

INHALATION RISK:
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C. See Notes.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance may cause effects on the blood , resulting in lesions of blood cells (haemolysis) . See Notes. The effects may be delayed. Exposure by ingestion may result in death. Medical observation is indicated.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The substance may have effects on the blood , resulting in chronic haemolytic anaemia. The substance may have effects on the eyes , resulting in the development of cataract. This substance is possibly carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 218°C

Sublimation slowly at room temperature
Melting point: 80°C
Density: 1.16
g/cm³
Solubility in water, g/100 ml at 25°C:
none

Vapour pressure, Pa at 25°C: 11
Relative vapour density (air = 1): 4.42
Flash point:
80°C c.c.
Auto-ignition temperature: 540°C
Explosive limits, vol% in air: 0.9-5.9
Octanol/water partition coefficient as log Pow: 3.3

ENVIRONMENTAL DATA

The substance is very toxic to aquatic organisms. The substance may cause long-term effects in the aquatic environment.

NOTES

Some individuals may be more sensitive to the effect of naphthalene on blood cells.

Transport Emergency Card: TEC (R)-41S1334 (solid); 41GF1-II+III (solid); 41S2304 (molten)

NFPA Code: H2; F2; R0;

ADDITIONAL INFORMATION

ICSC: 0667 **NAPHTHALENE**

IMPORTANT LEGAL NOTICE:

Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, 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. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

Material Safety Data Sheet

Normal-Butylbenzene, 99+%

ACC# 55434

Section 1 - Chemical Product and Company Identification

MSDS Name: Normal-Butylbenzene, 99+%
Catalog Numbers: AC107850000, AC107850050, AC107850250, AC107850500, AC107851000, AC107852500 AC107852500
Synonyms: 1-Phenylbutane
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
104-51-8	n-Butylbenzene	>99	203-209-7

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: clear, colorless liquid. Flash Point: 59 deg C.
Warning! **Flammable liquid and vapor.** May cause eye and skin irritation. May cause respiratory and digestive tract irritation. The toxicological properties of this material have not been fully investigated.
Target Organs: Liver, nervous system.

Potential Health Effects

Eye: May cause eye irritation. The toxicological properties of this material have not been fully investigated.
Skin: May cause skin irritation. The toxicological properties of this material have not been fully investigated.
Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea. The toxicological properties of this substance have not been fully investigated.
Inhalation: May cause respiratory tract irritation. The toxicological properties of this substance have not been fully investigated. Vapors may cause dizziness or suffocation.
Chronic: No information found.

Section 4 - First Aid Measures

Eyes: 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. Wash clothing before reuse.
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. Vapors may form an explosive mixture with air. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Will burn if involved in a fire. Use water spray to keep fire-exposed containers cool. Containers may explode in the heat of a fire. Flammable liquid and vapor. Vapors may be heavier than air. They can spread along the ground and collect in low or confined areas.
Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam. For large fires, use water spray, fog, or alcohol-resistant foam. Use water spray to cool fire-exposed containers. Water may be ineffective. Use agent most appropriate to extinguish fire. Do NOT use straight streams of water.
Flash Point: 59 deg C (138.20 deg F)
Autoignition Temperature: 412 deg C (773.60 deg F)
Explosion Limits, Lower:.80 vol %
Upper: 5.80 vol %
NFPA Rating: (estimated) Health: 1; Flammability: 2; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Clean up spills immediately, observing precautions in the Protective Equipment section. Remove all sources of ignition. Use a spark-proof tool. Provide ventilation. A vapor suppressing foam may be used to reduce vapors.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Ground and bond containers when transferring material. Use spark-proof tools and explosion proof equipment. Avoid contact with eyes, skin, and clothing. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Keep container tightly closed. Keep away from heat, sparks and flame. Avoid ingestion and inhalation. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames.
Storage: Keep away from heat, sparks, and flame. Keep away from sources of ignition. Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances. Flammables-area.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Use adequate ventilation to keep airborne concentrations low. Use process enclosure, local exhaust ventilation, or other engineering controls to control airborne levels.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
n-Butylbenzene	none listed	none listed	none listed

OSHA Vacated PELs: n-Butylbenzene: 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: Wear a NIOSH/MSHA or European Standard EN 149 approved full-facepiece airline respirator in the positive pressure mode with emergency escape provisions. 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: Liquid
Appearance: clear, colorless
Odor: None reported.
pH: Not available.
Vapor Pressure: 1.33 hPa @ 23 C
Vapor Density: 4.6
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 183 deg C @ 760.00mm Hg
Freezing/Melting Point:-88 deg C
Decomposition Temperature:> 183 deg C
Solubility: insoluble
Specific Gravity/Density:.8600g/cm3
Molecular Formula:$C_{10}H_{14}$
Molecular Weight:134.22

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Incompatible materials, ignition sources, excess heat, strong oxidants.
Incompatibilities with Other Materials: Oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, irritating and toxic fumes and gases, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 104-51-8: CY9070000
LD50/LC50:
Not available.

Carcinogenicity:
CAS# 104-51-8: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

Epidemiology: No information available.
Teratogenicity: No information available.
Reproductive Effects: No information available.
Mutagenicity: No information available.
Neurotoxicity: No information available.
Other Studies:

Section 12 - Ecological Information

Ecotoxicity: No data available. No information available.
Environmental: Rapidly volatilizes into the atmosphere where it is photochemically degraded by hydroxyl radicals.

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: None listed.

Section 14 - Transport Information

	US DOT	**Canada TDG**
Shipping Name:	BUTYL BENZENES	No information available.
Hazard Class:	3	
UN Number:	UN2709	
Packing Group:	III	

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 104-51-8 is listed on the TSCA inventory.
Health & Safety Reporting List
CAS# 104-51-8: Effective 6/1/87, Sunset 12/19/95
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
None of the chemicals in this material have an RQ.
SARA Section 302 Extremely Hazardous Substances
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 104-51-8: immediate, fire.
Section 313 No chemicals are reportable under Section 313.
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.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
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# 104-51-8 can be found on the following state right to know lists: 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:

Not available.

Risk Phrases:

R 10 Flammable.

Safety Phrases:

S 16 Keep away from sources of ignition - No smoking.
S 24/25 Avoid contact with skin and eyes.
S 33 Take precautionary measures against static discharges.
S 37 Wear suitable gloves.
S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S 9 Keep container in a well-ventilated place.
S 28A After contact with skin, wash immediately with plenty of water
.

WGK (Water Danger/Protection)

CAS# 104-51-8: 1

Canada - DSL/NDSL

CAS# 104-51-8 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of B3, 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

Section 16 - Additional Information

MSDS Creation Date: 4/15/1998
Revision #4 Date: 3/16/2007

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

SIGMA-ALDRICH

sigma-aldrich.com

Material Safety Data Sheet

Version 4.0
Revision Date 07/28/2010
Print Date 12/07/2011

1. PRODUCT AND COMPANY IDENTIFICATION

Product name : Propylbenzene

Product Number : P52407
Brand : Aldrich

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA
Telephone : +1 800-325-5832
Fax : +1 800-325-5052
Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

Emergency Overview

OSHA Hazards
Combustible Liquid

Target Organs

Lungs, Eyes, Kidney

GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)

H226	Flammable liquid and vapour.
H304	May be fatal if swallowed and enters airways.
H335	May cause respiratory irritation.
H401	Toxic to aquatic life.

Precautionary statement(s)

P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.
P331	Do NOT induce vomiting.

HMIS Classification
Health hazard: 0
Chronic Health Hazard: *
Flammability: 2
Physical hazards: 0

NFPA Rating
Health hazard: 1
Fire: 2
Reactivity Hazard: 0

Potential Health Effects

Inhalation	May be harmful if inhaled. May cause respiratory tract irritation.
Skin	May be harmful if absorbed through skin. May cause skin irritation.
Eyes	May cause eye irritation.

Ingestion Aspiration hazard if swallowed - can enter lungs and cause damage. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms : 1-Phenylpropane

Formula : C_9H_{12}
Molecular Weight : 120.19 g/mol

CAS-No.	EC-No.	Index-No.	Concentration
Propylbenzene			
103-65-1	203-132-9	601-024-00-X	-

4. FIRST AID MEASURES

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing give artificial respiration Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
For small (incipient) fires, use media such as "alcohol" foam, dry chemical, or carbon dioxide. For large fires, apply water from as far as possible. Use very large quantities (flooding) of water applied as a mist or spray; solid streams of water may be ineffective. Cool all affected containers with flooding quantities of water.

Special protective equipment for fire-fighters
Wear self contained breathing apparatus for fire fighting if necessary.

Further information
Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions
Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

Methods and materials for containment and cleaning up
Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13). Keep in suitable, closed containers for disposal.

7. HANDLING AND STORAGE

Precautions for safe handling
Avoid inhalation of vapour or mist.

Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

Conditions for safe storage
Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Store in cool place.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Contains no substances with occupational exposure limit values.

Personal protective equipment

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection
For prolonged or repeated contact use protective gloves.

Eye protection
Face shield and safety glasses

Skin and body protection
Choose body protection according to the amount and concentration of the dangerous substance at the work place.

Hygiene measures
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	liquid, clear
Colour	colourless

Safety data

pH	no data available
Melting point	-99 °C (-146 °F) - lit.
Boiling point	159 °C (318 °F) - lit.
Flash point	42.0 °C (107.6 °F) - closed cup
Ignition temperature	450 °C (842 °F)
Lower explosion limit	0.8 %(V)
Upper explosion limit	6 %(V)
Density	0.862 g/cm3 at 25 °C (77 °F)
Water solubility	slightly soluble

10. STABILITY AND REACTIVITY

Chemical stability
Stable under recommended storage conditions.

Possibility of hazardous reactions
Vapours may form explosive mixture with air.

Conditions to avoid
Heat, flames and sparks.

Materials to avoid
Strong oxidizing agents

Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides

11. TOXICOLOGICAL INFORMATION

Acute toxicity
LD50 Oral - rat - 6,040 mg/kg
Remarks: Behavioral:Somnolence (general depressed activity).

LC50 Inhalation - rat - 2 h - 65000 ppm

Skin corrosion/irritation
no data available

Serious eye damage/eye irritation
no data available

Respiratory or skin sensitization
no data available

Germ cell mutagenicity
no data available

Carcinogenicity

IARC:	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
ACGIH:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
NTP:	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)
May cause respiratory irritation.

Specific target organ toxicity - repeated exposure (Globally Harmonized System)
no data available

Aspiration hazard
May be fatal if swallowed and enters airways.

Potential health effects

Inhalation	May be harmful if inhaled. May cause respiratory tract irritation.
Ingestion	Aspiration hazard if swallowed - can enter lungs and cause damage. May be harmful if swallowed.
Skin	May be harmful if absorbed through skin. May cause skin irritation.
Eyes	May cause eye irritation.

Signs and Symptoms of Exposure
Damage to the lungs., To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Additional Information
RTECS: DA8750000

12. ECOLOGICAL INFORMATION

Toxicity

Toxicity to fish	LC50 - Oncorhynchus mykiss (rainbow trout) - 1.55 mg/l - 96.0 h

Toxicity to daphnia and other aquatic invertebrates.	Immobilization EC50 - Daphnia magna (Water flea) - 2 mg/l - 24 h

Persistence and degradability
no data available

Bioaccumulative potential
no data available

Mobility in soil
no data available

PBT and vPvB assessment
no data available

Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Avoid release to the environment.

13. DISPOSAL CONSIDERATIONS

Product
This combustible material may be burned in a chemical incinerator equipped with an afterburner and scrubber. Observe all federal, state, and local environmental regulations. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN-Number: 2364 Class: 3 Packing group: III
Proper shipping name: n-Propyl benzene
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG
UN-Number: 2364 Class: 3 Packing group: III EMS-No: F-E, S-D
Proper shipping name: PROPYLBENZENE
Marine pollutant: No

IATA
UN-Number: 2364 Class: 3 Packing group: III
Proper shipping name: n-Propylbenzene

15. REGULATORY INFORMATION

OSHA Hazards
Combustible Liquid

DSL Status
All components of this product are on the Canadian DSL list.

SARA 302 Components
SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
Fire Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Propylbenzene	103-65-1	2007-03-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Propylbenzene	103-65-1	2007-03-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Propylbenzene	103-65-1	2007-03-01

California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Co., shall not be held liable for any damage resulting from handling or from contact with the above product. See reverse side of invoice or packing slip for additional terms and conditions of sale.

International Chemical Safety Cards

o-XYLENE

ICSC: 0084

ortho-Xylene
1,2-Dimethylbenzene
o-Xylol
$C_6H_4(CH_3)_2$ / C_8H_{10}
Molecular mass: 106.2

ICSC # 0084
CAS # 95-47-6
RTECS # ZE2450000
UN # 1307
EC # 601-022-00-9
August 03, 2002 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable.	NO open flames, NO sparks, and NO smoking.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Above 32°C explosive vapour/air mixtures may be formed.	Above 32°C use a closed system, ventilation, and explosion-proof electrical equipment. Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN!	
•INHALATION	Dizziness. Drowsiness. Headache. Nausea.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Burning sensation. Abdominal pain. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Ventilation. Remove all ignition sources. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment. (Extra personal protection: filter respirator for organic gases and vapours.)	Fireproof. Separated from strong oxidants and strong acids .	Note: C Xn symbol R: 10-20/21-38 S: 2-25 UN Hazard Class: 3 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the

ICSC: 0084

International Chemical Safety Cards

o-XYLENE

ICSC: 0084

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR. **PHYSICAL DANGERS:** As a result of flow, agitation, etc., electrostatic charges can be generated. **CHEMICAL DANGERS:** Reacts with strong acids and strong oxidants . **OCCUPATIONAL EXPOSURE LIMITS:** TLV: 100 ppm as TWA; 150 ppm as STEL A4 (ACGIH 2001). BEI specified by (ACGIH 2001). EU OEL: 50 ppm as TWA; 100 ppm as STEL (skin) (EU 2000). OSHA PEL†: TWA 100 ppm (435 mg/m^3) NIOSH REL: TWA 100 ppm (435 mg/m^3) ST 150 ppm (655 mg/m^3) NIOSH IDLH: 900 ppm See: 95476	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation, through the skin and by ingestion. **INHALATION RISK:** A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance is irritating to the eyes and the skin . The substance may cause effects on the central nervous system . If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The liquid defats the skin. The substance may have effects on the central nervous system. Exposure to the substance may enhance hearing damage caused by exposure to noise. Animal tests show that this substance possibly causes toxicity to human reproduction or development.
PHYSICAL PROPERTIES	Boiling point: 144°C Melting point: -25°C Relative density (water = 1): 0.88 Solubility in water: none Vapour pressure, kPa at 20°C: 0.7	Relative vapour density (air = 1): 3.7 Relative density of the vapour/air-mixture at 20°C (air = 1): 1.02 Flash point: 32°C c.c. Auto-ignition temperature: 463°C Explosive limits, vol% in air: 0.9-6.7 Octanol/water partition coefficient as log Pow: 3.12
ENVIRONMENTAL DATA	The substance is toxic to aquatic organisms.	

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. The recommendations on this Card also apply to technical xylene. See ICSC 0086 p-Xylene and 0085 m-Xylene.

Transport Emergency Card: TEC (R)-30S1307-III

NFPA Code: H 2; F 3; R 0;

Card has been partially updated in January 2008: see Occupational Exposure Limits.

ADDITIONAL INFORMATION

ICSC: 0084 **o-XYLENE**

IMPORTANT LEGAL	Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, 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. The only

NOTICE:	modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

p-XYLENE

ICSC: 0086

para-Xylene
1,4-Dimethylbenzene
p-Xylol
$C_6H_4(CH_3)_2$ / C_8H_{10}
Molecular mass: 106.2

ICSC # 0086
CAS # 106-42-3
RTECS # ZE2625000
UN # 1307
EC # 601-022-00-9
August 03, 2002 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable.	NO open flames, NO sparks, and NO smoking.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Above 27°C explosive vapour/air mixtures may be formed.	Above 27°C use a closed system, ventilation, and explosion-proof electrical equipment. Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN!	
•INHALATION	Dizziness. Drowsiness. Headache. Nausea.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Burning sensation. Abdominal pain. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Ventilation. Remove all ignition sources. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment. (Extra personal protection: filter respirator for organic gases and vapours.)	Fireproof. Separated from strong oxidants, strong acids	Note: C Xn symbol R: 10-20/21-38 S: 2-25 UN Hazard Class: 3 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0086

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

p-XYLENE

ICSC: 0086

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
As a result of flow, agitation, etc., electrostatic charges can be generated.

CHEMICAL DANGERS:
Reacts with strong acids strong oxidants

OCCUPATIONAL EXPOSURE LIMITS:
TLV: 100 ppm as TWA 150 ppm as STEL A4 (ACGIH 2001). BEI (ACGIH 2001).
MAK: 100 ppm 440 mg/m^3
Peak limitation category: II(2)
skin absorption (H);
Pregnancy risk group: D
(DFG 2005).
EU OEL: 50 ppm as TWA 100 ppm as STEL (skin) (EU 2000).
OSHA PEL†: TWA 100 ppm (435 mg/m^3)
NIOSH REL: TWA 100 ppm (435 mg/m^3) ST 150 ppm (655 mg/m^3)
NIOSH IDLH: 900 ppm See: 95476

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

INHALATION RISK:
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is irritating to the eyes and the skin The substance may cause effects on the central nervous system If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The liquid defats the skin. The substance may have effects on the central nervous system. Animal tests show that this substance possibly causes toxicity to human reproduction or development.

PHYSICAL PROPERTIES

Boiling point: 138°C
Melting point: 13°C
Relative density (water = 1): 0.86
Solubility in water:
none
Vapour pressure, kPa at 20°C: 0.9
Relative vapour density (air = 1): 3.7
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.02
Flash point: 27°C c.c.
Auto-ignition temperature: 528°C
Explosive limits, vol% in air: 1.1-7.0
Octanol/water partition coefficient as log Pow: 3.15

ENVIRONMENTAL DATA

The substance is toxic to aquatic organisms.

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. The recommendations on this Card also apply to technical xylene. See ICSC 0084 o-Xylene and 0085 m-Xylene.

Transport Emergency Card: TEC (R)-30S1307-III
NFPA Code: H 2; F 3; R 0;

ADDITIONAL INFORMATION

ICSC: 0086 **p-XYLENE**

IMPORTANT LEGAL NOTICE:

Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, 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. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

m-XYLENE

ICSC: 0085

meta-Xylene
1,3-Dimethylbenzene
m-Xylol
$C_6H_4(CH_3)_2$ / C_8H_{10}
Molecular mass: 106.2

ICSC # 0085
CAS # 108-38-3
RTECS # ZE2275000
UN # 1307
EC # 601-022-00-9
August 03, 2002 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable.	NO open flames, NO sparks, and NO smoking.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Above 27°C explosive vapour/air mixtures may be formed.	Above 27°C use a closed system, ventilation, and explosion-proof electrical equipment. Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		STRICT HYGIENE!	
•INHALATION	Dizziness. Drowsiness. Headache. Nausea.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Burning sensation. Abdominal pain. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Ventilation. Remove all ignition sources. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment. (Extra personal protection: filter respirator for organic gases and vapours.)	Fireproof. Separated from strong oxidants strong acids	Note: C Xn symbol R: 10-20/21-38 S: 2-25 UN Hazard Class: 3 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0085

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

m-XYLENE

ICSC: 0085

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
As a result of flow, agitation, etc., electrostatic charges can be generated.

CHEMICAL DANGERS:
Reacts with strong acids strong oxidants

OCCUPATIONAL EXPOSURE LIMITS:
TLV: 100 ppm as TWA 150 ppm as STEL A4 (ACGIH 2001). BEI (ACGIH 2001).
MAK: 100 ppm 440 mg/m³
Peak limitation category: II(2)
skin absorption (H);
Pregnancy risk group: D
(DFG 2005).
EU OEL: 50 ppm as TWA 100 ppm as STEL (skin) (EU 2000).
OSHA PEL†: TWA 100 ppm (435 mg/m^3)
NIOSH REL: TWA 100 ppm (435 mg/m^3) ST 150 ppm (655 mg/m^3)
NIOSH IDLH: 900 ppm See: 95476

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

INHALATION RISK:
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is irritating to the eyes and the skin The substance may cause effects on the central nervous system If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The liquid defats the skin. The substance may have effects on the central nervous system Animal tests show that this substance possibly causes toxicity to human reproduction or development.

PHYSICAL PROPERTIES

Boiling point: 139°C
Melting point: -48°C
Relative density (water = 1): 0.86
Solubility in water:
none
Vapour pressure, kPa at 20°C: 0.8
Relative vapour density (air = 1): 3.7
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.02
Flash point: 27°C c.c.
Auto-ignition temperature: 527°C
Explosive limits, vol% in air: 1.1-7.0
Octanol/water partition coefficient as log Pow: 3.20

ENVIRONMENTAL DATA

The substance is toxic to aquatic organisms.

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. The recommendations on this Card also apply to technical xylene. See ICSC 0084 o-Xylene and 0086 p-Xylene.

NFPA Code: H 2; F 3; R 0;
Transport Emergency Card: TEC (R)-30S1307-III

ADDITIONAL INFORMATION

ICSC: 0085 **m-XYLENE**

IMPORTANT LEGAL NOTICE:

Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, 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. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

p-CYMENE

ICSC: 0617

1-Methyl-4-isopropylbenzene
Dolcymene
Camphogen
$C_{10}H_{14}$ / $CH_3C_6H_4CH(CH_3)_2$
Molecular mass: 134.2

ICSC # 0617
CAS # 99-87-6
RTECS # GZ5950000
UN # 2046
November 04, 1997 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable.	NO open flames, NO sparks, and NO smoking.	Powder, AFFF, foam, carbon dioxide.
EXPLOSION	Above 47°C explosive vapour/air mixtures may be formed.	Above 47°C use a closed system, ventilation, and explosion-proof electrical equipment. Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT GENERATION OF MISTS!	
•INHALATION	Dizziness. Drowsiness. Vomiting.	Ventilation.	Fresh air, rest. Half-upright position. Artificial respiration if indicated. Refer for medical attention.
•SKIN	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Wear protective gloves when administering first aid.
•EYES	Redness.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Diarrhoea. Drowsiness. Headache. Nausea. Vomiting. Unconsciousness.	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Rest. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Collect leaking liquid in sealable containers. Absorb remaining liquid in sand or inert absorbent and remove to safe place. (Extra personal protection: filter respirator for organic gases and vapours).	Fireproof.	UN Hazard Class: 3 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0617

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

p-CYMENE

ICSC: 0617

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR. **PHYSICAL DANGERS:** The vapour is heavier than air. **CHEMICAL DANGERS:** Reacts with oxidants. Attacks rubber. **OCCUPATIONAL EXPOSURE LIMITS:** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of its vapour and by ingestion. **INHALATION RISK:** No indication can be given about the rate in which a harmful concentration in the air is reached on evaporation of this substance at 20°C. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance is irritating to the eyes and the skin . Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The liquid defats the skin.
PHYSICAL PROPERTIES	Boiling point: 177°C Melting point: -68°C Relative density (water = 1): 0.85 Solubility in water, g/100 ml at 25°C: 0.002 Vapour pressure, Pa at 20°C: 200	Relative vapour density (air = 1): 4.62 Flash point: 47°C c.c. Auto-ignition temperature: 435°C Explosive limits, vol% in air: 0.7-5.6 Octanol/water partition coefficient as log Pow: 4.1
ENVIRONMENTAL DATA		

NOTES

Transport Emergency Card: TEC (R)-30G35

NFPA Code: H2; F2; R0;

ADDITIONAL INFORMATION

ICSC: 0617 **p-CYMENE**

IMPORTANT LEGAL NOTICE:	Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, 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. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

SIGMA-ALDRICH

sigma-aldrich.com

Material Safety Data Sheet

Version 4.0
Revision Date 07/24/2010
Print Date 12/07/2011

1. PRODUCT AND COMPANY IDENTIFICATION

Product name : *sec*-Butylbenzene

Product Number : B90408
Brand : Aldrich

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA
Telephone : +1 800-325-5832
Fax : +1 800-325-5052
Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

Emergency Overview

OSHA Hazards
Combustible Liquid, Irritant

GHS Label elements, including precautionary statements

Pictogram

Signal word Warning

Hazard statement(s)

H226	Flammable liquid and vapour.
H315 + H320	Causes skin and eye irritation.
H401	Toxic to aquatic life.

Precautionary statement(s)

P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

HMIS Classification
Health hazard: 2
Flammability: 2
Physical hazards: 0

NFPA Rating
Health hazard: 2
Fire: 2
Reactivity Hazard: 0

Potential Health Effects

Inhalation	May be harmful if inhaled. Causes respiratory tract irritation.
Skin	May be harmful if absorbed through skin. Causes skin irritation.
Eyes	Causes eye irritation.
Ingestion	May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms : 2-Phenylbutane

Formula : $C_{10}H_{14}$
Molecular Weight : 134.22 g/mol

CAS-No.	EC-No.	Index-No.	Concentration
sec-Butylbenzene			
135-98-8	205-227-0	-	-

4. FIRST AID MEASURES

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing give artificial respiration Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media

For small (incipient) fires, use media such as "alcohol" foam, dry chemical, or carbon dioxide. For large fires, apply water from as far as possible. Use very large quantities (flooding) of water applied as a mist or spray; solid streams of water may be ineffective. Cool all affected containers with flooding quantities of water.

Special protective equipment for fire-fighters

Wear self contained breathing apparatus for fire fighting if necessary.

Further information

Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

Methods and materials for containment and cleaning up

Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13). Keep in suitable, closed containers for disposal.

7. HANDLING AND STORAGE

Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

Conditions for safe storage

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Store in cool place.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Contains no substances with occupational exposure limit values.

Personal protective equipment

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection
Handle with gloves.

Eye protection
Face shield and safety glasses

Skin and body protection
Choose body protection according to the amount and concentration of the dangerous substance at the work place.

Hygiene measures
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	liquid, clear
Colour	colourless

Safety data

pH	no data available
Melting point	75.5 °C (167.9 °F) - lit.
Boiling point	173 - 174 °C (343 - 345 °F) - lit.
Flash point	52.0 °C (125.6 °F) - closed cup
Ignition temperature	418 °C (784 °F)
Lower explosion limit	0.8 %(V)
Density	0.863 g/mL at 25 °C (77 °F)
Water solubility	no data available

10. STABILITY AND REACTIVITY

Chemical stability
Stable under recommended storage conditions.

Possibility of hazardous reactions
Vapours may form explosive mixture with air.

Conditions to avoid
Heat, flames and sparks.

Materials to avoid
Strong oxidizing agents

Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides

11. TOXICOLOGICAL INFORMATION

Acute toxicity
LD50 Dermal - rabbit - > 13,792 mg/kg

Skin corrosion/irritation
Skin - rabbit - irritating - 24 h

Serious eye damage/eye irritation
Eyes - rabbit - Mild eye irritation - 24 h

Respiratory or skin sensitization
no data available

Germ cell mutagenicity
no data available

Carcinogenicity

IARC:	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
ACGIH:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
NTP:	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)
no data available

Specific target organ toxicity - repeated exposure (Globally Harmonized System)
no data available

Aspiration hazard
no data available

Potential health effects

Inhalation	May be harmful if inhaled. Causes respiratory tract irritation.
Ingestion	May be harmful if swallowed.
Skin	May be harmful if absorbed through skin. Causes skin irritation.
Eyes	Causes eye irritation.

Signs and Symptoms of Exposure
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Additional Information
RTECS: CY9100000

12. ECOLOGICAL INFORMATION

Toxicity

no data available

Persistence and degradability
no data available

Bioaccumulative potential
no data available

Mobility in soil
no data available

PBT and vPvB assessment
no data available

Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

13. DISPOSAL CONSIDERATIONS

Product
This combustible material may be burned in a chemical incinerator equipped with an afterburner and scrubber. Observe all federal, state, and local environmental regulations. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN-Number: 2709 Class: 3 Packing group: III
Proper shipping name: Butyl benzenes
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG
UN-Number: 2709 Class: 3 Packing group: III EMS-No: F-E, S-D
Proper shipping name: BUTYLBENZENES
Marine pollutant: No

IATA
UN-Number: 2709 Class: 3 Packing group: III
Proper shipping name: Butylbenzenes

15. REGULATORY INFORMATION

OSHA Hazards
Combustible Liquid, Irritant

DSL Status
This product contains the following components that are not on the Canadian DSL nor NDSL lists.

	CAS-No.
sec-Butylbenzene	135-98-8

SARA 302 Components
SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
Fire Hazard, Acute Health Hazard

Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
sec-Butylbenzene	135-98-8	

New Jersey Right To Know Components

	CAS-No.	Revision Date
sec-Butylbenzene	135-98-8	

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

Further information

Material Safety Data Sheet

Version 3.0
Revision Date 08/21/2009
Print Date 12/07/2011

1. PRODUCT AND COMPANY IDENTIFICATION

Product name : *tert*-Butylbenzene

Product Number : B90602
Brand : Aldrich

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA
Telephone : +1 800-325-5832
Fax : +1 800-325-5052
Emergency Phone # : (314) 776-6555

2. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms : 2-Methyl-2-phenylpropane

Formula : $C_{10}H_{14}$
Molecular Weight : 134.22 g/mol

CAS-No.	EC-No.	Index-No.	Concentration
tert-Butylbenzene			
98-06-6	202-632-4	-	-

3. HAZARDS IDENTIFICATION

Emergency Overview

OSHA Hazards
Flammable Liquid, Irritant

HMIS Classification
Health Hazard: 2
Flammability: 3
Physical hazards: 0

NFPA Rating
Health Hazard: 2
Fire: 3
Reactivity Hazard: 0

Potential Health Effects

Inhalation	May be harmful if inhaled. Causes respiratory tract irritation.
Skin	May be harmful if absorbed through skin. Causes skin irritation.
Eyes	Causes eye irritation.
Ingestion	May be harmful if swallowed.

4. FIRST AID MEASURES

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing give artificial respiration Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIRE-FIGHTING MEASURES

Flammable properties

Flash point	34.0 °C (93.2 °F) - closed cup
Ignition temperature	450 °C (842 °F)

Suitable extinguishing media
For small (incipient) fires, use media such as "alcohol" foam, dry chemical, or carbon dioxide. For large fires, apply water from as far as possible. Use very large quantities (flooding) of water applied as a mist or spray; solid streams of water may be ineffective. Cool all affected containers with flooding quantities of water.

Special protective equipment for fire-fighters
Wear self contained breathing apparatus for fire fighting if necessary.

Further information
Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions
Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

Methods for cleaning up
Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13). Keep in suitable, closed containers for disposal.

7. HANDLING AND STORAGE

Handling
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

Storage
Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Store in cool place.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Contains no substances with occupational exposure limit values.

Personal protective equipment

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection
Handle with gloves.

Eye protection
Face shield and safety glasses

Skin and body protection
Choose body protection according to the amount and concentration of the dangerous substance at the work place.

Hygiene measures
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	liquid, clear
Colour	colourless

Safety data

pH	no data available
Melting point	-58 °C (-72 °F) - lit.
Boiling point	169 °C (336 °F) - lit.
Flash point	34.0 °C (93.2 °F) - closed cup
Ignition temperature	450 °C (842 °F)
Lower explosion limit	0.8 %(V)
Density	0.867 g/mL at 25 °C (77 °F)
Water solubility	no data available
Partition coefficient: n-octanol/water	log Pow: 3.80

10. STABILITY AND REACTIVITY

Storage stability
Stable under recommended storage conditions.

Conditions to avoid
Heat, flames and sparks.

Materials to avoid
Strong oxidizing agents

Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides

Hazardous reactions
Vapours may form explosive mixture with air.

11. TOXICOLOGICAL INFORMATION

Acute toxicity

LD50 Oral - rat - 3,045 mg/kg
Remarks: Behavioral:Somnolence (general depressed activity). Behavioral:Tremor. Gastrointestinal:Changes in structure or function of salivary glands.

Irritation and corrosion

no data available

Sensitisation

no data available

Chronic exposure

IARC:	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
ACGIH:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
NTP:	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Potential Health Effects

Inhalation	May be harmful if inhaled. Causes respiratory tract irritation.
Skin	May be harmful if absorbed through skin. Causes skin irritation.
Eyes	Causes eye irritation.
Ingestion	May be harmful if swallowed.

Additional Information
RTECS: CY9120000

12. ECOLOGICAL INFORMATION

Elimination information (persistence and degradability)

no data available

Ecotoxicity effects

Toxicity to fish	LC0 - Leuciscus idus (Golden orfe) - 44 mg/l - 48 h
	LC50 - Leuciscus idus (Golden orfe) - 65 mg/l - 48 h
Toxicity to daphnia and other aquatic	LC50 - Daphnia magna (Water flea) - 41 mg/l - 24 h

invertebrates.

Further information on ecology

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

13. DISPOSAL CONSIDERATIONS

Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. This combustible material may be burned in a chemical incinerator equipped with an afterburner and scrubber. Observe all federal, state, and local environmental regulations. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)

UN-Number: 2709 Class: 3 Packing group: III
Proper shipping name: Butyl benzenes
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG

UN-Number: 2709 Class: 3 Packing group: III EMS-No: F-E, S-D
Proper shipping name: BUTYLBENZENES
Marine pollutant: No

IATA

UN-Number: 2709 Class: 3 Packing group: III
Proper shipping name: Butylbenzenes

15. REGULATORY INFORMATION

OSHA Hazards

Flammable Liquid, Irritant

DSL Status

All components of this product are on the Canadian DSL list.

SARA 302 Components

SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
tert-Butylbenzene	98-06-6	1993-04-24

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
tert-Butylbenzene	98-06-6	1993-04-24

New Jersey Right To Know Components

	CAS-No.	Revision Date
tert-Butylbenzene	98-06-6	1993-04-24

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth, or any other reproductive defects.

16. OTHER INFORMATION

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Co., shall not be held liable for any damage resulting from handling or from contact with the above product. See reverse side of invoice or packing slip for additional terms and conditions of sale.

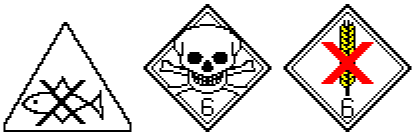
International Chemical Safety Cards

TETRACHLOROETHYLENE

ICSC: 0076

1,1,2,2-Tetrachloroethylene
Perchloroethylene
Tetrachloroethene
C_2Cl_4 / $Cl_2C=CCl_2$
Molecular mass: 165.8

ICSC # 0076
CAS # 127-18-4
RTECS # KX3850000
UN # 1897
EC # 602-028-00-4
April 13, 2000 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: use appropriate extinguishing media.
EXPLOSION			
EXPOSURE		STRICT HYGIENE! PREVENT GENERATION OF MISTS!	
•INHALATION	Dizziness. Drowsiness. Headache. Nausea. Weakness. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration may be needed. Refer for medical attention.
•SKIN	Dry skin. Redness.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain.	Safety goggles , face shield .	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Abdominal pain. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Give plenty of water to drink. Rest.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Ventilation. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment. Personal protection: filter respirator for organic gases and vapours.	Separated from metals ,(see Chemical Dangers), food and feedstuffs . Keep in the dark. Ventilation along the floor.	Do not transport with food and feedstuffs. Marine pollutant. Xn symbol N symbol R: 40-51/53 S: (2-)23-36/37-61 UN Hazard Class: 6.1 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0076

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

TETRACHLOROETHYLENE

ICSC: 0076

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air.

CHEMICAL DANGERS:
On contact with hot surfaces or flames this substance decomposes forming toxic and corrosive fumes (hydrogen chloride, phosgene, chlorine). The substance decomposes slowly on contact with moisture producing trichloroacetic acid and hydrochloric acid. Reacts with metals such as aluminium, lithium, barium, beryllium.

OCCUPATIONAL EXPOSURE LIMITS:
TLV: 25 ppm as TWA, 100 ppm as STEL; A3 (confirmed animal carcinogen with unknown relevance to humans); BEI issued; (ACGIH 2004).
MAK: skin absorption (H);
Carcinogen category: 3B;
(DFG 2004).
OSHA PEL†: TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 3-hours)
NIOSH REL: Ca Minimize workplace exposure concentrations. See Appendix A
NIOSH IDLH: Ca 150 ppm See: 127184

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation and by ingestion.

INHALATION RISK:
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is irritating to the eyes , the skin and the respiratory tract . If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis. The substance may cause effects on the central nervous system. Exposure at high levels may result in unconsciousness.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the liver and kidneys. This substance is probably carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 121°C
Melting point: -22°C
Relative density (water = 1): 1.6
Solubility in water, g/100 ml at 20°C: 0.015
Vapour pressure, kPa at 20°C: 1.9
Relative vapour density (air = 1): 5.8
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.09
Octanol/water partition coefficient as log Pow: 2.9

ENVIRONMENTAL DATA

The substance is toxic to aquatic organisms. The substance may cause long-term effects in the aquatic environment.

NOTES

Depending on the degree of exposure, periodic medical examination is suggested. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding. An added stabilizer or inhibitor can influence the toxicological properties of this substance, consult an expert. Card has been partly updated in April 2005. See section Occupational Exposure Limits.

Transport Emergency Card: TEC (R)-61S1897

NFPA Code: H2; F0; R0;

ADDITIONAL INFORMATION

ICSC: 0076 **TETRACHLOROETHYLENE**

IMPORTANT LEGAL NOTICE:

Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, 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. The only

	modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

TOLUENE

ICSC: 0078

Methylbenzene
Toluol
Phenylmethane
$C_6H_5CH_3$ / C_7H_8
Molecular mass: 92.1

ICSC # 0078
CAS # 108-88-3
RTECS # XS5250000
UN # 1294
EC # 601-021-00-3
October 10, 2002 Peer reviewed

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Highly flammable.	NO open flames, NO sparks, and NO smoking.	Powder, AFFF, foam, carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Prevent build-up of electrostatic charges (e.g., by grounding). Do NOT use compressed air for filling, discharging, or handling. Use non-sparking handtools.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN!	
•INHALATION	Cough. Sore throat. Dizziness. Drowsiness. Headache. Nausea. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
•EYES	Redness. Pain.	Safety goggles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Burning sensation. Abdominal pain. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area in large spill! Consult an expert in large spill! Remove all ignition sources. Ventilation. Collect leaking liquid in sealable containers. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. Do NOT let this chemical enter the environment. Personal protection: self-contained breathing apparatus	Fireproof. Separated from strong oxidants.	F symbol Xn symbol R: 11-38-48/20-63-65-67 S: 2-36/37-46-62 UN Hazard Class: 3 UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0078

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

TOLUENE

ICSC: 0078

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour mixes well with air, explosive mixtures are formed easily. As a result of flow, agitation, etc., electrostatic charges can be generated.

CHEMICAL DANGERS:
Reacts violently with strong oxidants causing fire and explosion hazard.

OCCUPATIONAL EXPOSURE LIMITS:
TLV: 50 ppm as TWA (skin) A4 BEI issued (ACGIH 2004).
MAK: 50 ppm 190 mg/m^3 H
Peak limitation category: II(4) Pregnancy risk group: C (DFG 2004).
OSHA PEL†: TWA 200 ppm C 300 ppm 500 ppm (10-minute maximum peak)
NIOSH REL: TWA 100 ppm (375 mg/m^3) ST 150 ppm (560 mg/m^3)
NIOSH IDLH: 500 ppm See: 108883

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

INHALATION RISK:
A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is irritating to the eyes and the respiratory tract The substance may cause effects on the central nervous system If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis. Exposure at high levels may result in cardiac dysrhythmiaandunconsciousness.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The liquid defats the skin. The substance may have effects on the central nervous system Exposure to the substance may enhance hearing damage caused by exposure to noise. Animal tests show that this substance possibly causes toxicity to human reproduction or development.

PHYSICAL PROPERTIES

Boiling point: 111°C
Melting point: -95°C
Relative density (water = 1): 0.87
Solubility in water: none
Vapour pressure, kPa at 25°C: 3.8
Relative vapour density (air = 1): 3.1
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.01
Flash point: 4°C c.c.
Auto-ignition temperature: 480°C
Explosive limits, vol% in air: 1.1-7.1
Octanol/water partition coefficient as log Pow: 2.69

ENVIRONMENTAL DATA

The substance is toxic to aquatic organisms.

NOTES

Depending on the degree of exposure, periodic medical examination is suggested. Use of alcoholic beverages enhances the harmful effect.

Transport Emergency Card: TEC (R)-30S1294
NFPA Code: H 2; F 3; R 0;

ADDITIONAL INFORMATION

ICSC: 0078 **TOLUENE**

IMPORTANT LEGAL NOTICE:

Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, 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. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

SIGMA-ALDRICH

sigma-aldrich.com

Material Safety Data Sheet

Version 4.2
Revision Date 01/19/2011
Print Date 12/07/2011

1. PRODUCT AND COMPANY IDENTIFICATION

Product name : *trans*-1,2-Dichloroethene

Product Number : 48527
Brand : Supelco
Product Use : For laboratory research purposes.

Supplier : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Manufacturer : Sigma-Aldrich Corporation
3050 Spruce St.
St. Louis, Missouri 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052
Emergency Phone # (For both supplier and manufacturer) : (314) 776-6555
Preparation Information : Sigma-Aldrich Corporation
Product Safety - Americas Region
1-800-521-8956

2. HAZARDS IDENTIFICATION

Emergency Overview

OSHA Hazards
Flammable liquid, Harmful by ingestion., Irritant

Target Organs

Central nervous system, Liver, Kidney

GHS Classification
Flammable liquids (Category 2)
Acute toxicity, Inhalation (Category 4)
Acute toxicity, Oral (Category 4)
Skin irritation (Category 2)
Eye irritation (Category 2A)
Acute aquatic toxicity (Category 3)

GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)

H225	Highly flammable liquid and vapour.
H302 + H332	Harmful if swallowed or if inhaled.
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H402	Harmful to aquatic life.

Precautionary statement(s)

P210	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

HMIS Classification

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical hazards:	0

NFPA Rating

Health hazard:	2
Fire:	3
Reactivity Hazard:	0

Potential Health Effects

Inhalation	May be harmful if inhaled. Causes respiratory tract irritation.
Skin	Harmful if absorbed through skin. Causes skin irritation.
Eyes	Causes eye irritation.
Ingestion	Harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms	:	*trans*-1,2-Dichloroethene *trans*-1,2-Dichloroethylene *trans*-Acetylene dichloride
Formula	:	$C_2H_2Cl_2$ $C_2H_2Cl_2$
Molecular Weight	:	96.94 g/mol

CAS-No.	EC-No.	Index-No.	Concentration
trans-Dichloroethylene			
156-60-5	205-860-2	602-026-00-3	-

4. FIRST AID MEASURES

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media

For small (incipient) fires, use media such as "alcohol" foam, dry chemical, or carbon dioxide. For large fires, apply water from as far as possible. Use very large quantities (flooding) of water applied as a mist or spray; solid streams of water may be ineffective. Cool all affected containers with flooding quantities of water.

Special protective equipment for fire-fighters

Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products

Hazardous decomposition products formed under fire conditions. - Hydrogen chloride gas, Carbon oxides, Phosgene gas
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas

Further information

Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

7. HANDLING AND STORAGE

Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

Conditions for safe storage

Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Value	Control parameters	Basis
trans-Dichloroethylene	156-60-5	TWA	200 ppm	USA. ACGIH Threshold Limit Values (TLV)
Remarks	Central Nervous System impairment Eye irritation			

Personal protective equipment

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Eye protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	liquid, clear
Colour	light yellow

Safety data

pH	no data available
Melting/freezing point	Melting point/range: -50 °C (-58 °F)
Boiling point	48 °C (118 °F)
Flash point	6.0 °C (42.8 °F) - closed cup
Ignition temperature	no data available
Autoignition temperature	no data available
Lower explosion limit	9.7 %(V)
Upper explosion limit	12.8 %(V)
Vapour pressure	no data available
Density	1.257 g/mL at 25 °C (77 °F)
Water solubility	no data available
Partition coefficient: n-octanol/water	no data available
Relative vapour density	no data available
Odour	no data available
Odour Threshold	no data available
Evaporation rate	no data available

10. STABILITY AND REACTIVITY

Chemical stability
Stable under recommended storage conditions.

Possibility of hazardous reactions

Vapours may form explosive mixture with air.

Conditions to avoid
Heat, flames and sparks. Extremes of temperature and direct sunlight.

Materials to avoid
Oxidizing agents, Bases

Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Hydrogen chloride gas, Carbon oxides, Phosgene gas
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas
Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral LD50
LD50 Oral - rat - 1,235 mg/kg

Inhalation LC50
LC50 Inhalation - rat - 24100 ppm

Remarks: Behavioral:Somnolence (general depressed activity).

Dermal LD50
LD50 Dermal - rabbit - > 5,000 mg/kg
Remarks: Prolonged skin contact may cause skin irritation and/or dermatitis. Nutritional and Gross Metabolic:Weight loss or decreased weight gain.

Other information on acute toxicity
no data available

Skin corrosion/irritation
Skin - rabbit - Skin irritation - 24 h

Serious eye damage/eye irritation
Eyes - rabbit - Eye irritation

Respiratory or skin sensitization
no data available

Germ cell mutagenicity
no data available

Carcinogenicity

IARC:	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
ACGIH:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
NTP:	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity

no data available

Teratogenicity

no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)
no data available

Specific target organ toxicity - repeated exposure (Globally Harmonized System)
no data available

Aspiration hazard
no data available

Potential health effects

Inhalation	May be harmful if inhaled. Causes respiratory tract irritation.
Ingestion	Harmful if swallowed.
Skin	Harmful if absorbed through skin. Causes skin irritation.
Eyes	Causes eye irritation.

Signs and Symptoms of Exposure
prolonged or repeated exposure can cause:, narcosis, To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Synergistic effects
no data available

Additional Information

RTECS: Not available

12. ECOLOGICAL INFORMATION

Toxicity

Toxicity to daphnia and other aquatic invertebrates.	EC50 - Daphnia magna (Water flea) - 220.00 mg/l - 48 h

Persistence and degradability
no data available

Bioaccumulative potential
no data available

Mobility in soil
no data available

PBT and vPvB assessment
no data available

Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Harmful to aquatic life.

13. DISPOSAL CONSIDERATIONS

Product
Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN-Number: 1150 Class: 3 Packing group: II
Proper shipping name: 1,2-Dichloroethylene
Reportable Quantity (RQ): 1000 lbs
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG
UN-Number: 1150 Class: 3 Packing group: II EMS-No: F-E, S-D
Proper shipping name: 1,2-DICHLOROETHYLENE
Marine pollutant: No

IATA
UN-Number: 1150 Class: 3 Packing group: II
Proper shipping name: 1,2-Dichloroethylene

15. REGULATORY INFORMATION

OSHA Hazards
Flammable liquid, Harmful by ingestion., Irritant

DSL Status
All components of this product are on the Canadian DSL list.

SARA 302 Components
SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
trans-Dichloroethylene	156-60-5	1993-04-24

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
trans-Dichloroethylene	156-60-5	1993-04-24

New Jersey Right To Know Components

	CAS-No.	Revision Date
trans-Dichloroethylene	156-60-5	1993-04-24

California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Co., shall not be held liable for any damage resulting from handling or from contact with the above product. See reverse side of invoice or packing slip for additional terms and conditions of sale.

International Chemical Safety Cards

TRICHLOROETHYLENE

ICSC: 0081

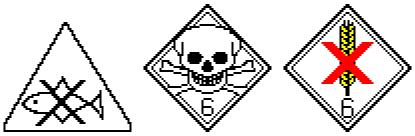
UNEP

National Institute for Occupational Safety and Health

NIOSH

1,1,2-Trichloroethylene
Trichloroethene
Ethylene trichloride
Acetylene trichloride
C_2HCl_3 / $ClCH=CCl_2$
Molecular mass: 131.4

ICSC # 0081
CAS # 79-01-6
RTECS # KX4550000
UN # 1710
EC # 602-027-00-9
April 10, 2000 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible under specific conditions. See Notes.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION		Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT GENERATION OF MISTS! STRICT HYGIENE!	
•INHALATION	Dizziness. Drowsiness. Headache. Weakness. Nausea. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration may be needed. Refer for medical attention.
•SKIN	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain.	Safety spectacles, 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	Abdominal pain. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Give one or two glasses of water to drink. Rest.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Ventilation. Personal protection: filter respirator for organic gases and vapours adapted to the airborne concentration of the substance. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment.	Separated from metals (see Chemical Dangers), strong bases, food and feedstuffs . Dry. Keep in the dark. Ventilation along the floor. Store in an area without drain or sewer access.	Do not transport with food and feedstuffs. Marine pollutant. T symbol R: 45-36/38-52/53-67 S: 53-45-61 UN Hazard Class: 6.1 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the

ICSC: 0081 OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

TRICHLOROETHYLENE

ICSC: 0081

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air. As a result of flow, agitation, etc., electrostatic charges can be generated.

CHEMICAL DANGERS:
On contact with hot surfaces or flames this substance decomposes forming toxic and corrosive fumes (phosgene , hydrogen chloride). The substance decomposes on contact with strong alkali producing dichloroacetylene , which increases fire hazard. Reacts violently with metal powders such as magnesium, aluminium, titanium, and barium. Slowly decomposed by light in presence of moisture, with formation of corrosive hydrochloric acid.

OCCUPATIONAL EXPOSURE LIMITS:
TLV: 50 ppm as TWA; 100 ppm as STEL; A5; BEI issued; (ACGIH 2004).
MAK:
Carcinogen category: 1; Germ cell mutagen group: 3B; (DFG 2007).
OSHA PEL†: TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours)
NIOSH REL: Ca See Appendix A See Appendix C
NIOSH IDLH: Ca 1000 ppm See: 79016

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation and by ingestion.

INHALATION RISK:
A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is irritating to the eyes and the skin . Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system , resulting in respiratory failure . Exposure could cause lowering of consciousness.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the central nervous system , resulting in loss of memory. The substance may have effects on the liver and kidneys (see Notes). This substance is probably carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 87°C
Melting point: -73°C
Relative density (water = 1): 1.5
Solubility in water, g/100 ml at 20°C: 0.1
Vapour pressure, kPa at 20°C: 7.8
Relative vapour density (air = 1): 4.5
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.3
Auto-ignition temperature: 410°C
Explosive limits, vol% in air: 8-10.5
Octanol/water partition coefficient as log Pow: 2.42
Electrical conductivity: 800pS/m

ENVIRONMENTAL DATA

The substance is harmful to aquatic organisms. The substance may cause long-term effects in the aquatic environment.

NOTES

Combustible vapour/air mixtures difficult to ignite, may be developed under certain conditions. Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is suggested. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding. An added stabilizer or inhibitor can influence the toxicological properties of this substance, consult an expert.

Transport Emergency Card: TEC (R)-61S1710

NFPA Code: H2; F1; R0;
Card has been partially updated in October 2004: see Occupational Exposure Limits, EU Classification, Emergency Response.
Card has been partially updated in April 2010: see Occupational Exposure Limits, Ingestion First Aid, Storage.

ADDITIONAL INFORMATION

ICSC: 0081 **TRICHLOROETHYLENE**

IMPORTANT LEGAL NOTICE:	Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, 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. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

VINYL CHLORIDE

ICSC: 0082

Chloroethene
Chloroethylene
VCM
C_2H_3Cl / $H_2C{=}CHCl$
Molecular mass: 62.5
(cylinder)

ICSC # 0082
CAS # 75-01-4
RTECS # KU9625000
UN # 1086 (stabilized)
EC # 602-023-00-7
April 13, 2000 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Extremely flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking.	Shut off supply; if not possible and no risk to surroundings, let the fire burn itself out; in other cases extinguish with powder, carbon dioxide.
EXPLOSION	Gas/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Use non-sparking handtools.	In case of fire: keep cylinder cool by spraying with water. Combat fire from a sheltered position.
EXPOSURE		AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
•INHALATION	Dizziness. Drowsiness. Headache. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	ON CONTACT WITH LIQUID: FROSTBITE.	Protective gloves. Cold-insulating gloves. Protective clothing.	ON FROSTBITE: rinse with plenty of water, do NOT remove clothes.
•EYES	Redness. Pain.	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.	

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Consult an expert! Ventilation. Remove all ignition sources. Personal protection: complete protective clothing including self-contained breathing apparatus.	Fireproof. Separated from incompatible materials .(See Chemical Dangers.) Cool. Store only if stabilized.	Note: D F+ symbol T symbol R: 45-12 S: 53-45 UN Hazard Class: 2.1

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0082

International Chemical Safety Cards

VINYL CHLORIDE

ICSC: 0082

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS COMPRESSED LIQUEFIED GAS , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The gas is heavier than air, and may travel along the ground; distant ignition possible. Vinyl chloride monomer vapours are uninhibited and may form polymers in vents or flame arresters of storage tanks, resulting in blockage of vents.

CHEMICAL DANGERS:
The substance can under specific circumstances form peroxides, initiating explosive polymerization. The substance will polymerize readily due to heating and under the influence of air, light and on contact with a catalyst, strong oxidizing agents and metals such as copper and aluminium, with fire or explosion hazard. The substance decomposes on burning producing toxic and corrosive fumes (hydrogen chloride , phosgene). Attacks iron and steel in the presence of moisture.

OCCUPATIONAL EXPOSURE LIMITS:
TLV: 1 ppm as TWA; A1 (confirmed human carcinogen); (ACGIH 2004).
MAK:
Carcinogen category: 1;
(DFG 2004).
OSHA PEL: 1910.1017 TWA 1 ppm C 5 ppm 15-minute
NIOSH REL: Ca See Appendix A
NIOSH IDLH: Ca N.D. See: IDLH INDEX

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation.

INHALATION RISK:
A harmful concentration of this gas in the air will be reached very quickly on loss of containment.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is irritating to the eyes . The liquid may cause frostbite. The substance may cause effects on the central nervous system . Exposure could cause lowering of consciousness. Medical observation is indicated.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The substance may have effects on the liver, spleen, blood andperipheral blood vessels, and tissue and bones of the fingers. This substance is carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: -13°C
Melting point: -154°C
Relative density (water = 1): 0.9 (liquid)
Density: 8 (vapour) at 15°C
g/l
Solubility in water:
none
Relative vapour density (air = 1): 2.2
Flash point:
-78°C c.c.
Auto-ignition temperature: 472°C
Explosive limits, vol% in air: 3.6-33
Octanol/water partition coefficient as log Pow: 0.6

ENVIRONMENTAL DATA

This substance may be hazardous to the environment; special attention should be given to ground water contamination.

N O T E S

Depending on the degree of exposure, periodic medical examination is suggested. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding. An added stabilizer or inhibitor can influence the toxicological properties of this substance, consult an expert. Card has been partly updated in April 2005. See section Occupational Exposure Limits.

Transport Emergency Card: TEC (R)-20S1086

NFPA Code: H 2; F 4; R 2;

ADDITIONAL INFORMATION

ICSC: 0082 **VINYL CHLORIDE**

APPENDIX D

HOSPITAL INFORMATION AND MAP

FIELD ACCIDENT REPORT

FIELD ACCIDENT REPORT

This report is to be filled out by the designated Site Safety Officer after EVERY accident.

PROJECT NAME ________________________________ PROJECT. NO.______________

Date of Accident ____________________ Time ________ Report By _________________

Type of Accident (Check One):

( ) Vehicular ( ) Personal ( ) Property

Name of Injured ____ DOB or Age ________

How Long Employed ____

Names of Witnesses ____

____

Description of Accident ____

____

____

Action Taken ____

____

____

Did the Injured Lose Any Time? _______ How Much (Days/Hrs.)? ___________________

Was Safety Equipment in Use at the Time of the Accident (Hard Hat, Safety Glasses, Gloves, Safety Shoes, etc.)? ____

____

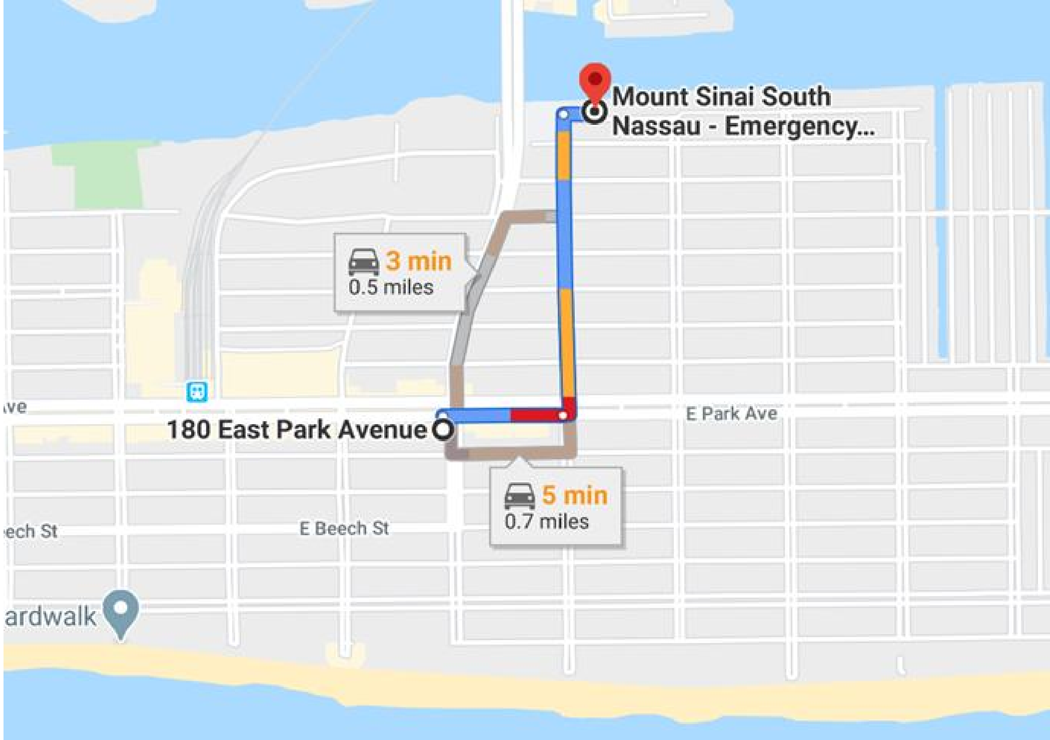
(If not, it is the EMPLOYEE'S sole responsibility to process his/her claim through his/her Health and Welfare Fund.)

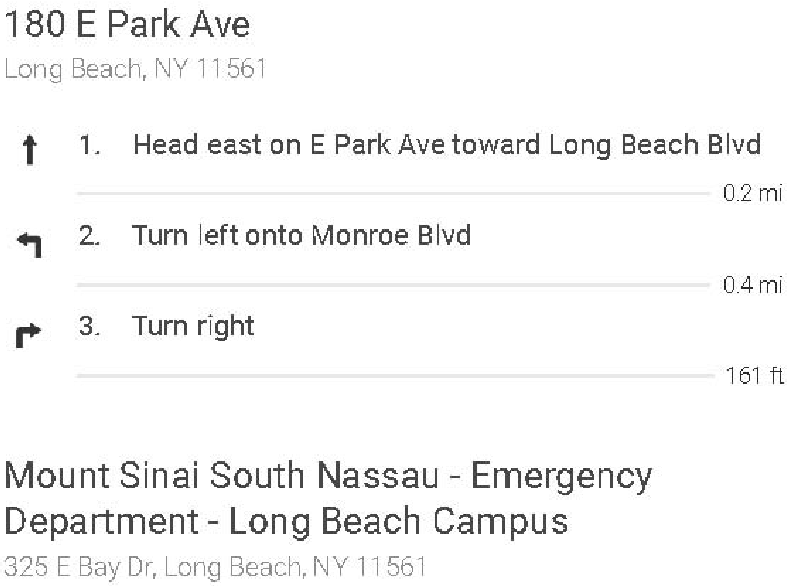
INDICATE STREET NAMES, DESCRIPTION OF VEHICLES, AND NORTH ARROW

HOSPITAL INFORMATION AND MAP

The hospital nearest the site is:

WYCKOFF HEIGHTS MEDICAL CENTER
374 Stockholm St, Brooklyn, NY 11237
718-963-7272
0.6 Miles – About 4 Minutes





180 E Park Ave
Long Beach, NY 11561

↑ 1. Head east on E Park Ave toward Long Beach Blvd
0.2 mi

↰ 2. Turn left onto Monroe Blvd
0.4 mi

↱ 3. Turn right
161 ft

Mount Sinai South Nassau - Emergency Department - Long Beach Campus
325 E Bay Dr, Long Beach, NY 11561

ATTACHMENT C
Quality Assurance Project Plan

QUALITY ASSURANCE PROJECT PLAN
Former Nu-Clear Cleaners Site

Prepared on behalf of:

180 Park Avenue LLC
54 Regent Drive
Lido Beach, NY 11561

Prepared by:

EBC
ENVIRONMENTAL BUSINESS CONSULTANTS
RIDGE, NY 11961

TABLE OF CONTENTS

QUALITY ASSURANCE PROJECT PLAN

Former Nu-Clear Cleaners Site
180 E. Park Avenue, Long Beach, NY

1.0 PROJECT ORGANIZATION AND RESPONSIBILITIES 1
  1.1 Organization 1

2.0 QUALITY ASSURANCE PROJECT PLAN OBJECTIVES 2
  2.1 Overview 2
  2.2 QA/QC Requirements for Analytical Laboratory 2
    2.2.1 Instrument calibration 2
    2.2.2 Continuing Instrument calibration 2
    2.2.3 Method Blanks 2
    2.2.4 Trip Blanks 3
    2.2.5 Surrogate Spike Analysis 3
    2.2.6 Matrix Spike / Matrix Spike duplicate / Matrix Spike Blank 3
  2.3 Accuracy 3
  2.4 Precision 4
  2.5 Sensitivity 4
  2.6 Representativeness 4
  2.7 Completeness 4
  2.8 Laboratory Custody Procedures 5

3.0 ANALYTICAL PROCEDURES 6
  3.1 Laboratory Analyses 6

4.0 DATA REDUCTION, VALIDATION, REVIEW. AND REPORTING 7
  4.1 Overview 7
  4.2 Data Reduction 7
  4.3 Laboratory Data Reporting 7

5.0 CORRECTIVE ACTION 8

TABLES

Table 1 Analytical Summary Table
Table 2 Containers Preservatives and Holding Times

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been prepared in accordance with DER-10 to detail procedures to be followed during the course of the sampling and analytical portion of the project, as required by the approved work plan.

To ensure the successful completion of the project each individual responsible for a given component of the project must be aware of the quality assurance objectives of his / her particular work and of the overall project. The EBC Project Director, Charles Sosik will be directly responsible to the client for the overall project conduct and quality assurance/quality control (QA/QC) for the project. The Project Director will be responsible for overseeing all technical and administrative aspects of the project and for directing QA/QC activities. As Project Director Mr. Sosik will also serve as the Quality Assurance Officer (QAO) and in this role may conduct:

- conduct periodic field and sampling audits;
- interface with the analytical laboratory to resolve problems; and
- interface with the data validator and/or the preparer of the DUSR to resolve problems.

Keith Butler will serve as the Project Manager and will be responsible for implementation of the Remedial Investigation and coordination with field sampling crews and subcontractors. Reporting directly to the Project Manager will be the Field Operations Officer, Tom Gallo; who will serve as the on-Site qualified environmental professional who will record observations, direct the drilling crew and be responsible for the collection and handling of all samples.

1.1 Organization

Project QA will be maintained under the direction of the Project Manager, in accordance with this QAPP. QC for specific tasks will be the responsibility of the individuals and organizations listed below, under the direction and coordination of the Project Manager
.

GENERAL RESPONSIBILITY	SCOPE OF WORK	RESPONSIBILITY OF QUALITY CONTROL
Field Operations	Supervision of Field Crew, sample collection and handling	T. Gallo, EBC
Project Manager	Implementation of the RI according to the RIWP.	K. Butler, EBC
Laboratory Analysis	Analysis of soil samples by NYSDEC ASP methods Laboratory	NYSDOH-Certified Laboratory
Data review	Review for completeness and compliance	3rd party validation

2.0 QUALITY ASSURANCE PROJECT PLAN OBJECTIVES

2.1 Overview

Overall project goals are defined through the development of Data Quality Objectives (DQOs), which are qualitative and quantitative Statements that specify the quality of the data required to support decisions; DQOs, as described in this section, are based on the end uses of the data as described in the work plan.

In this plan, Quality Assurance and Quality Control are defined as follows:

- Quality Assurance - The overall integrated program for assuring reliability of monitoring and measurement data.

- Quality Control - The routine application of procedures for obtaining prescribed standards of performance in the monitoring and measurement process.

2.2 QA / QC Requirements for Analytical Laboratory

Samples will be analyzed by a New York State Department of Health (NYSDOH) certified laboratory that is certified in the appropriate categories. Data generated from the laboratory will be used to evaluate contaminants such as chlorinated and other volatile organic compounds (VOCs) in soil, soil gas and groundwater. The QA requirements for all subcontracted analytical laboratory work performed on this project are described below. QA elements to be evaluated include accuracy, precision, sensitivity, representativeness, and completeness. The data generated by the analytical laboratory for this project are required to be sensitive enough to achieve required quantification limits as specified in NYSDEC Analytical Services Protocol (NYSDEC ASP, 07/2005) and useful for comparison with clean-up objectives. The analytical results meeting the required quantification limits will provide data sensitive enough to meet the data quality objectives of this remedial program as described in the work plan. Reporting of the data must be clear, concise, and comprehensive. The QC elements that are important to this project are completeness of field data, sample custody, sample holding times, sample preservation, sample storage, instrument calibration and blank contamination.

2.2.1 Instrument Calibration

Calibration curves will be developed for each of the compounds to be analyzed. Standard concentrations and a blank will be used to produce the initial curves. The development of calibration curves and initial calibration response factors must be consistent with method requirements presented in the most recent version of NYSDEC ASP 07/2005).

2.2.2 Continuing Instrument Calibration

The initial calibration curve will be verified every 12 hrs by analyzing one calibration standard. The standard concentration will be the midpoint concentration of the initial calibration curve. The calibration check compound must come within 25% relative percent difference (RPD) of the average response factor obtained during initial calibration. If the RPD is greater than 25%, then corrective action must be taken as provided in the specific methodology.

2.2.3 Method Blanks

Method blank or preparation blank is prepared from an analyte·free matrix which includes the same reagents, internal standards and surrogate standards as me related samples. II is carried through the entire sample preparation and analytical procedure. A method blank analysis will be performed once for each 12 hr period during the analysis of samples for volatiles. An acceptable method blank will contain less than two (2) times the CRQL of methylene chloride, acetone and 2-butanone. For all other target compounds, the method blank must contain less than or equal to the CRQL of any single target compound. For non-target peaks in the method blank, the peak area must be less than 10 percent of the nearest internal standard. The method blank will be used to demonstrate the level of laboratory background and reagent contamination that might result from the analytical process itself.

2.2.4 Trip Blanks.

Trip blanks consist of a single set of sample containers filled at the laboratory with deionized. laboratory-grade water. The water used will be from the same source as that used for the laboratory method blank. The containers will be carried into the field and handled and transported in the same way as the samples collected that day. Analysis of the trip blank for VOCs is used to identify contamination from the air, shipping containers, or from other items coming in contact with the sample bottles. (The bottles holding the trip blanks will be not opened during this procedure.) A complete set of trip blanks will be provided with each shipment of samples to the certified laboratory.

2.2.5 Surrogate Spike Analysis

For organic analyses, all samples and blanks will be spiked with surrogate compounds before purging or extraction in order to monitor preparation and analyses of samples. Surrogate spike recoveries shall fall within the advisory limits in accordance with the NY5DEC ASP protocols for samples falling within the quantification limits without dilution.

2.2.6 Matrix Spike / Matrix Spike Duplicate / Matrix Spike Blank (MS/MSDIMSB) Analysis

MS, MSD and MSB analyses will be performed to evaluate the matrix effect of the sample upon the analytical methodology along with the precision of the instrument by measuring recoveries. The MS / MSD / MSB samples will be analyzed for each group of samples of a similar matrix at a rate of 5% (one for every 20 field samples). The RPD will be calculated from the difference between the MS and MSD. Matrix spike blank analysis will be performed to indicate the appropriateness of the spiking solution(s) used for the MS/MSD. 10% of the samples of each matrix should be sampled and anlayzed as Duplicates.

2.3 Accuracy

Accuracy is defined as the nearness of a real or the mean (x) of a set of results to the true value. Accuracy is assessed by means of reference samples and percent recoveries. Accuracy includes both precision and recovery and is expressed as percent recovery (% REC). The MS sample is used to determine the percent recovery. The matrix spike percent recovery (% REC) is calculated by the following equation:

$$\%REC = \frac{SSR - SR}{SA} \times 100$$

Where:
SSR = spike sample results
SR = sample results
SA = spike added from spiking mix

2.4 Precision

Precision is defined as the measurement of agreement of a set of replicate results among themselves without a Precision is defined as the measurement of agreement of a set of replicate results among themselves without assumption of any prior information as to the true result. Precision is assessed by means of duplicate/replicate sample analyses.

Analytical precision is expressed in terms of RPD. The RPD is calculated using the following formula:

$$RPD = \frac{D^1 - D^2}{(D^1 + D^2)/2} \times 100$$

Where:
RPD = relative percent difference
D^1 = first sample value
D^2 = second sample value (duplicate)

2.5 Sensitivity

The sensitivity objectives for this plan require that data generated by the analytical laboratory achieve quantification levels low enough to meet the required detection limits specified by NYSDEC ASP and to meet all site-specific standards, criteria and guidance values (SGCs) established for this project.

2.6 Representativeness

Representativeness is a measure of the relationship of an individual sample taken from a particular site to the remainder of that site and the relationship of a small aliquot of the sample (i.e., the one used in the actual analysis) to the sample remaining on site. The representativeness of samples is assured by adherence to sampling procedures described in the Remedial Investigation Work Plan.

2.7 Completeness

Completeness is a measure of the quantity of data obtained from a measurement system as compared to the amount of data expected from the measurement system. Completeness is defined as the percentage of all results that are not affected by failing QC qualifiers, and should be between 70 and 100% of all analyses performed. The objective of completeness in laboratory reporting is to provide a thorough data support package. The laboratory data package provides documentation of sample analysis and results in the form of summaries, QC data, and raw analytical data. The laboratory will be required to submit data packages that follow NYSDEC ASP Category B reporting format which, at a minimum, will include the following components:

1. All sample chain-of-custody forms.
2. The case narrative(s) presenting a discussion of any problems and/or procedural changes required during analyses. Also presented in the case narrative are sample summary forms.
3. Documentation demonstrating the laboratory's ability to attain the contract specified detection limits for all target analytes in all required matrices.
4. Tabulated target compound results and tentatively identified compounds.
5. Surrogate spike analysis results (organics).
6. Matrix spike/matrix spike duplicate/matrix spike blank results.
7. QC check sample and standard recovery results
8. Blank results (field, trip, and method).
9. Internal standard area and RT summary.

2.8 Laboratory Custody Procedures

The following elements are important for maintaining the field custody of samples:

- Sample identification
- Sample labels
- Custody records
- Shipping records
- Packaging procedures

Sample labels will be attached to all sampling bottles before field activities begin; each label will contain an identifying number. Each number will have a suffix that identifies the site and where the sample was taken. Approximate sampling locations will be marked on a map with a description of the sample location. The number, type of sample, and sample identification will be entered into the field logbook. A chain-of-custody form, initiated at the analytical laboratory will accompany the sample bottles from the laboratory into the field. Upon receipt of the bottles and cooler, the sampler will sign and date the first received blank space. After each sample is collected and appropriately identified, entries will be made on the chain-of-custody form that will include:

- Site name and address
- Samplers' names and signatures

2.9 Sample Handling and Decontamination Procedures

Collected samples will be appropriately packaged, placed in coolers and shipped via overnight courier or delivered directly to the analytical laboratory by field personnel. Samples will be containerized in appropriate laboratory provided glassware and shipped in plastic coolers. Samples will be preserved through the use of ice or cold-pak(s) to maintain a temperature of 4^{o}C.

Dedicated disposable sampling materials will be used for both soil and groundwater samples (if collected), eliminating the need to prepare field equipment (rinsate) blanks. However, if non-disposable equipment is used, (stainless steel scoop, etc.) field rinsate blanks will be prepared at the rate of 1 for every eight samples collected. No field filtering will be conducted; any required filtration will be completed by the laboratory.

Decontamination of non-dedicated sampling equipment will consist of the following:

- Gently tap or scrape to remove adhered soil;
- Rinse with tap water;
- Wash with alconox® detergent solution and scrub ;
- Rinse with tap water;
- Rinse with distilled or deionized water.

Prepare field blanks by pouring distilled or deionized water over decontaminated equipment and collecting the water in laboratory provided containers. Trip blanks will accompany samples each time they are transported to the laboratory. Matrix spike and matrix spike duplicates (MS/MSD) will be collected at the rate of one per 20 samples submitted to the laboratory and duplicate samples will be collected at a rate of one per ten samples submitted to the laboratory.

3.0 ANALYTICAL PROCEDURES

3.1 Laboratory Analysis

Samples will be analyzed by the NYSDOH ELAP laboratory for one or more of the following parameters: VOCs in soil / groundwater by USEPA Method 8260C, SVOCs and 1,4 dioxane in soil / groundwater by USEPA Method 8270D, Target Analyte List (TAL) Metals 6010 in soil and groundwater, pesticides / PCBs by USEPA Method 8081B/8082A and PFAS compounds by EPA Method 537 (Table 2). If any modifications or additions to the standard procedures are anticipated and if any nonstandard sample preparation or analytical protocol is to be used, the modifications and the nonstandard protocol will be explicitly defined and documented. Prior approval by EBC's PM will be necessary for any nonstandard analytical or sample preparation protocol used by the laboratory, i.e., dilution of samples or extracts by greater than a factor of five (5).

4.0 DATA REDUCTION, REVIEW, AND REPORTING

4.1 Overview

The process of data reduction, review, and reporting ensures the assessments or a conclusion based on the final data accurately reflects actual site conditions. This plan presents the specific procedures, methods, and format that will be employed for data reduction, review and reporting of each measurement parameter determined in the laboratory and field. Also described in this section is the process by which all data, reports, and work plans are proofed and checked for technical and numerical errors prior to final submission.

4.2 Data Reduction

Standard methods and references will be used as guidelines for data handling, reduction, validation, and reporting. All data for the project will be compiled and summarized with an independent verification at each step in the process to prevent transcription/typographical errors. Any computerized entry of data will also undergo verification review.

Sample analysis will be provided by a New York State certified environmental laboratory. Laboratory reports will include ASP category B deliverables for use in the preparation of a data usability summary report (DUSR). All results will be provided in accordance with the NYSDEC Environmental Information Management System (EIMS) electronic data deliverable (EDD) format. Analytical results shall be presented on standard NYSDEC ASP-B forms or equivalents, and include the dates the samples were received and analyzed, and the actual methodology used. Note that if waste characterization samples are analyzed they will be in results only format and will not be evaluated in the DUSR.

Laboratory QA/QC information required by the method protocols will be compiled, including the application of data QA/QC qualifiers as appropriate. In addition, laboratory worksheets, laboratory notebooks, chains-of-custody, instrument logs, standards records, calibration records, and maintenance records, as applicable, will be provided in the laboratory data packages to determine the validity of data. Specifics on internal laboratory data reduction protocols are identified in the laboratory's SOPs.

Following receipt of the laboratory analytical results by EBC, the data results will be compiled and presented in an appropriate tabular form. Where appropriate, the impacts of QA/QC qualifiers resulting from laboratory or external validation reviews will be assessed in terms of data usability.

4.3 Laboratory Data Reporting

All sample data packages submitted by the analytical laboratory will be required to be reported in conformance to the NYSDEC ASP (7/2005), Category B data deliverable requirements as applicable to the method utilized. All results will be provided in accordance with the NYSDEC Environmental Information Management System (EIMS) electronic data deliverable (EDD) format. Note that waste characterization samples, if analyzed, will be in results only format and will not be evaluated in the DUSR.

5.0 CORRECTIVE ACTION

Review and implementation of systems and procedures may result in recommendations for corrective action. Any deviations from the specified procedures within approved project plans due to unexpected site-specific conditions shall warrant corrective action. All errors, deficiencies, or other problems shall be brought to the immediate attention of the EBC PM, who in turn shall contact the Quality Assurance/Data Quality Manager or his designee (if applicable).

Procedures have been established to ensure that conditions adverse to data quality are promptly investigated, evaluated and corrected. These procedures for review and implementation of a change are as follows:

- Define the problem.
- Investigate the cause of the problem.
- Develop a corrective action to eliminate the problem, in consultation with the personnel who defined the problem and who will implement the change.
- Complete the required form describing the change and its rationale (see below for form requirements).
- Obtain all required written approvals.
- Implement the corrective action.
- Verify that the change has eliminated the problem.

During the field investigation, all changes to the sampling program will be documented in field logs/sheets and the EBC PM advised.

If any problems occur with the laboratory or analyses, the laboratory must immediately notify the PM, who will consult with other project staff. All approved corrective actions shall be controlled and documented.

All corrective action documentation shall include an explanation of the problem and a proposed solution which will be maintained in the project file or associated logs. Each report must be approved by the necessary personnel (e.g., the PM) before implementation of the change occurs. The PM shall be responsible for controlling, tracking, implementing and distributing identified changes.

TABLE 1
SUMMARY OF
SAMPLING PROGRAM RATIONALE AND ANALYSIS

Matrix	Location	Approximate Number of Samples	Frequency	Rationale for Sampling	Laboratory Analysis	Duplicates	Matrix Spikes	Spike Duplicates	Trip Blanks
Soil	Sitewide excavation base	9	Base: 1 per 900 sq ft	Endpoint Verification of SCOs for specified Cleanup Track	VOCs EPA Method 8260B, SVOCs EPA Method 8270, pesticide / PCBs EPA Method 8081/8082, TAL metals EPA 6010.	1 per day	1 per 20 samples	1 per 20 samples	1 per trip
Soil	Sitewide excavation base	2	Base: 20 percent of total base samples	Endpoint Verification of SCOs for specified Cleanup Track	PFOS Compounds EPA Method 537, 1,4-dioxane EPA Method 8270 SIM	1 per day	1 per 20 samples	1 per 20 samples	1 per trip
Soil	CVOC Hotspots	9	Sidewall: 1 per side.	Endpoint Verification of SCOs for specified Cleanup Track	VOCs EPA Method 8260B	1 per day	1 per 20 samples	1 per 20 samples	1 per trip
Soil	Excavated clean native soil for on-site reuse	based on soil volume as per CP51	based on soil volume as per CP51	Comparison to SCOs for on-site reuse	VOCs EPA Method 8260B, SVOCs by 8270C pesticides and PCBs by EPA 8081/8082, other as per disposal facility	0	0	0	0
Water	Three Monitoring Wells	4	1 basline round, two post remedial rounds	To evaluate ISCO effectiveness	VOCs EPA Method 8260B	1 per day	1 per 20 samples	1 per 20 samples	1 per trip

TABLE 2
SAMPLE COLLECTION AND ANALYSIS PROTOCOLS

Sample Type	Matrix	Sampling Device	Parameter	Sample Container	Sample Preservation	Analytical Method#	CRQL / MDLH	Holding Time
Grab	Soil	Scoop Direct into Jar	VOCs	(1) 2 oz Jar	Cool to 4^{o} C	EPA Method 8260C (test method 5035A)	Compound specific (1-5 ug/kg)	14 days
Grab	Soil	Scoop Direct into Jar	SVOCs	(1) 8 oz jar	Cool to 4^{o} C	EPA Method 8270D	Compound specific (1-5 ug/kg)	14 day ext/40 days
Grab	Soil	Scoop Direct into Jar	Pest/PCBs	from 8oz jar above	Cool to 4^{o} C	EPA Method 8081B/8082A	Compound specific (1-5 ug/kg)	14 day ext/40 days
Grab	Soil	Scoop Direct into Jar	1,4-dioxane	(1) 8 oz jar	Cool to 4^{o} C Water ice only	Method 8270 SIM	[0.1 mg/kg (ppm)]	14 days 40 days after extraction
Grab	Soil	Scoop Direct into Jar	PFAS Target Analyte List	(1) 8 oz jar	Cool to 4^{o} C Water ice only	EPA Method 537 Modified	Compound specific [but less than 1 ug/kg (ppb)]	14 days 40 days after extraction
Grab	Soil	Scoop Direct into Jar	Metals	from 8oz jar above	Cool to 4^{o} C	TAL Metals 6010	Compound specific (01-1 mg/kg)	6 months
Grab	Water	Pump tubing	VOCs	(3) 40 ml vials	Cool to 4^{o} C 1:1 HCL	EPA Method 8260C	Compound specific (1-5 ug/L)	14 days

Notes:
All holding times listed are from Verified Time of Sample Receipt (VTSR) unless noted otherwise. * Holding time listed is from time of sample collection.
The number in parentheses in the "Sample Container" column denotes the number of containers needed.
Triple volume required when collected MS/MSD samples
The number of trip blanks are estimated.
CRQL / MDL = Contract Required Quantitation Limit / Method Detection Limit
NA = Not available or not applicable.

EPA 537 (PFAS) Field Sampling Guidelines

PLEASE READ INSTRUCTIONS ENTIRELY PRIOR TO SAMPLING EVENT

Sampling for PFAS via EPA 537 can be challenging due to the prevalence of these compounds in consumer products. The following guidelines are strongly recommended when conducting sampling.

Reference-NHDES https://www.des.nh.gov/organization/divisions/waste/hwrb/documents/pfc-stakeholder-notification-20161122.pdf

FIELD CLOTHING and PPE

- No clothing or boots containing Gore-Tex®
- All safety boots made from polyurethane and PVC
- No materials containing Tyvek®
- Do not use fabric softener on clothing to be worn in field
- Do not used cosmetics, moisturizers, hand cream, or other related products the morning of sampling
- Do not use unauthorized sunscreen or insect repellant (see reference above for acceptable products)

SAMPLE CONTAINERS

- All sample containers made of HDPE or polypropylene
- Caps are unlined and made of HDPE or polypropylene (no Teflon®-lined caps)

WET WEATHER (AS APPLICABLE)

Wet weather gear made of polyurethane and PVC only

EQUIPMENT DECONTAMINATION

- "PFAS-free" water on-site for decontamination of sample equipment. No other water sources to be used
- Only Alconox and Liquinox can be used as decontamination materials

FOOD CONSIDERATIONS

No food or drink on-site with exception of bottled water and/or hydration drinks (i.e., Gatorade and Powerade) that is available for consumption only in the staging area

OTHER RECOMMENDATIONS

Sample for PFAS first! Other containers for other methods may have PFAS present on their sampling containers

FIELD EQUIPMENT

- Must not contain Teflon® (aka PTFE) or LDPE materials
- All sampling materials must be made from stainless steel, HDPE, acetate, silicon, or polypropylene
- No waterproof field books can be used
- No plastic clipboards, binders, or spiral hard cover notebooks can be used
- No adhesives (i.e. Post-It® Notes) can be used
- Sharpies and permanent markers not allowed; regular ball point pens are acceptable
- Aluminum foil must not be used
- Keep PFC samples in separate cooler, away from sampling containers that may contain PFAS
- Coolers filled with regular ice only - Do not use chemical (blue) ice packs

EPA 537 (PFAS) Field Sampling Guidelines

PLEASE READ INSTRUCTIONS ENTIRELY PRIOR TO SAMPLING EVENT

Sampler must wash hands before wearing nitrile gloves in order to limit contamination during sampling. Each sample set requires a set of containers to comply with the method as indicated below. **Sample set is composed of samples collected from the same sample site and at the same time.*

Container Count	Container Type	Preservative
3 Sampling Containers - Empty	250 mL container	Pre preserved with 1.25 g Trizma
1 Reagent Water for Field Blank use	250 mL container	Pre preserved with 1.25 g Trizma
P1 Field Blank (FRB) - Empty	250 mL container	Unpreserved

Sampling container must be filled to the neck. For instructional purposes a black line has been drawn to illustrate the required fill level for each of the 3 Sample containers

Field blanks are recommended and the containers have been provided, please follow the instructions below.

Field Blank Instructions:

1. Locate the Reagent Water container from the bottle order. The Reagent Water container will be pre-filled with PFAS-free water and is preserved with Trizma.
2. Locate the empty container labeled "Field Blank".
3. Open both containers and proceed to transfer contents of the "Reagent Water" container into the "Field Blank" container.
4. If field blanks are to be analyzed, they need to be noted on COC, and will be billed accordingly as a sample.

Both the empty Reagent Water container and the filled Field Blank container must be returned to the lab along with the samples taken.

Sampling Instructions:

1. Each sampling event requires 3 containers to be filled to the neck of the provided containers for each sampling location.
2. Before sampling, remove faucet aerator, run water for 5 min, slow water to flow of pencil to avoid splashing and fill sample containers to neck of container (as previously illustrated) and invert 5 times.
3. Do not overfill or rinse the container.
4. Close containers securely. Place containers in sealed ZipLoc® bags, and in a separate cooler (no other container types).
5. Ensure Chain-of-Custody and all labels on containers contain required information. Place sample, Field Blank and empty Reagent Blank containers in ice filled cooler (do not use blue ice) and return to the laboratory. Samples should be kept at 4°C ±2. Samples must not exceed 10°C during first 48 hours after collection. Hold time is 14 days.

Please contact your Alpha Analytical project manager with additional questions or concerns.

PFAS Sampling Instructions for non-Drinking Water (non-SDWA) for EPA Method 537 and/or LC/MS/MS Incorporating the Isotope Dilution Technique

Please read instructions entirely prior to sampling event.

It should be noted that there is considerable information available from the US EPA as well as a multitude of state regulatory agencies regarding the potential for PFAS cross-contamination during sampling. It is recommended that samplers consult the applicable regulatory guidance prior to sampling. For additional information, please refer to “METHOD 537. Version 1.1, September 2009, EPA Document #: EPA/600/R-08/092”.

The sample handler should wash their hands before sampling and wear nitrile gloves while filling and sealing the sample bottles. PFAS contamination during sampling can occur from a number of common sources, such as food packaging and certain foods and beverages. Proper hand washing and wearing nitrile gloves will aid in minimizing this type of accidental contamination of the samples.

Container Count	Container Type	Preservative
2 Sampling Containers - Empty	275 mL container	Unpreserved
Reagent Water for Field Blank use	275 mL container	Unpreserved
1 Field Blank (FRB) Container - Empty	275 mL container	Unpreserved

**** Sampling container <u>must be filled to the neck</u>. For instructional purposes a black line has been drawn to illustrate the required fill level for each of the 2 Sample containers****

Sample containers for field blanks are included with your container order. If you wish to submit field blanks (billable samples) in addition to your field samples, please prepare them as instructed below:

Field Blank Instructions:

1. Locate the Reagent Water container from the bottle order. The Reagent Water container is prefilled with PFAS-free water and preserved with Trizma.
2. Locate the empty container labeled “Field Blank”.
3. Open both containers and proceed to transfer contents of the “Reagent Water” container into the “Field Blank” container.

Both the <u>empty</u> Reagent Water container and the <u>filled</u> Field Blank container must be returned to the laboratory along with the samples taken.

Sampling Instructions:

1. Each sampling event requires 2 containers to be filled to the neck of the provided containers for each sampling location.
2. Fill sample containers to neck of container (as previously illustrated) and invert 5 times.
3. Do not overfill or rinse the container.
4. Close containers securely.
5. Ensure Chain-of-Custody and all labels on containers contain required information.
   Place sample, Field Blank and empty Reagent Blank containers in ice filled cooler and return to the laboratory. Samples should be kept at 4°C ±2. Samples must not exceed 10°C during first 48 hours after collection. Hold time is 14 days.

Please contact your project manager with additional questions or concerns.

Date Created: 05/14/19
Created By: Tom Tanico
File: PM6636-1
Page: 1

NY PFAAs via EPA 537(M)-Isotope Dilution (SOIL)

Holding Time: 28 days
Container/Sample Preservation: 1 - Plastic 8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Perfluorobutanoic Acid (PFBA)	375-22-4	1	0.0213	ng/g	71-135	30	71-135	30	30			
Perfluoropentanoic Acid (PFPeA)	2706-90-3	1	0.01035	ng/g	69-132	30	69-132	30	30			
Perfluorobutanesulfonic Acid (PFBS)	375-73-5	1	0.0635	ng/g	72-128	30	72-128	30	30			
Perfluorohexanoic Acid (PFHxA)	307-24-4	1	0.064	ng/g	70-132	30	70-132	30	30			
Perfluoroheptanoic Acid (PFHpA)	375-85-9	1	0.064	ng/g	71-131	30	71-131	30	30			
Perfluorohexanesulfonic Acid (PFHxS)	355-46-4	1	0.057	ng/g	67-130	30	67-130	30	30			
Perfluorooctanoic Acid (PFOA)	335-67-1	1	0.04105	ng/g	69-133	30	69-133	30	30			
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	27619-97-2	1	0.198	ng/g	64-140	30	64-140	30	30			
Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8	1	0.136	ng/g	70-132	30	70-132	30	30			
Perfluorononanoic Acid (PFNA)	375-95-1	1	0.083	ng/g	72-129	30	72-129	30	30			
Perfluorooctanesulfonic Acid (PFOS)	1763-23-1	1	0.1205	ng/g	68-136	30	68-136	30	30			
Perfluorodecanoic Acid (PFDA)	335-76-2	1	0.072	ng/g	69-133	30	69-133	30	30			
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	39108-34-4	1	0.275	ng/g	65-137	30	65-137	30	30			
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSA	2355-31-9	1	0.103	ng/g	63-144	30	63-144	30	30			
Perfluoroundecanoic Acid (PFUnA)	2058-94-8	1	0.056	ng/g	64-136	30	64-136	30	30			
Perfluorodecanesulfonic Acid (PFDS)	335-77-3	1	0.097	ng/g	59-134	30	59-134	30	30			
Perfluorooctanesulfonamide (FOSA)	754-91-6	1	0.1025	ng/g	67-137	30	67-137	30	30			
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	2991-50-6	1	0.09	ng/g	61-139	30	61-139	30	30			
Perfluorododecanoic Acid (PFDoA)	307-55-1	1	0.086	ng/g	69-135	30	69-135	30	30			
Perfluorotridecanoic Acid (PFTrDA)	72629-94-8	1	0.062	ng/g	66-139	30	66-139	30	30			
Perfluorotetradecanoic Acid (PFTA)	376-06-7	1	0.07	ng/g	69-133	30	69-133	30	30			
PFOA/PFOS, Total		1	0.04105	ng/g				30	30			
Perfluoro[13C4]Butanoic Acid (MPFBA)	*NONE*									*60-153*		
Perfluoro[13C5]Pentanoic Acid (M5PFPEA)	*NONE*									*65-182*		
Perfluoro[2,3,4-13C3]Butanesulfonic Acid (M3PFBS)	*NONE*									*70-151*		
Perfluoro[1,2,3,4,6-13C5]Hexanoic Acid (M5PFHxA)	*NONE*									*61-147*		
Perfluoro[1,2,3,4-13C4]Heptanoic Acid (M4PFHpA)	*NONE*									*62-149*		
Perfluoro[1,2,3-13C3]Hexanesulfonic Acid (M3PFHxS)	*NONE*									*63-166*		
Perfluoro[13C8]Octanoic Acid (M8PFOA)	*NONE*									*62-152*		
1H,1H,2H,2H-Perfluoro[1,2-13C2]Octanesulfonic Acid (M2-	*NONE*									*32-182*		
Perfluoro[13C9]Nonanoic Acid (M9PFNA)	*NONE*									*61-154*		
Perfluoro[13C8]Octanesulfonic Acid (M8PFOS)	*NONE*									*65-151*		
Perfluoro[1,2,3,4,5,6-13C6]Decanoic Acid (M6PFDA)	*NONE*									*65-150*		
1H,1H,2H,2H-Perfluoro[1,2-13C2]Decanesulfonic Acid (M2-	*NONE*									*25-186*		
N-Deuteriomethylperfluoro-1-octanesulfonamidoacetic Acid	*NONE*									*45-137*		
Perfluoro[1,2,3,4,5,6,7-13C7]Undecanoic Acid (M7-PFUDA)	*NONE*									*64-158*		
Perfluoro[13C8]Octanesulfonamide (M8FOSA)	*NONE*									*1-125*		
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (	*NONE*									*42-136*		
Perfluoro[1,2-13C2]Dodecanoic Acid (MPFDOA)	*NONE*									*56-148*		
Perfluoro[1,2-13C2]Tetradecanoic Acid (M2PFTEDA)	*NONE*									*26-160*		

Please Note that the RL information provided in this table is calculated using a 100% Solids factor (Soil/Solids only)
Please Note that the information provided in this table is subject to change at anytime at the discretion of Alpha Analytical, In

ATTACHMENT D

Community Air Monitoring Plan

COMMUNITY AIR MONITORING PLAN

180 PARK AVENUE, LONG BEACH, NY

JUNE - 2020

Prepared on behalf of:

180 Park Avenue LLC
54 Regent Drive
Lido Beach, NY 11561

Prepared by:

EBC

ENVIRONMENTAL BUSINESS CONSULTANTS
RIDGE, NY 11961

COMMUNITY AIR MONITORING PLAN
TABLE OF CONTENTS

1.0 INTRODUCTION........1
1.1 Regulatory Requirements........1

2.0 AIR MONITORING........2
2.1 Meteorological Data........2
2.2 Community Air Monitoring Requirements........2

3.0 VOC MONITORING, RESPONSE LEVELS, AND ACTIONS........3
3.1 Potential Corrective Measures and VOC Suppression Techniques........3

4.0 PARTICULATE MONITORING........4
4.1 Potential Particulate Suppression Techniques........4

5.0 DATA QUALITY ASSURANCE........6
5.1 Calibration........6
5.2 Operations........6
5.3 Data Review........6

6.0 RECORDS AND REPORTING........7

APPENDICES

Appendix A Action Limit Report

1.0 INTRODUCTION

This Community Air Monitoring Plan (CAMP) has been prepared for the excavation and remediation activities to be performed under a Remedial Action Work Plan (RAWP). The CAMP provides measures for protection for the downwind community (i.e., off-site receptors including residences, businesses, and on-site workers not directly involved in the remedial activities) from potential airborne contaminant releases resulting from remedial activities at the site.

Compliance with this CAMP is required during all activities associated with redevelopment that have the potential to generate airborne particulate matter and volatile organic compounds (VOCs). These activities include soil excavation and tank removal. This CAMP has been prepared to ensure that remedial activities do not adversely affect passersby, residents, or workers in the area immediately surrounding the Site and to preclude or minimize airborne migration of site-related contaminants to off-site areas.

1.1 Regulatory Requirements

This CAMP was established in accordance with the following requirements:

- New York State Department of Health's (NYSDOH) Generic Community Air Monitoring Plan as presented in DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC May 3, 2010). This guidance specifies that a community air-monitoring program shall be implemented to protect the surrounding community and to confirm that the work does not spread contamination off-site through the air;

- New York State Department of Environmental Conservation (NYSDEC) DER-10 Technical Guidance for Site Investigation and Remediation: This guidance provides a basis for developing and implementing a fugitive dust suppression and particulate monitoring program as an element of a hazardous waste site's health and safety program.

2.0 AIR MONITORING

Petroleum related VOCs, chlorinated VOCs are the constituents of concern at the Site. The appropriate method to monitor air for these constituents during remediation activities is through real-time VOC and air particulate (dust) monitoring.

The continuous monitoring locations for VOCs and particulates must reflect the nearest potentially exposed individuals and the location of ventilation system intakes for nearby structures.

2.1 Meteorological Data

At a minimum, wind direction will be evaluated at the start of each workday, noon of each workday, and the end of each workday. These readings will be utilized to position the monitoring equipment in appropriate upwind and downwind locations.

2.2 Community Air Monitoring Requirements

To establish ambient air background concentrations, air will be monitored at several locations around the site perimeter before activities begin. These points will be monitored continuously in series during the site work. The perimeter monitoring points will be located to represent the nearest potentially exposed individuals at the downwind location.

Fugitive respirable dust will be monitored using a MiniRam Model PDM-3 aerosol monitor (or equivalent). Air will be monitored for VOCs with a portable miniRAE 3000 photoionization detector (PID), or equivalent. All air monitoring data will be documented in a site log book by the designated site safety officer. The site safety officer or delegate must ensure that air monitoring instruments are calibrated and maintained in accordance with manufacturer's specifications. All instruments will be zeroed daily and checked for accuracy. A daily log will be kept. If additional monitoring is required, the protocols will be developed and appended to this plan.

Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures

When work areas are within 20 feet of potentially exposed populations or occupied structures, the continuous monitoring locations for VOCs and particulates must reflect the nearest potentially exposed individuals and the location of ventilation system intakes for nearby structures. The use of engineering controls such as vapor/dust barriers, temporary negative-pressure enclosures, or special ventilation devices should be considered to prevent exposures related to the work activities and to control dust and odors. Consideration should be given to implementing the planned activities when potentially exposed populations are at a minimum, such as during weekends or evening hours in non-residential settings.

- If total VOC concentrations opposite the walls of occupied structures or next to intake vents exceed 1 ppm, monitoring should occur within the occupied structure(s). Background readings in the occupied spaces must be taken prior to commencement of the planned work. Any unusual background readings should be discussed with NYSDOH prior to commencement of the work.

- If total particulate concentrations opposite the walls of occupied structures or next to intake vents exceed 150 mcg/m3, work activities should be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 mcg/m3 or less at the monitoring point.

- Depending upon the nature of contamination and remedial activities, other parameters (e.g., explosivity, oxygen, hydrogen sulfide, carbon monoxide) may also need to be monitored. Response levels and actions should be pre-determined, as necessary, for each site.

3.0 VOC MONITORING, RESPONSE LEVELS, AND ACTIONS

Volatile organic compounds (VOCs) will be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis. 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 equipment appropriate to measure the types of contaminants known or suspected to be present.

The equipment will be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 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 must be shutdown. All 15-minute readings must be recorded and be available for State (DEC and DOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

- If total VOC concentrations opposite the walls of occupied structures or next to the intake vents exceed 1 ppm, monitoring should occur within the occupied structure(s) (if access is granted by owner or occupants). Background readings in the occupied spaces must be taken prior to the commencement of the planned work. Any unusual background readings should be discussed with NYSDOH prior to the commencement of the work.

All readings will be recorded and made available for NYSDEC and NYSDOH personnel to review. If an exceedance of the Action Limits occurs, an Action Limit Report, as shown in Appendix A, will be completed.

3.1 Potential Corrective Measures and VOC Suppression Techniques

If the 15-minute integrated VOC level at the downwind location persists at a concentration that exceeds the upwind level by more than 5 ppm but less than 25 ppm during remediation activities, then vapor suppression techniques will be employed. The following techniques, or others, may be employed to mitigate the generation and migration of fugitive organic vapors:

- limiting the excavation size;
- limiting the drop-height when loading soil into trucks;
- spraying chemical odorants onto the soil;
- covering soil stockpiles with 6-mil plastic sheeting or tarps;
- hauling waste materials in properly tarped containers; and/or
- applying vapor suppressant foam.

4.0 PARTICULATE MONITORING

Air monitoring for particulates (i.e., dust) will be performed continuously during excavation and loading activities using both air monitoring equipment and visual observation at upwind and downwind locations. Monitoring equipment capable of measuring particulate matter smaller than 10 microns (PM10) and capable of integrating (averaging) over periods of 15 minutes or less will be set up at upwind (i.e., background) and downwind locations, at heights approximately four to five feet above land surface (i.e., the breathing zone). Monitoring equipment will be MIE Data Ram monitors, or equivalent. The audible alarm on the particulate monitoring device will be set at 90 micrograms per cubic meter (µg/m3). This setting will allow proactive evaluation of worksite conditions prior to reaching the action level of 100 µg/m^3 above background. The monitors will be calibrated at least once per day prior to work activities and recalibrated as needed thereafter. In addition, fugitive dust migration will be visually assessed during all intrusive work activities.

The following summarizes particulate action levels and the appropriate responses:

- If the downwind PM-10 particulate level is 100 µg/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 must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 µg/m^3 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 greater than 150 µg/m^3 above the upwind level, work must be stopped and an evaluation of activities initiated. Work can resume provided that dust suppression measures (as described in Section 2.3.1 below) and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 µg/m^3 of the upwind level and in preventing visible dust migration.

- If the total particulate concentrations opposite the walls of occupied structures or next to intake vents exceeds 150 µg/m^3, work activities should be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 µg/m^3 or less at the monitoring point.

All readings will be recorded and be available for NYSDEC and NYSDOH personnel to review. If an exceedance of the Action Limits occurs, an Action Limit Report as shown in **Appendix A** will be completed.

4.1 Potential Particulate Suppression Techniques

If the integrated particulate level at the downwind location exceeds the upwind level by more than 100 µg/m^3 at any time during remediation activities, then dust suppression techniques will be employed. The following techniques, or others, may be employed to mitigate the generation and migration of fugitive dusts:

- limiting the excavation size;

- spraying water onto the excavation faces and equipment;
- covering soil stockpiles with plastic sheeting or tarps;
- Use of gravel paths / roadways;
- hauling waste materials in properly tarped containers; and/or
- limiting vehicle speeds onsite.

Work may continue with dust suppression techniques provided that downwind PM_{10} levels are not more than 150 $\mu g/m^3$ greater than the upwind levels.

There may also be situations where the dust is generated by remediation activities and migrates to downwind locations, but is not detected by the monitoring equipment at or above the action level. Therefore, if dust is observed leaving the working area, dust suppression techniques such as those listed above will be employed.

If dust suppression techniques do not lower particulates to below 150 $\mu g/m^3$, or visible dust persists, work will be suspended until appropriate corrective measures are identified and implemented to remedy the situation.

All air monitoring readings will be recorded in the field logbook and will be available for the NYSDEC and NYSDOH personnel to review.

5.0 DATA QUALITY ASSURANCE

5.1 Calibration

Instrument calibration shall be documented on instrument calibration and maintenance sheets or in the designated field logbook. All instruments shall be calibrated as required by the manufacturer. Calibration checks may be used during the day to confirm instrument accuracy. Duplicate readings may be taken to confirm individual instrument response.

5.2 Operations

All instruments shall be operated in accordance with the manufacturer's specifications. Manufacturers' literature, including an operations manual for each piece of monitoring equipment will be maintained on-site by the SSO for reference.

5.3 Data Review

The SSO will interpret all monitoring data based the established criteria and his/her professional judgment. The SSO shall review the data with the PM to evaluate the potential for worker exposure, upgrades/downgrades in level of protection, comparison to direct reading instrumentation and changes in the integrated monitoring strategy.

Monitoring and sampling data, along with all sample documentation will be periodically reviewed by the PM.

6.0 RECORDS AND REPORTING

- All air readings must be recorded on daily air monitoring log sheets and made available for review by personnel from NYSDEC and NYSDOH. CAMP summary tables will also be provided on a weekly basis and NYSDEC and NYSDOH will be notified immediately (within 24 hours) of any exceedances of CAMP action levels as well as corrective actions taken.

APPENDIX A
ACTION LIMIT REPORT

CAMP
ACTION LIMIT REPORT

Project Location:____

Date: __________________________ Time:_____________________

Name:__________________________

Contaminant:______________________ PM-10: _________ VOC: ____________________

Wind Speed:_______________________ Wind Direction: _____________

Temperature:______________________ Barometric Pressure: ________

DOWNWIND DATA

Monitor ID #: _____________________ Location: ________ Level Reported: _____________

Monitor ID#: _____________________ Location: ________ Level Reported: _____________

UPWIND DATA

Monitor ID #: _____________________ Location: ________ Level Reported: _____________

Monitor ID#: _____________________ Location: ________ Level Reported: _____________

BACKGROUND CORRECTED LEVELS

Monitor ID #: Location: _____________ Level Reported: Level Reported: _________________

ACTIONS TAKEN

____

____

____

____

____

____

____

____

____

____

____

____

ATTACHMENT E
Resumes

ARIEL CZEMERINSKI, P.E.

Mr. Czemerinski is a New York State Professional Engineer and CEO of AMC Engineering PLLC an EBC affiliate. Mr. Czemerinski has with 20 years of experience in the chemical and environmental areas. Areas of expertise include environmental compliance, permitting, remedial system design, process and plant safety, and management of a production facility. Mr. Czemerinski is a Registered Professional Engineer in NY, IN, IL, and MI.

Professional Experience

AMC: 14
Prior: 6 years

Education

Master of Science in Chemical Engineering, Columbia University, New York, NY, Feb. 1990. Bachelor of Science in Chemical Engineering, University Of Buenos Aires, Buenos Aires, Argentina, May 1987

Areas of Expertise

- Vapor Intrusion - Barrier and Sub Slab Venting System Design
- Environmental Assessment Statements and Environmental Impact Assessments under CEQR, ULURP
- Remedial Program Design and Management
- Environmental Compliance, Clean Water Act, Clean Air Act, Hazardous Materials
- Dewatering & Treatment System Design
- NYCDEP Sewer Discharge Permitting
- Transfer Station Permitting and Compliance
- Chemical Process Design and Optimization
- Wastewater Treatment Systems and Permitting, SPEDES, Air
- Zoning Regulations and Permitting
- Safety and Environmental Training
- Waste Management Plans

Professional Certifications

- OSHA 40-hr HAZWOPER
- OSHA 10-hr Construction Safety and Health

PROJECT EXPERIENCE (Representative Projects)

Project: Domsey Fiber Corp. - 431 Kent Avenue, Brooklyn NY
Project Description: NYS Brownfield cleanup project / NYC E-Designation. Soil contaminated with chlorinated solvents, petroleum and heavy metals requiring excavation, soil management and disposal under a Remedial Action Work Plan, Soil / Materials Management Plan, Construction Health and Safety Plan and Community Air Monitoring Plan
Client: Express Builders
Regulatory Authority: NYSDEC, NYCOER
Role: Mr. Czemerinski served as the Remedial Engineer for the project.

Project: Springfield Gardens Residential Area BMP - Springfield Gardens, Queens, NY
Project Description: NYC Residential infrastructure (sewer, gas, water) upgrade, drainage channel installation and pond restoration. Soil contaminated with, petroleum and heavy metals requiring excavation, soil management and disposal under a Materials Handling Plan, Construction Health and Safety Plan and Community Air Monitoring Plan
Client: EIC Associates - NYCEDC
Regulatory Authority: NYSDEC, NYCParks
Role: Mr. Czemerinski served as the Remedial Engineer for the project.

Project: Former Domino Sugar Site - Kent Avenue, Brooklyn NY
Project Description: NYC E-Designation. Soil contaminated with semi-volatile organic compounds and heavy metals requiring excavation, soil management and disposal under a Remedial Action Work Plan, Soil / Materials Management Plan, Construction Health and Safety Plan and Community Air Monitoring Plan
Client: Two Trees Management
Regulatory Authority: NYCOER
Role: Mr. Czemerinski served as the Remedial Engineer for the project.

Project: Former Uniforms For Industry Site - Jamaica Avenue, Queens NY
Project Description: NYS Brownfield cleanup project / NYC E-Designation. Soil contaminated with chlorinated solvents, petroleum, mop oil and heavy metals requiring excavation, soil management and disposal under a Remedial Action Work Plan, Soil / Materials Management Plan, Construction Health and Safety Plan and Community Air Monitoring Plan
Client: The Arker Companies
Regulatory Authority: NYSDEC, NYCOER
Role: Mr. Czemerinski served as the Remedial Engineer for the project.

PROJECT EXPERIENCE (Representative Projects)

Project: Former Charles Pfizer & Co. Site - 407 Marcy Avenue, Brooklyn, NY
Project Description: NYS Brownfield cleanup project / NYC E-Designation. Soil contaminated with chlorinated solvents, petroleum, and heavy metals requiring excavation, soil management and disposal under a Remedial Action Work Plan, Soil / Materials Management Plan, Construction Health and Safety Plan and Community Air Monitoring Plan
Client: The Rabsky Group
Regulatory Authority: NYSDEC, NYCOER
Role: Mr. Czemerinski served as the Remedial Engineer for the project.

Project: Former East Coast Industrial Uniforms Site - 39 Skillman Street, Brooklyn, NY
Project Description: NYS Brownfield cleanup project / NYC E-Designation. Soil contaminated with chlorinated solvents, petroleum, and heavy metals requiring excavation, soil management and disposal under a Remedial Action Work Plan, Soil / Materials Management Plan, Construction Health and Safety Plan and Community Air Monitoring Plan
Client: Riverside Builders
Regulatory Authority: NYSDEC, NYCOER
Role: Mr. Czemerinski served as the Remedial Engineer for the project.

Project: Former BP Amoco Service Station Site - 1800 Southern Boulevard, Bronx, NY
Project Description: NYS Brownfield cleanup project / NYC E-Designation. Soil contaminated with petroleum, and heavy metals requiring excavation, soil management and disposal under a Remedial Action Work Plan, Soil / Materials Management Plan, Construction Health and Safety Plan and Community Air Monitoring Plan
Client: SoBro, Joy Construction
Regulatory Authority: NYSDEC, NYCOER
Role: Mr. Czemerinski served as the Remedial Engineer for the project.

Project: Former Dico G Auto & Truck Repair Site - 3035 White Plains Road, Bronx, NY
Project Description: NYS Brownfield cleanup project. Soil contaminated with petroleum, and heavy metals requiring excavation, soil management and disposal under a Remedial Action Work Plan, Soil / Materials Management Plan, Construction Health and Safety Plan and Community Air Monitoring Plan
Client: The Arker Companies
Regulatory Authority: NYSDEC
Role: Mr. Czemerinski served as the Remedial Engineer for the project.

Charles B. Sosik, PG, PHG, Principal

Professional Experience

28 years

Education

MS, Hydrogeology, Adelphi University, NY
BS, Geology, Northern Arizona University, AZ

Areas of Expertise

- Brownfields Redevelopment
- Hazardous Waste Site Investigations
- Pre-purchase Site Evaluations and Support
- Regulatory Negotiations
- Remedial Planning and "Cost to Cure" Analysis
- Strategic Planning
- Real Estate Transactions
- NYC "E" Designations

Professional Certification

- Professional Geologist, NH
- Professional Geologist, Hydrogeologist, WA
- OSHA 40-hr HAZMAT
- OSHA 8-hr. Supervisor
- NYC OER Qualified Environmental Professional

Professional Affiliation / Committees

- NYS Council of Professional Geologists (NYSCPG)
- Association of Groundwater Scientists & Engineers (AGSE)
- NYS RBCA Advisory Committee
- Massachusetts LSP Association
- New Hampshire Association of Professional Geologists
- Interstate Technology Regulatory Council/MTBE Team
- Environmental Business Association, Brownfields Task Force
- Part 375 Working Group

PROFILE

Mr. Sosik has 28 years of experience in environmental consulting. He specializes in advising clients on managing environmental compliance with federal, state, and municipal agencies and has successfully directed numerous investigation and remediation projects involving petroleum, pesticides, chlorinated solvents, heavy metals and radiologically activated media. His work included extensive three-dimensional investigations on MTBE, which have been used effectively to help shape public policy. He also has experience in applying models to groundwater related problems and has completed several large-scale projects to determine fate and transport of contaminants, establish spill scenarios, and closure criteria. His experience and expertise in the area of contaminant hydrogeology has resulted in requests from environmental attorneys, property owners and New York State to serve as an expert witness and technical advisor on a variety of legal disputes.

For the past 15 years Mr. Sosik has been primarily engaged in providing environmental consulting to developers responding to the extensive re-zoning of former industrial and commercial properties, which is currently taking place throughout New York City. These services include everything from pre-purchase evaluations and contract negotiations to gaining acceptance in and moving projects through the NYS Brownfields Program. Mr. Sosik has taken a pro-active role in the continued development of the NYS Brownfields Program and related policy, by attending numerous working seminars, active participation in work groups and task forces and by providing commentary to draft versions of new guidance documents. Throughout his professional career, Mr. Sosik has remained committed to developing innovative cost- efficient solutions to environmental issues, specifically tailored to the needs of his clients.

SELECTED PROJECTS

Scavenger Waste Treatment Facility (SWTF), Suffolk County, NY

Water Treatment Plant EIS - Focused EIS - In response to requests from the Suffolk County Council on Environmental Quality and the Brookhaven Conservation Advisory Council, Mr. Sosik prepared a focused EIS to evaluate the potential impacts to an important surface water resource from the proposed facility including cumulative and synergistic effects with established contaminant plumes in the area.

Advanced Residential Communities, Rockville Centre, NY

Brownfield Project – As the senior project manager on this large scale, high profile redevelopment project, Mr. Sosik was asked to develop a plan to accelerate the regulatory process in the face of general community opposition. Through numerous discussions with the BCP management team, He was able to condense the schedule and review period, through the submission of supporting documents (Investigation Report, Remedial Work Plan) with the BCP application package. Community opposition, which focused on the environmental condition of the site as a means to block the project, was used to advantage in expediting approval of the aggressive interim remedial plan. This will allow the developer to begin remedial work approximately 5 months ahead of schedule.

Former Temco Uniform site, West Haverstraw, NY

Brownfield Project – Mr. Sosik took over management of this project from another consultant following transition of this VCP site to the BCP. Mr. Sosik used the opportunity to renegotiate and revise the scope of work to allow a more cost effective and focused investigation plan without re-writing or resubmitting the RIWP. During the NYSDEC's review of the transition package, he met with and coordinated changes with the NYSDEC Project Manager to gain approval. The result saved the client a significant amount of money, but perhaps more importantly in this case, did so without loss of time.

Grovick Properties, Jackson Heights, NY

Brownfield Project – This Brownfield property is somewhat unique in that it had been investigated and partially remediated by the NYSDEC through the petroleum spill fund. The client was interested in purchasing the property and redeveloping it as office and retail space. Mr. Sosik reviewed the NYSDEC investigation and developed a supplemental plan to meet the requirements of an RI under the BCP program. By performing this limited amount of field work “up-front” he was able to complete an RI Report and Remedial Plan and submit both with the BCP application package. The NYSDEC and NYSDOH approved the RI Report and the Remedial Plan with minor changes. This cut 120 days from the review process and allowed the client to arrange financing and move his project forward knowing what the clean-up costs would be at the outset.

Metro Management, Bronx, NY

Brownfield Project – The site of a former gas station, the developer had planned to construct a 12-story affordable housing apartment complex with first floor retail space. Since the site was located in an Environmental zone, potential tax credits of 22% for site development, remediation and tangible property could be realized under the BCP. In a pre-application meeting with the NYSDEC, Mr. Sosik realized that the department did not believe the site was eligible for the BCP, since it had been previously investigated and closed under the spills program.

Mr. Sosik assisted the developer in securing financing, and due to the demands of an aggressive construction schedule developed an Interim Remedial Measure (IRM), based on chemical oxidation treatment. Working closely with the clients environmental counsel, Mr. Sosik was able to get the IRM approved without a public comment period. Implementation of the IRM is currently underway.

The project was awarded the 2009 NYC Brownfield Award for Innovation.

Brandt Airflex, NY

Technical Consulting Services - Mr. Sosik provided senior level technical advice and strategic planning in developing an off-site RI/FS for the site, in negotiating a tax reduction for the property due to the environmental condition and in preparing a cost to cure estimate for settlement between business partners. After achieving a favorable tax consideration and settlement agreement for his client

Allied Aviation Services, Dallas, Fort Worth, Airport, Dallas, TX

Jet Fuel Investigation - Mr. Sosik developed and managed an investigative plan to quickly identify the extent and source of jet fuel which was discharging from the Airport’s storm drain system to a creek a mile away. Through the use of a refined conceptual model, accelerated investigative techniques and a flexible work plan, he was able to identify the source of the fuel and the migration route within a single week. He then identifled remedial options and successfully negotiated a risk based plan with the Texas regulatory agency that had issued a notice of enforcement action against the facility.

KeySpan – Former LILCO Facilities, Various NY Locations

Pesticide Impact Evaluation - Mr. Sosik developed, negotiated and implemented a site screening procedure to evaluate impact to public health and the environment as the result of past herbicide use at 211 utility sites. Using an unsaturated zone leaching model (PRZM) on a small subset of the sites, he was able to establish mass loading schedules for the remaining sites. This was combined with public well data in a GIS environment to perform queries with respect to mass loading, time transport and proximity to vunerable public supply wells. Using this approach Mr. Sosik was able to show that there were no concerns for future impact. This effort satisfied the public health and resource concerns of the state environmental agency and county health department in a reasonable amount of time and at a fraction of the cost of a full scale investigation.

Former Computer Circuits (Superfund) Site, Hauppauge, NY

CERCLA RI/FS - As Senior Project Manager for the site, he played a major role in regaining control of the investigation activites for the PRP. This action prevented the USEPA from initiating an extensive investigation at the site using a RAC II contractor allowing the client to perform a more efficient investigation. He was involved in all negotiations with EPA and was the project lead in developing a revised site characterization plan (work plan, field sampling plan, quality assurance plan, etc.). By carefully managing all phases of the investigation and continued interaction with each of the three regulatory agencies involved, Mr. Sosik was able to keep the project focused and incrementally reinforce the clients position. The estimated cost of the revised investigation is expected to save the client 1.5 to 2 million dollars.

Sun Oil, Seaford, NY

Remediation Consuliting Services & Project Management - Under an atmosphere of regulatory distrust, political pressure and mounting public hostility toward the client, Mr. Sosik conducted an off-site 3-D investigation to define the extent of contamination and the potential impact on public health. By designing and implementing an aggressive source area remediation program and personal interaction with the public and regulatory agencies, he was able to successfully negotiate a limited off-site remediation favorable to the client. Source area remediation was completed within 6 months and the project successfully closed without damage to the client’s public image or working relationship with the regulatory agencies.

Con Edison, Various Locations, NY

Hydrogeologic Consulting Services - Under a general consulting contract, Mr. Sosik conducted detailed subsurface hydrogeologic investigations at five locations to assist in the development of groundwater contingency planning. He also developed and implemented work plans to investigate and remediate existing petroleum, cable fluid, and PCB releases at many of the generating facilities and substations. An important aspect of his role was in assisting the client in strategic planning and negotiations with the regulatory agency.

Keyspan - Tuthill Substation, Aqueboque, NY

Accelerated Site Characterization - Using accelerated site characterization techniques, Mr. Sosik presented the project as a case study in establishing the transport of an herbacide and its metobolites aplied at utility sites in the 1980’s The results were then used to establish a screening method for evaluating 211 similar sites controlled by the client in a reasonable and eficient manner.

NYSDEC Spill, East Moriches, NY

Spill Release Analysis - With recognized expertise in the area of gasoline plume development on Long Island, Mr. Sosik was asked by

Charles B. Sosik, PG, PHG, Principal

the State to establish the release date (and principal responsible party) of an extensive petroleum spill, which impacted a residential neighborhood. He used multiple lines of evidence, and a new EPA model (HSSM), which he has helped to refine, to reconstruct the release scenario and spill date, in support of the State Attorney General's cost recovery effort from the PRP.

Minmilt Realty, Farmingdale, NY

Fate & Transport Modeling - He completed an RI/FS at this location for a PCE plume that had been in transit for over 30 years. Mr. Sosik applied a conservative model to evaluate time/concentration impacts under a variety of transport scenarios to a municipal wellfield located 13,000 feet away. Through the use of the model and careful interpretation of an extensive data set compiled from several sources, Mr. Sosik was able to propose a plan which was both acceptable to the regulator and favorable to the client.

Sebonack Golf Course Project, Town of Southampton, NY

IPM Pesticide Study - Provided professional hydrogeologic services in support of the EIS prepared for the development of the site. The proposed development included an 18-hole golf course, clubhouse, dormitory facility, cottages, associated structures, and a 6,000 square foot research station for Southampton College. Mr. Sosik performed an extensive evaluation (using a pesticide-leaching model) on the effects of pesticide and nitrogen loading to groundwater as part of the projects commitment to an Integrated Pest Management (IPM) approach.

NYSDEC, Spills Division, Regions 1 – 4

Petroleum Spills Investigation & Remediation - As a prime contractor/consultant for the NYSDEC in Regions 1-4, Mr. Sosik has managed the investigation and remediation of numerous petroleum spills throughout the State. Many of these projects required the development of innovative investigation and remediation techniques to achieve project goals. He was also involved in many pilot projects and research studies to evaluate innovative investigation techniques such as accelerated site characterization, and alternative approaches to remediation such as monitored natural attenuation and risk based corrective action.

Sun Oil, E. Meadow, NY

Exposure Assessment - Performed to seek closure of the spill file, despite the presence of contaminants above standards, Mr. Sosik determined after the extended assessment that the level of remaining contamination would not pose a future threat to human health or the environment. He used multiple lines of evidence, and a fate and transport model to show that degradation processes would achieve standards within a reasonable time.

Sand & Gravel Mine, NY

Property Development - As part of the development of a sand and gravel mine, Mr. Sosik provided environmental consulting services to assist in obtaining a mining permit, which would result in the construction of a 150-acre lake. Specifically, Mr. Sosik investigated if the proposed lake would reduce groundwater quantity to domestic and public well fields, and/or accelerate the migration of potential surface contaminants to the lower part of the aquifer. After assuming the lead role in negotiations with the regulatory agency, Mr. Sosik was able to obtain a permit for the client by adequately addressing water quality and quantity issues, and by preparing a monitoring plan and spill response plan, acceptable to all parties.

NYSDEC, Mamaroneck, NY

Site Characterization / Source Identification - In a complex hydrogeologic setting consisting of contaminant transport through fractured metomorphic bedrock and variable overburden materials, Mr. Sosik was able to develop and implement a sub-surface investigation to differentiate and separate the impact associated with each of two sources. The results of this investigation were successful in encouraging the spiller to accept responsibility for the release.

Riverhead Municipal Water District, NY

Site Characterization / Remedial Planning - Using accelerated characterization techniques, he implemented a 3-D site investigation to identify two service stations 4,000 ft. away as the source of contamination impacting a municipal wellfield. In accordance with the strict time table imposed by the need to return the wellfield to production by early spring, he designed and implemented a multi-point (9 RW, 6 IW) recovery and injection well system using a 3-d numerical flow model, and completed the project on time. Using a contaminant transport model, Mr. Sosik developed clean-up goals which were achieved in 9 months of operation, well below the projected 3 to 5 year project duration.

Montauk Fire Department, NY

Site Assessment - Mr. Sosik performed a limited investigation and used a 2-D flow model to demonstrate that the property could not have been the source of contamination which had impacted an adjacent wellfield as per the results of a previous investigation. This small focused effort successfully reversed a $500,000, and rising, claim against the department by the water district and the NYSDEC.

PREVIOUS EXPERIENCE

P.W. Grosser Consulting, Bohemia, NY
Senior Project Manager, 1999-2006

Environmental Assessment & Remediation, Patchogue, NY
Senior Project Manager, 1994-1999

Miller Environmental Group, Calverton, NY
Project Manager, 1989-1994

DuPont Biosystems, Aston, PA
Hydrogeologist, 1988-1989

Charles B. Sosik, PG, PHG, Principal

EXPERT WITNESS TESTIMONY AND DEPOSITIONS

Fact Witness -Testimony on relative age of petroleum spill based on nature and extent of residual and dissolved components at the Delta Service Station in Uniondale, NY Fall/1999

Expert Witness / Expert Report for defendant in cost recovery case by NYS Attorney General regarding a Class II Inactive Hazardous Waste (State Superfund) project by the NYSDEC (October 2004 – present, Report: March 2005, Deposition: April 2005, 2nd Report: Aug. 2013, 2nd Deposition Nov. 2013, Bench Trial: December 2013 - qualified as expert in Federal Court),

Expert Witness / Fact Witness for plaintiff seeking compensation for partial expenses incurred during the investigation and remediation of a USEPA CERCLA site due to the release and migration of contaminants from an “upgradient” industrial property. (Deposition May 2005, case settled April 2007).

Expert Witness / Fact Witness for NYS Attorney General with respect to cost recovery for a NYSDEC petroleum spill site in Holtzville, NY (Deposition April 2005 - case settled).

Expert Witness – Statement of opinion and expert testimony at trial for plaintiff seeking damages from a major oil corporation for contamination under a prior leasing agreement in Rego Park, NY. Case decided in favor of plaintiff. Trial July 2007, in favor of Plaintiff. Qualified as Expert.

Expert Witness / Fact Witness for NYS Attorney General with respect to cost recovery for a NYSDEC petroleum spill site in Lindenhurst, NY (Trial date Dec. 2009, in favor of plaintiff. Qualified as Expert State Supreme Court.

Expert Witness - for NYS Attorney General regarding NYSDEC cost recovery for a petroleum spill site at Riverhead, NY. Case settled July 2008.

Expert Witness for plaintiffs in class action case with respect to damages from chlorinated plume impact to residences in Dayton, OH. (Draft Report – May 2013).

Expert Witness / Fact Witness for defendant with respect to cost recovery and third party responsibility for a NYSDEC petroleum spill site in Lindenhurst, NY (Expert Statement of Fact – October 2005).

Expert Witness for plaintiff seeking damages related to a petroleum spill from the previous owner/operator of a gas station in College Point, NY. Case settled 2009.

Expert Witness for plaintiff (municipal water supply purveyor) seeking damages from major oil companies and manufacturer of MTBE at various locations in Suffolk County, NY. Expert reports July 2007, August 2007 and October 2007, Case settled August, 2008.

Expert Witness - Deposition for NYS Attorney General regarding NYSDEC cost recovery for a petroleum spill site at Sag Harbor, NY. August 2002

Expert Witness for defendant responding to a claim from adjacent commercial property owner on the origin of chlorinated solvents on plaintiff's property located in Cedarhurst, NY. Expert opinion submitted to lead counsel on March 6, 2009, case settled April 2009.

Expert Report - for Attorney General on modeling performed to determine the spill release scenario at a NYSDEC petroleum spill site in East Moriches, NY. June 2000.

Expert Witness - for plaintiff in case regarding impact to private wells from a spill at adjacent Town and County properties with open gasoline spill files in Goshen, NY. Expert report submitted August 2013.

Expert Witness for defendant with respect to cost recovery from Sunoco for a NYSDEC petroleum spill site. (Declaration – January 2013).

Expert Witness - for plaintiff (municipal water supply purveyor) seeking damages from Dow Chemical for PCE impact at various locations in Suffolk County, NY. Affidavit submitted 2011.

MODELING EXPERIENCE (PARTIAL LISTING)

PROJECT	MODEL	APPLICATION
Riverhead Water District, Riverhead, NY	MODFLOW, MODPATH	Remediation system design to intercept MTBE plume and prevent continued impact to municipal well field.
NYSDEC - Region 1, Holbrook, NY	MODFLOW, MODPATH	Simulate transport of MTBE plume to predict future impact.
NYSDEC - Region 1, East Moriches, NY	HSSM	Evaluate release scenario and start date of petroleum spill in support of cost recovery by NYS AG office.
AMOCO, Deer Park, NY	HSSM	Estimate release amount, start date and spill scenario to evaluate the potential for mass unaccounted for
Keyspan Energy, Nassau/Suffolk Counties Substations	PRZM	Estimate mass load of simazine used at 211 electric substations and screen sites according to potential for human health and ecological impacts.
Saboneck Golf Club, Southampton NY	PRZM	Estimate mass load of proposed pesticides on new golf course to evaluate acceptability under an IPM program.
Suffolk County Department of Public Works (SCDPW) Scavenger Waste Treatment Plant, Yaphank, NY	DYNFLOW, DYNTRAC	Evaluate time-transport and nitrogen impact on local river system.
SCDPW SUNY Waste Water Treatment Plant, Stony Brook, NY	DYNFLOW, DYNTRAC	Determine outfall location and time-transport of nitrogen from proposed upgrades to an existing wastewater treatment plant
Water Authority of Great Neck North Great Neck, NY	MODFLOW, MODPATH, MT3D	Review of modeling study performed by EPA to evaluate potential future impact to Well field from PCE plume. Identified serious flaws in model construction and implementation, which invalidated conclusions

PUBLICATIONS / PROFESSIONAL PAPERS

Smart Pump & Treat Strategy for MTBE Impacting a Public Water Supply (14th Annual Conference on Contaminated Soils Proceedings, 1998)

Transport & Transformation of BTEX & MTBE in a Sand Aquifer (Groundwater Monitoring & Remediation 05/1998)

Characteristics of Gasoline Releases in the Water Table Aquifer of Long Island (Petroleum Hydrocarbons Conference Proceedings, 1999)

Field Applications of the Hydrocarbon Spill Screening Model (HSSM) (USEPA Interactive Modeling Web Course www.epa.gov/athens/software/training/webcourse Authored module on model application and applied use of calculators, 02/2000)

Comparative Evaluation of MTBE Sites on Long Island, US EPA Workshop on MTBE Bioremediation (Cincinnati, 02/2000)

Comparison of Four MTBE Plumes in the Upper Glacial Aquifer of Long Island (American Geophysical Union, San Francisco, 12/1996)

Analysis and Simulation of the Gasoline Spill at East Patchogue, New York (American Geophysical Union, San Francisco, 12/1998)

Keith W. Butler, Senior Project Manager

PROFILE

Mr. Butler has extensive project management experience with respect to environmental due diligence and subsurface investigations. He is responsible for the preparation of project proposals, Phase I and II Environmental Site Assessments, Work Plans, Health and Safety Plans, Quality Assurance Project Plans, and investigation reports. Additionally, Mr. Butler has conducted and managed numerous Phase I and II ESAs. In these roles, Mr. Butler is responsible for applying the various state and local regulations, which govern environmental compliance and determine the need for additional investigation and/or remediation.

SELECTED PROJECTS

Madison National Bank, Various Sites, New York

Mr. Butler served as the Project Manager and principal contact for Madison National Bank. He was responsible for the preparation of Transaction Screen and Phase I/II Environmental Site Assessments (ESAs) at various sites throughout the New York metropolitan area, as required by the bank to satisfy client mortgage or construction loan requests.

Jewish Home & Hospital, Manhattan, NY

Most recently, Mr. Butler completed a Phase I ESA at their Bronx campus to obtain US. Housing and Urban Development (HUD) funding for a future construction project. Mr. Butler was also responsible for implementing a Remedial Action Work (RAW) Plan at the Bronx facility as required by the NYSDEC under a Voluntary Cleanup Agreement. The RAW included the preparation of contract documents, excavation of over 2,000 tons petroleum contaminated soils, installation of a Soil Vapor Extraction (SVE) system remedial oversight, and sampling.

Pulte Homes of New York, Patchogue, NY

Mr. Butler served as the Project Manager for the re-development of this six-acre site and was responsible for field oversight and coordination between remediation contractors and various regulatory agencies. Initial phases of the project included the completion of Phase I and II ESAs. Subsequent remediation consisted of UST removal, excavation of petroleum-impacted soils, closure of three NYSDEC spill numbers, removal of contaminated UIC sediment/sludge, the closure of commercial and residential UIC structures and the excavation of arsenic and metals contaminated soil. The project was conducted under approved Remedial Work and Soil Management Plans with oversight from the State, County and Village agencies.

Town of Islip, Blydenburgh Road Landfill, Hauppauge, NY

Mr. Butler served as the Project Manager for the groundwater and leachate monitoring program at the Blydenburgh Road Landfill - Cleanfills 1 and 2 and Leachate Impoundment Area. Mr. Butler was the principal contact for the Town's Resource Recovery Agency. He prepared the quarterly and annual monitoring reports, oversaw sampling efforts, and coordinated with the Town's analytical laboratory and data validation contractors. Mr. Butler was also responsible for preparing quarterly well condition reports and leachate quality reports for compliance with the Town's Suffolk County Discharge Certification Permit.

Ogden Aviation, Various Sites, JFK International Airport, Jamaica, New York

Mr. Butler served as the project manager for the rehabilitation of the satellite fuel farm recovery well system. Recovery wells at the fuel farm had become clogged with iron deposits and bacteria limiting product recovery efforts. Mr. Butler developed and supervised chemical cleaning and redevelopment of recovery wells under the approval of the NYSDEC. The chemical treatment has resulted in significant increases in product recovery volumes.

Brookhaven National Laboratory, Upton, NY

Mr. Butler has worked on a number of remediation system and monitoring well installation projects at BNL. His duties included oversight of installations, system pump tests, performance evaluations, and well development. He also provided oversight of soil borings, temporary well construction, soil and water sampling, and air monitoring for groundwater screening survey of two operable units in hazardous and radioactive waste storage areas. Mr. Butler also provided oversight for groundwater monitoring, well construction, well abandonment, and methane-monitoring wells for landfill closure.

metroPCS, Various Sites, New York

Mr. Butler served as the Project Manager for metroPCS' Long Island region telecommunications site acquisition and expansion program. Mr. Butler was responsible for the preparation of Phase I ESAs, the conduct of Phase II ESAs, including asbestos, lead paint and soil sampling, and coordination of National Environmental Policy Act (NEPA) reports and planning studies at various locations proposed for construction of new cellular telephone facilities. Reports and associated communications were transmitted electronically through metroPCS' data management system.

Dormitory Authority - State of New York, Harlem Hospital Center Modernization Project - Hazardous and Universal Waste Survey, Harlem Hospital, New York, NY

Mr. Butler served as the field team leader for conducting hazardous and universal waste surveys in multiple buildings affiliated with Harlem Hospital Center. The survey included the identification of hazardous and universal waste materials including chemicals, paints, fluorescent bulbs, high intensity discharge bulbs/fixtures, battery operated equipment, above and underground petroleum storage tank identification, PCB containing light ballasts and electrical equipment.

The hospital is comprised of a number of buildings, many that were abandoned and slated for demolition.

SVE Monitoring at Newark International Airport, Elizabeth, NJ

A routine leak detection test indicated that two 10,000-gallon underground storage tanks, which were used to store unleaded gasoline, had failed tightness tests. Follow-up investigation revealed that the product had impacted the subsurface environment. In response to this, a soil vapor extraction system was installed to reduce the residual concentrations of petroleum constituents in soil and groundwater and to minimize vapor migration into subsurface utility vaults. Mr. Butler was responsible for implementing the Remedial Action Work Plan, developed for the site by Ogden and the State of New Jersey. Activities conducted under the RAW include quarterly groundwater monitoring, air sampling, vacuum pressure monitoring, system maintenance and reporting.

Federal Express Site, Newark International Airport, Elizabeth, NJ

Mr. Butler worked with Ogden Aviation and the State of New Jersey to address outstanding environmental issues at the site related to a spill of jet fuel, which occurred during a construction accident. Mr. Butler performed a site assessment, which included groundwater monitoring, product gauging, and groundwater flow modeling. After reviewing these data, Mr. Butler determined that fill material at the site was contributing to soil and groundwater contamination and has petitioned the State for partial site closure. Mr. Butler is continuing to address the remaining area of concern through product recovery and continued monitoring.

Northrop Grumman, Various Sites

Mr. Butler conducted three Phase I ESAs and a Phase II investigation for the presence of PCBs in soil. He also inspected and supervised the removal of underground storage tanks, asbestos abatement projects, and sanitary system closures related to the facility decommissioning. Mr. Butler also conducted groundwater investigations and provided oversight during soil sampling, drilling and soil remediation activities.

New York City Department of Environmental Protection, Various Sites

Mr. Butler served as an Environmental Scientist for hazard investigation at seven sewage pump stations. Mr. Butler addressed a wide range of environmental concerns including asbestos, lead based paints, PCB oil, light ballasts, and other hazardous building materials. He conducted field investigations, sampling, and prepared Hazardous Materials Survey Reports for use during preparation of plans and specifications for proposed pump station construction projects.

Fresh Kills Landfill, Staten Island, New York

Mr. Butler participated in the field operations during pump and yield tests conducted on Cells 1 and 9. The tests were performed to determine the hydraulic properties of the landfill's refuse. He collected groundwater and leachate measurements in recovery wells and in adjacent observation wells under pumping and non-pumping conditions.

PREVIOUS EXPERIENCE

DECA Real Estate Advisors
Director of Environmental Services, 2011-2017

VHB Engineering, Surveying and Landscape Architecture PC, Hauppague NY
Senior Project Manager, 2005-2011

Parsons Brinkerhoff, Inc. New York NY
Senior Project Manager, 2004-2005

P.W. Grosser Consulting, Bohemia, NY
Senior Project Manager, 1998-2004

Eder Associates, Locust Valley, NY
Field Hydrogeologist, 1992-1998

EDUCATION

BS, Geology, Slippery Rock University of Pennsylvania, 1990

PROFESSIONAL REGISTRATIONS/CERTIFICATIONS

OSHA Certification, 40-hour Health & Safety Training at Hazardous Waste Sites

OSHA Certification, 8-hour Refresher Health & Safety Training at Hazardous Waste Sites

OSHA Confined Space Entry Training

Thomas Gallo, Field Manager

Professional Experience
EBC: July 2015

Education
Bachelor of Arts, Geology, State University of New York at Potsdam, NY

Areas of Expertise
- Phase I Property Assessments
- Phase II Subsurface Investigations
- Indoor Air Quality (IAQ) Investigations
- Asbestos Surveys
- Site Logistics
- Waste Characterization and Soil Disposal
- Soil Management Planning and Field Oversight
- Health & Safety / Air Monitoring
- Remedial Investigation Work Plans, Remedial Investigation Reports, Remedial Action Work Plans
- Remedial Oversight of NYC E-Designation Sites

Professional Certification
- OSHA 40-hr HAZWOPER
- NYS Asbestos Inspector
- OSHA 10-hr Construction Health and Safety
- OSHA 30-hr Construction Health and Safety Lead Awareness Training
- OSHA 8-hr Supervisor
- Lead Awareness Training

PROFILE

Mr. Gallo has 4 years' experience as an environmental consultant and has worked on a wide range of environmental projects. Mr. Gallo is EBC's Manager of Field Operations and is responsible for coordinating and scheduling a field crew of 7. He has extensive experience on remedial construction projects including site characterization, waste classification, soil management and disposal, dewatering operations, community air monitoring and health & safety and performance sampling.

Mr. Gallo also contributes to the preparation of Phase I and Phase II Site Assessments and Investigations for commercial, industrial, and residential properties in New York and New Jersey. Additional responsibilities include Remedial Investigation Work Plans, Remedial Investigation Reports, and Remedial Investigation Work Plans.

Mr. Gallo's field experience includes soil, air and groundwater sampling, operation and maintenance of groundwater remediation systems, tank removals, spill management and closure, and oversight of monitoring well installations. In addition, Mr. Gallo has prepared reports for both regulatory and client use.

ATTACHMENT F
Estimated Remedial Costs

FORMER NU-CLEAR CLEANERS SITE
180 E. Park Avenue, Long Beach, NY

Summary of Project Costs

NYS Brownfields Cleanup Program

Costs by Task

TASK - ENVIRONMENTAL REMEDIATION	**Alternative 1 Track 1**	**Alternative 2 Track 2**	**Alternative 3 Track 4**
Excavation and Disposal	$ 176,448.00	$ 82,800.00	-
Waste Charaterization	$ 6,600.00	$ 4,200.00	-
Endpoint analyis, DUSR, EDDs	$ 13,655.00	$ 11,155.00	$ 11,300.00
Air Monitoring and Field Oversight	$ 8,500.00	$ 4,250.00	$ 4,250.00
Project Management	$ 14,850.00	$ 11,300.00	$ 12,450.00
Oxidant Injection Program	$ 29,090.00	$ 29,090.00	-
Capping the Site with the Concrete building slab and asphalt	-	-	$ 85,000.00
Status Reports	$ 3,000.00	$ 3,000.00	$ 3,000.00
Environmental Easement Package	-	$ 12,500.00	$ 12,500.00
Site Management Plan	-		$ 14,000.00
Final Engineering Report	$ 25,450.00	$ 25,450.00	$ 25,450.00
Subtotal	$ 277,593.00	$ 183,745.00	$ 167,950.00
15% Contigency	$ 41,638.95	$ 27,561.75	$ 25,192.50
Total	**$ 319,231.95**	**$ 211,306.75**	**$ 193,142.50**

ATTACHMENT G

Oxidant Calculations & Manufacturer's Specifications

Enter Data Here to Input in All Zones

		Height of Water Column Contamination (ft)	Height of Soil Contamination Layer (ft)	Soil Density (lb/ft^3)	Total Mass of Contaminants in Groundwater (lb)	Amount of Klozur Required to Treat Groundwater (lb)	Total Mass of Contaminants in Soil (lb)	Amount of Klozur Required to Treat Soil (lb)	Total Amount of Klozur Required for Site (lb)
Zone 1		0	0	0	0.011156217	0.379332186	0	0	29.81879476
Zone 2		0	0	0	9.895498314	28.69694511	0	0	
Zone 3		0	0	0	0.256040506	0.742517466	0	0	
Zone 4		0	0	0	0	0	0	0	
Zone 5		0	0	0	0	0	0	0	
Zone 6		0	0	0	0	0	0	0	
Zone 7		0	0	0	0	0	0	0	
							0		
							0		
							0		
							0		

ZONE 1

						Enter Data		Enter Data		Enter Data					
						125		5		0.30					
Contaminant	Groundwater Concentration (µg/L)	Groundwater Concentration (lb/L)		Converstion (ft^3 to L)		Area (ft^2)		Height of Water Column Contamination (ft)		Porosity		Mass of Contaminant (lb)		Klozur Required (lb)	Total Klozur Required (lb)
1,2,4-Trimethylbenzene	120	0.000000264	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0.001401682	=	0.05004	0.379332
1,3,5-Trimethylbenzene	30	0.000000066	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0.00035042	=	0.01251	
2-Butanone		0	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0	=	0	
2-Chlorotoluene		0	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0	=	0	
2-Hexanone		0	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0	=	0	
4-Methyl-2-Pentanone		0	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0	=	0	
Acetone		0	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0	=	0	
Benzene	1	3.08E-09	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	1.6353E-05	=	0.000749	
Bromobenzene		0	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0	=	0	
Cyclohexane		0	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0	=	0	
Ethyl Benzene	82	1.804E-07	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0.000957816	=	0.040803	
Hexachlorobutadiene		0	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0	=	0	
Isopropylbenzene	18	3.96E-08	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0.000210252	=	0.009188	
m/p-Xylenes	82	1.804E-07	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0.000957816	=	0.045113	
Methyl Cyclohexane		0	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0	=	0	
methyl tert-butyl Ether		0	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0	=	0	
Naphthalene	410	0.000000902	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0.004789079	=	0.190126	
n-Butylbenzene	4	7.92E-09	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	4.20504E-05	=	0.001867	
n-Propylbenzene	27	5.94E-08	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0.000315378	=	0.013782	
o-Xylene	12	2.64E-08	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0.000140168	=	0.006602	
p-Isopropyltoluene	7	1.496E-08	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	7.94286E-05	=	0	
sec-Butylbenzene	6	1.386E-08	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	7.35883E-05	=	0.003267	
Styrene		0	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0	=	0	
tert-Butylbenzene		0	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0	=	0	
Toluene		0	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0	=	0	
CVOCs	156	3.432E-07	(X)	28.3168	(X)	125	(X)	5	(X)	0.30	=	0.001822186	=	0.005284	
										Total	=	0.011156217		0	

ZONE 2

						Enter Data		Enter Data		Enter Data					
						427		8		0.30					
Contaminant	Groundwater Concentration (µg/L)	Groundwater Concentration (lb/L)		Converstion (ft^3 to L)		Area (ft^2)		Height of Water Column Contamination (ft)		Porosity		Mass of Contaminant (lb)		Klozur Required (lb)	Total Klozur Required (lb)
1,2,4-Trimethylbenzene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	28.69695
1,3,5-Trimethylbenzene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
2-Butanone		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
2-Chlorotoluene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
2-Hexanone		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
4-Methyl-2-Pentanone		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
Acetone		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
Benzene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
Bromobenzene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
Cyclohexane		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
Ethyl Benzene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
Hexachlorobutadiene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
Isopropylbenzene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
m/p-Xylenes		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
Methyl Cyclohexane		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
methyl tert-butyl Ether		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
Naphthalene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
n-Butylbenzene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
n-Propylbenzene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
o-Xylene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
p-Isopropyltoluene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
sec-Butylbenzene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
Styrene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
tert-Butylbenzene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
Toluene		0	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	0	=	0	
CVOCs	155,000	0.000341	(X)	28.3168	(X)	427	(X)	8	(X)	0.30	=	9.895498314	=	28.69695	
										Total	**=**	9.895498314		0	0

ZONE 3

						Enter Data		Enter Data		Enter Data					
						125		8		0.30					
Contaminant	Groundwater Concentration (µg/L)	Groundwater Concentration (lb/L)		Converstion (ft^3 to L)		Area (ft^2)		Height of Water Column Contamination (ft)		Porosity		Mass of Contaminant (lb)		Klozur Required (lb)	Total Klozur Required (lb)
1,2,4-Trimethylbenzene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	0.742517
1,3,5-Trimethylbenzene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
2-Butanone		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
2-Chlorotoluene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
2-Hexanone		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
4-Methyl-2-Pentanone		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
Acetone		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
Benzene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
Bromobenzene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
Cyclohexane		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
Ethyl Benzene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
Hexachlorobutadiene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
Isopropylbenzene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
m/p-Xylenes		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
Methyl Cyclohexane		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
methyl tert-butyl Ether		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
Naphthalene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
n-Butylbenzene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
n-Propylbenzene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
o-Xylene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
p-Isopropyltoluene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
sec-Butylbenzene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
Styrene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
tert-Butylbenzene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	
Toluene		0	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0	=	0	0.742517
CVOCs	13,700	0.00003014	(X)	28.3168	(X)	125	(X)	8	(X)	0.30	=	0.256040506	=	0.742517	0.742517
										Total	**=**	0.256040506		0	0

Environmental Solutions

KLOZUR® CR

Product Sheet

An All-In-One Combined Remedy Approach to Address Soil and Groundwater Contamination

Klozur® CR, a Combined Remedy technology, is comprised of a specially formulated mixture of Klozur® SP and PermeOx® Ultra.

Klozur CR is a single, all-in-one formulated product that can be readily applied to either source areas or plumes with mixed petroleum and chlorinated solvents contamination. Klozur CR destroys contaminants in soil and groundwater by promoting three modes of action: Klozur activated persulfate chemical oxidation, aerobic bioremediation and anaerobic bioremediation.

The benefits of Klozur CR

Two field proven technologies formulated into an all-in-one preblended product.

- **The Power of Klozur Activated Persulfate**
  - A built in Klozur persulfate activator delivers proven and powerful chemical oxidation action from generated sulfate and hydroxyl radicals
  - Rapid in situ chemical oxidation to target source and hot spot contaminate zones, typically lasting 3-6 months
- **The Performance of PermeOx Ultra**
  - Engineered calcium peroxide providing extended oxygen release for up to one year; longer than any other oxygen release compound available
  - Longevity delivers enhanced aerobic bioremediation in down gradient plumes

The sound science of Klozur CR

Klozur CR provides self-activating Klozur persulfation oxidation technology, utilizing the alkalinity generated by calcium peroxide to achieve a pH in the range of 11. In addition, the calcium peroxide will slowly generate hydrogen peroxide allowing for peroxide activation of persulfate. High pH activated persulfate is capable of destroying a wide range of contaminants, including petroleum hydrocarbons and chlorinated solvents.

Following the initial chemical oxidation phase, Klozur CR will continue to release oxygen to be used as an electron receptor for aerobic bioremeidaiton for up to a year, as a result of the slow hydration of the engineerd calcium peroxide. Diffusion and transport of oxygen downgradient will support contaminant reductions in plume areas, treating BTEX, PAH’s and petroleum hydrocarbons.

As a result of the persulfate oxidation with organic compounds, generated sulfate ions can be utilized by sulfate reducting bacteria as an electron acceptor under anaerobic conditions to degrade BTEX, PAH’s and petroleum hydrocarbons.

Examples of Contaminants of Concern
CHLORINATED SOLVENTS PCE, TCE, DCE, VC, TCA, DCA
PETROLEUM GRO, DRO, ORO, BTEX
PAHs Creosote, MGP residuals 1,4-dioxane, MTBE, TBA

Application Methods

- Direct push injection
- Soil blending
- Direct application in an excavation

For more information and detailed case studies, please visit our website.

PeroxyChem

remediation@peroxychem.com | 1.866.860.4760 | peroxychem.com/remediation

Klozur® CR Slurry Preparation and Application Guidelines

Klozur® CR is a blended formulation of Klozur® SP and PermeOx® Ultra, providing a combined remedy (CR) of activated persulfate and bioremediation when applied into the subsurface in a single application. Klozur CR is self-activating with no mixing of additional chemicals or reagents.

Klozur CR is most commonly injected as a slurry, but can also be applied as an amendment to an excavation, trench, or with backfill. This document provides guidance for the makeup and delivery of the slurry via direct injection and some general recommendations for backfill applications.

Slurry Preparation

Klozur CR is not fully soluble in water, and upon makeup will form a slurry. The slurry should be stirred until the entire product is suspended in solution. Mixing should take place in a chemically compatible tank, such as high density polyethylene (HDPE), with a chemically compatible mechanical mixer, such as 304 or 316 stainless steel. If the temperature of the makeup water or the outside temperature is cold, then it may take a little longer to get the slurry suspended into solution.

Klozur CR slurries are typically made in small batches with the intent of immediate injection. PeroxyChem does not recommend making a Klozur CR slurry in advance or storing prior to use. (*See Tank and Pump Safety Note)

A 20 weight % (wt%) is the typical slurry concentration for Klozur CR. Table 1 provides slurry makeup ratios for common concentrations per every 45lb drums of Klozur CR or per 500 gallons of final slurry volume.

Klozur CR Slurry, wt%	Makeup water per 45lb pail of Klozur CR, gal	Ratios per 500 gallons of Slurry			Specific Gravity
		Klozur CR Mass, lbs	Makeup Water, gal	Total Slurry Volume, gal	
10%	45	436	470	500	1.031
20%	22	930	445		1.124
30%	13	1500	419		1.190

Table 1. Klozur CR slurry makeup formulations

Tank and Pump Recommendations

The Klozur CR slurry is typically made up in a chemically compatible, vented, vertical tank. A tank with a cone bottom and bottom drain can aide in the removal of the slurry. The slurry within the tank should be under constant agitation until emptied. In addition to the main line to the injection network, a small recycle loop from the pump back into the tank will prevent the accumulation of a final slurry contents that may be too high in solids or if the slurry begins to settle out when getting to levels below the mechanical mixer. Near the very end of the tank cycle, the pump recycle line should be shut-off entirely to allow full flow forward via the pump to the injection point. All wetted parts in the injection system, including the tank, valves, flanges, gaskets, check valves, pumps, pipes, and gauges should be chemically compatible with Klozur CR.

Air-operated, positive displacement, self-priming double diaphragm pumps have been successfully used for the injection of 10 to 30 wt% Klozur CR. It is recommended that the double diaphragm pump with a minimum of 1 ½ inch inlet and outlet be used. A variety of these types of pumps are manufactured by Wilden® and Sandpiper®. All wetted parts of the pump and all parts coming in contact with Klozur CR must be constructed of or coated with materials compatible with oxidizers and high pH, such as 304L or 316L stainless steel, polyethylene, polyvinylidene fluoride (PVDF) or polytetrafluoroethylene (PTFE or Teflon®).

TANK AND PUMP SAFETY NOTE*

Klozur CR may undergo decomposition if stored or handled improperly or if it comes into contact with impurities. Please refer to the Klozur CR Safety Data Sheet (SDS) and the Klozur Persulfate Safety and Handling Technical Bulletin, available on PeroxyChem's website. Klozur persulfate slurries/solutions decompose auto-catalytically. Decomposition is a function of temperature, time, the presence of activators including transition metals, and exposure to incompatible materials.

The pump and tank system MUST be designed to relieve pressure that may build up upon normal decomposition, and includes over-pressure relief in zones between valves.

All equipment, such as pumps, tanks, and hoses, MUST be cleaned out with a water flush at the end of every work day. This is to avoid potential pressure buildup due to decomposition and to reduce potential corrosion on equipment.

Injection Approach

When injecting, Klozur CR needs to be applied in a manner that will allow for transport and distribution of the solid material into the subsurface. To facilitate this distribution Klozur CR is typically applied through large orifice direct push technology (DPT) tooling at pressures high enough to create fractures that aide distribution. If using DPT tooling, for each injection point, the rods are initially advanced to the top (or bottom) of the targeted depth interval and a specified volume of slurry is injected before proceeding to the next depth. Using DPT tooling allows for targeting vertical injection intervals of approximately 1 to 3 ft. The preferred approach for the injections is often in the top-down direction using an injection tip that directs the slurry horizontally. However, different contractors may prefer a bottom-up approach based on their specific tooling or evaluation of site conditions.

Injection Spacing

The recommended spacing between injection points is based on two factors: distribution (ROI) and soil acceptance. Both of these factors may vary greatly depending on injection technique and lithology. A flexible approach is recommended during a field installation and/or to evaluate these parameters during a pilot-scale test injection. Based on experience from a range of sites, a ROI of approximately 5 ft from an injection location and spacing of injection locations of 8 to 12 ft are typical. Injection locations tend to be located in staggered rows with overlapping ROIs from different injection locations. Greater ROIs can be achieved with specific techniques and equipment. PeroxyChem recommends discussing injection spacing with your selected contractor.

Soil acceptance may also vary greatly depending on the Klozur CR slurry concentration, site lithology, the ability to fracture the soil, and injection depth. As a general guideline the amount of Klozur CR accepted by soils in more permeable formations is limited to no more than 100 lbs Klozur CR per vertical foot. For less permeable formations, soil acceptance is typically no more than 50 lbs per vertical foot. The actual soil acceptance can be tested and confirmed in field pilot scale tests. If greater amounts of Klozur CR are required, a closer spacing of the injection locations, or smaller ROI, may need to be used or the slurry concentration can be increased, if possible.
Note: Significantly greater ROIs have been observed with certain fracturing techniques. Please contact PeroxyChem for further information regarding ROI monitoring and site observations.

Backfill Approach

Absent any specific site information, a range of 1 to 4 lbs Klozur CR per square foot of the pit surface area, or approximately 5 to 20 Kg per square meter, is commonly used during mixing as a polishing treatment for residual contamination in the aqueous phase. If the Klozur CR is to be blended into the bottom of the excavation, 1 to 4 lbs Klozur CR per cubic foot or approximately 16 to 64 Kg per cubic meter, is often used depending upon the vertical extent of the blending.

Considerations for higher Klozur CR dosage rates:

- Site/receptors are more contaminant sensitive
- More extensive soil and groundwater impacts
- High soil and groundwater contaminant concentrations
- High groundwater flow velocity environments

Considerations for lower Klozur CR dosage rates:

- Site/receptors are less contaminant sensitive
- Less extensive soil and groundwater impacts
- Low soil and groundwater contaminant concentrations
- Low groundwater flow velocity environments

Klozur CR can be applied as a backfill amendment in a variety of modes, including: 1) Directly applying Klozur CR to the base of the excavation and backfilling on top of the Klozur CR; 2) Applying directly to the base of the excavation and then using a device such as a mixing tool or excavator to blend the Klozur CR with the soil or soil slurry; or, 3) Blending Klozur CR with additional backfill material and applying the combined material to the bottom of the excavation. It is recommended that Klozur CR be applied very close to or directly on the base of the excavation to minimize dusting and that all personnel be wearing proper personal protective equipment (PPE) as specified in the Klozur CR SDS. The high pH (typically pH

>11) of Klozur CR will minimize the corrosive properties of the persulfate in the product, however, chemical compatibility with the equipment or other materials Klozur CR will contact should be considered.

Klozur CR is intended to be applied under saturated conditions, as it relies on a sufficient amount of water to facilitate the biotic reactions that are part of the intended treatment mechanism. Because of this, Klozur CR is intended to be applied as a backfill amendment in the saturated zone or in zones that will be saturated with water very shortly after the application of Klozur CR. If Klozur CR is applied as a dry reagent it should be wetted down and the area should be saturated with water so that the conditions will remain saturated for a sustained period of time. Applying Klozur CR with less than saturated conditions should be carefully evaluated, since if Klozur CR is applied with insufficient water it could easily react resulting in the evolution of heat and steam.

Materials of Compatibility

As specified by the Klozur CR SDS, Klozur CR is a DOT class 5.1 oxidizer and a corrosive material. Upon dissolution it typically creates alkaline conditions but also has the potential to be acidic. All materials contacting Klozur CR should be chemically compatible including tanks, pumps, injection rods, seals, gaskets, tubing, hoses, and mixing equipment.

Compatible materials include: stainless steel (304L and 316L), polyethylene (PE), polyvinylchloride (PVC), polytetrafluoroethylene (PTFE), Viton®, polyvinylidene fluoride (PVDF), and butyl rubber are also compatible materials. Materials NOT compatible include, nitrile rubber, carbon steel, aluminum, brass, galvanized steel, or any other metal susceptible to corrosion. Please refer to PeroxyChem's Corrosion and Material Compatibility of Klozur Persulfate Technical Bulletin for more detailed information, available at www.peroxychem.com/remediation.

Health and Safety

Klozur CR has been applied safely and effectively at numerous sites. However, as with any chemical, proper procedures and equipment are recommended in its use. When working with Klozur CR, ensure to have adequate ventilation and use the appropriate personal protective equipment, including safety glasses, suitable protective clothing, boots (steel toed or equivalent), chemical resistant gloves, hard hat, and hearing protection (when direct push is used). For dust, splash, mist, or spray exposures wear a filtering dust mask and chemical protective goggles. A face shield can also be used in addition to goggles.

Please consult the Klozur CR SDS for guidelines regarding proper handling procedures. The SDS can be found at: http://www.peroxychem.com/remediation. Additional safety equipment may be required for mechanical and site operations.

Please contact PeroxyChem for additional guidance.

Persulfates: Storage Essentials

PeroxyChem

Persulfates can react dangerously when stored incorrectly. Safety depends on you, your team, and anyone handling persulfates to store the product properly. Understanding and practicing the following storage procedures will ensure the integrity of the product and the safety of people and property:

Storage Climate:

All persulfates should be stored in a cool, dry, well-ventilated space. For optimal stability, persulfates must be stored at temperatures below 77ºF (25ºC), and never at temperatures approaching 113ºF (45ºC). Be aware of moisture, too! Do not store persulfates anywhere with the potential for exposure to moisture.

Never store persulfates near heating vents, steam pipes, appliances, gas flames, welding sparks or any heat source. Moreover, make sure your persulfates aren't stored near incompatible materials such as metals, reducing agents, acids, bases, halides, salt solutions, organics, ammonia solutions, other oxidizers, and cleaners. Control of potential decomposition and firefighting efforts are enhanced if persulfates are stored within containment areas.

How to Store Persulfates:

Persulfates can retain active oxygen content specification for approximately three years if stored under cool, dry conditions. However, if stored in a less-than-optimal environment, the product's flow characteristics can be affected in a matter of months and the material may become noticeably caked within a year. As a result, your storage inventory should be consumed on a First-In, First-Out basis.

Compatible Storage & Transport Materials:

The recommended materials for storage and conveyance equipment (tanks, pipelines, etc.) are 304 and 316 stainless steel. Other acceptable materials include polyvinyl chloride, polyethylene, Plexiglas® plastic (or other suitable generic), Teflon® resin (or other suitable generic), chemical stoneware, and glass. PeroxyChem packages and ships crystalline persulfate chemicals in three different container types, per customer requests.

Preserving or extending the product's useful life – and protecting your investment – depends heavily on the right storage conditions. More importantly, avoiding potentially hazardous storage conditions will prevent the possible loss of life and property.

Refer to Safety Data Sheet for the relevant persulfate product for further information.

Persulfates: Spill Cleanup

Persulfate spills are a serious matter. If cleaned up improperly, a persulfate spill can result in a dangerous decomposition event. Make certain you and your co-workers know what to do if a spill occurs:

Contain the Spill:

Berms should be available throughout the work area to quickly contain chemical spills. This action can significantly reduce the risk of the spill spreading and endangering others.

Dilute the Spill:

Large amounts of water should be added to the spill immediately. A 10 to 1 ratio of water to persulfate product must be applied to stop decomposition.

Neutralization:

Slowly adding a mild alkali (bicarbonate) will neutralize persulfate chemicals. Make sure to add the mild alkali slowly, until the spill stops fizzing.

Large Persulfate Spills:

Any large persulfate spill should be considered and treated as solid hazardous waste. In the case of a decomposition event, alert your supervisor and call for emergency help, being sure to alert emergency responders that persulfate products are involved.

Remember: carbon dioxide (CO2) or other gas-filled extinguishers will have NO effect on decomposing persulfate.

Disposal:

Never return spilled material back to its original container. Cross contamination can result in decomposition. Always comply with all local, state and federal regulations when disposing of persulfates.

Remember: you can avoid a potential spill by storing and handling the product with care and respect.

Refer to Safety Data Sheet for the relevant persulfate product for further information.

Safe Handling of Persulfates: Protect Yourself & Others

PeroxyChem

Persulfates are hazardous chemicals and should be handled with focus and care. To ensure the safety of yourself and others, always take the time to practice the following handling procedures:

Always Wear Protective Equipment:

- Chemical-type goggles or face mask
- Approved dust respirators
- General purpose neoprene gloves
- Long-sleeve shirts and full-length pants
- Shoes with neoprene soles.

Avoid Cross Contamination:

It's very important that you never cross contaminate persulfates by using scoops, cups or stirrers that may have been exposed to other chemicals. Use only dedicated, clean, dry plastic or stainless steel scoops and utensils for transfer. Also avoid contact with metals, halides, alkalis, other oxidants, combustibles, organics, reducing agents, ammonia solutions, acids, salt solutions, and cleaners.

Avoid Overheating:

Overheating can activate persulfate decomposition quickly. Never grind or dry-mix persulfates in equipment or machines that create frictional heat. Always handle and store persulfates in a cool place where the temperature is below 77ºF (25ºC), and never at temperatures approaching
113ºF (45ºC).

Avoid Inadvertent Contact with Moisture:

Moisture can cause rapid decomposition, clumping, and caking of persulfates. Avoid handling persulfate near sources of moisture.

Your focus when safely handling persulfates should be to avoid all potential for overheating, moisture and contamination.

Refer to Safety Data Sheet for the relevant persulfate product for further information.

Persulfates First Aid: What to Do After Product Exposure

PeroxyChem

In the event of chemical exposure, knowing what to do quickly is critical! Upon contact with the body, persulfates can be dangerous but with the proper knowledge, you can address an accidental exposure effectively.

In the event of product exposure, follow these procedures:

For Eye Contact

Flush with water for at least 15 minutes. If irritation occurs and persists, obtain medical attention.

For Skin Contact

Wash with plenty of soap and water. If irritation occurs and persists, consult a healthcare professional. Wash clothing before reuse.

For Inhalation

Get fresh air. If breathing difficulty or discomfort occurs, seek medical attention.

For Ingestion

Drink one to two glasses of water. Do not induce vomiting. Do not give anything by mouth to an unconscious individual. Get medical care immediately.

Persulfates are safe when stored and handled properly but when accidents happen, it’s important that you know what to do. You and your co-workers must understand the proper safety responses for accidental exposures and always have appropriate, readily accessible first aid supplies in place – and those supplies should be refreshed on a routine basis.

Be sure to read our companion fact sheets on persulfate storage, handling and accidental spill clean-up.

Refer to Safety Data Sheet for the relevant persulfate product for further information.

In the event of an emergency, take immediate action to protect yourself and others. Once you are safe, alert your supervisor. Be prepared for the worst case scenario and know the proper emergency response procedures:

Alert Proper Authorities:

Outside agencies (fire departments, EMTs, etc.) must be made aware that persulfates are involved prior to responding to an incident. Responders must wear full protective rubber clothing, face and head protection, plus a self-contained breathing apparatus due to sulfur oxide generation.

Responding to Decomposition:

Immediately following any spill or accidental mixture, dilute the chemicals with plenty of water. A 10 to 1 ratio of water to persulfate product must be applied to stop decomposition. Use available berms to contain the spill.

Remember: carbon dioxide (CO2) or other gas-filled extinguishers will have NO effect on decomposing persulfate, but you can neutralize the decomposition by using a mild alkali such as bicarbonate until the product stops fizzing.

Emergency Prevention:

Prevention is always a best practice. Ensuring proper storage, handling and disposal of persulfates is crucial to emergency prevention. Overheating and contamination are two events that can trigger chemical emergencies.

See the companion fact sheet on dealing with spills and spill clean-up.

Refer to Safety Data Sheet for the relevant persulfate product for further information.

Persulfates
Technical Information

Leading the persulfate market with the highest quality products and reliable supply.

PeroxyChem

Index

Applications and Chemistry

04 Applications

05 Oxidation Chemistry / Free Radical Chemistry
Persulfate Chemical Structure

Physical and Chemical Data

06 Physical and Chemical Properties of Persulfates /
Solubilities of Persulfate Salts

07 Density of Aqueous Solutions / Viscosity of Aqueous Solutions

08 Electrical Conductance of Aqueous Solutions /
Heat Capacity of Aqueous Solutions

09 Conversion Grams/Liter to Weight Percent

10 Decomposition Rates of 4% Solutions / Decomposition Rates of 10% Solutions

11 Typical Analysis of Persulfates

12 Analytical Chemistry / Assay Procedures

General Material Information

13 Handling and Safety / First Aid / Storage /
Containers and Packaging

14 Disposal / Shipping / Decomposition Hazard & Prevention

Customer Support Services

15 Quality Assurance / Technical Services

16 Contact Information

Introduction

> **Persulfates are the most chemically active of the peroxygens, with great utility in a variety of chemical processes. PeroxyChem persulfates, backed by years of experience, are manufactured to strict specifications for thermal stability, making them among the most stable available.**

PeroxyChem is the leading producer of peroxygen chemicals and a major researcher in active oxidant chemistry. We are the world's largest and North America's only producer of peroxydisulfates, a group of chemicals commonly referred to as persulfates. PeroxyChem manufactures ammonium, potassium, and sodium persulfates at a plant in Tonawanda, New York and ammonium and sodium persulfates at a plant in Rheinfelden, Germany. Our dedicated plant employees contribute to PeroxyChem's 70+ years of peroxygen production experience.

PeroxyChem provides a reliable supply of high-quality, stable persulfates to the global market. The Tonawanda plant is an ISO-9002 certified facility near the Niagara River outside Buffalo, NY. The Rheinfelden plant is an ISO-9001, ISO-14001, and ISO-15001certified facility on the Rhine River in Germany. Both locations provide abundant local resources, including reliable supplies of hydroelectric power and cooling water.

PeroxyChem has been the world's leading producer of persulfates for decades, yet we continually find ways to improve our products, especially their safety. Our research into the characteristics of peroxydisulfates has improved the quality and the stability of all PeroxyChem persulfates. An understanding of the crystalline structure of persulfates and the interplay with heat and moisture have changed quality control procedures, manufacturing processes, and storage requirements for these products. We have established new specifications for thermal stability which make persulfates among the most stable available. Persulfates are strong oxidants, have excellent shelf life when stored properly, and are economical to use. These properties make persulfates suitable for a variety of applications.

PeroxyChem is committed to the principles of Product Stewardship and to manufacturing, transporting, storing, and using chemicals in a safe manner.

The commitment begins with the manufacturing process and continues throughout the life cycle of our products. Our continuing effort is to ensure that safety, health, and environmental issues are addressed wherever persulfates are handled or used.

Applications & Chemistry

APPLICATIONS

Persulfates are key components in many industrial processes and commercial products. The polymer industry uses aqueous solutions of persulfates as initiators in the polymerization of latex and synthetic rubber. The electronics industry considers sodium persulfate an efficient microetchant in the manufacture of printed circuit boards. The following examples further illustrate the chemical versatility of persulfates.

Polymerization

PLASTICS AND RUBBER: Ammonium, potassium, and sodium persulfates are used as initiators for emulsion polymerization reactions in the preparation of acrylics, polyvinyl chlorides, polystyrenes, and neoprene. They are used as polymerization initiators in the manufacture of synthetic rubber (styrene butadiene and isoprene) for automobile and truck tires. Persulfate initiation is used to prepare latex polymers for paints, coatings, and carpet backing.

STRUCTURAL MATERIALS: Persulfates are used as initiators in polymeric concrete formulations.

INORGANIC CHEMICALS AND MINERALS: Persulfates are also initiators for the polymeric coating of graphite filaments.

SOIL STABILIZATION: Ammonium persulfate is used as a curing agent in chemical grout systems used to stabilize soil near dams, tunnels, and buildings.

Oxidation

SURFACE PREPARATION: The oxidation power of persulfates is used to clean and microetch a variety of printed circuit board substrates. Persulfates are important oxidants in plating and coating processes. They are also etchants for nickel, titanium, and zinc alloys. Persulfates are used to clean and mill aluminum, brass, copper, and many other metal surfaces prior to plating or adhesive bonding. Persulfates are used to clean and activate carbon and charcoal before and after their use as absorbents.

COSMETICS: The cosmetic industry has developed formulations which use persulfates to boost hair bleaching performance.

ORGANIC SYNTHESIS: Persulfates are oxidizing agents in the preparation of aldehydes, ketones, carboxylic acids, quinones, and a variety of other compounds. The pharmaceutical industry uses sodium persulfate as a reagent in the preparation of antibiotics.

Other Applications

ADHESIVE: Persulfates are used in the preparation of adhesive films and metal bonding adhesives.

GAS AND OIL PRODUCTION: In enhanced oil recovery, persulfates are used "down hole" for gel forming and breaking.

INKS, PIGMENTS, AND DISPERSANTS: Persulfates are used to graft substrates to polymers (for example, carbon black to sodium acrylate). Persulfates are used in the preparation of dispersants for ink jetting and toner formulations.

MINING: Persulfates can be used in nickel and cobalt separation processes.

PEROXYMONOSULFATE: PeroxyChem developed a process using ammonium and sodium persulfates to prepare peroxymonosulfate solutions. This patented process allows fast, efficient, on-site production of an alternative to Caro's acid and potassium caroate.

PHOTOGRAPHY: Persulfates are used in many photographic applications, including bleaching solutions, solution regeneration, equipment cleaning, and wastewater treatment.

PULP AND PAPER: Persulfates are used in the sizing of paper, preparation of binders and coatings, and production of special papers.

An activated alkali metal persulfate effectively repulps neutral/ alkaline wet-strength broke and decolorizes dyes and optical brightener.

TEXTILES: Ammonium and sodium persulfates are used in the desizing and bleaching of textiles and the development of dyestuffs.

ENVIRONMENTAL: Persulfates are very strong oxidants, have excellent shelf life when stored properly, and are economical to use. These properties make persulfates suitable for a variety of environmental applications, such as soil remediation and wastewater/groundwater cleanup.

OXIDATION CHEMISTRY

The persulfate anion is the most powerful oxidant of the peroxygen family of compounds.

The electromotive force data listed below compares three commonly used peroxygens:

$S_2O_{8-2} + 2H^+ + 2e^- \longrightarrow 2HSO_4^-$ E = 2.12V

$H_2O_2 + 2H^+ + 2e^- \longrightarrow 2H_2O$ E = 1.77V

$HSO_5^- + 2H^+ + 2e^- \longrightarrow HSO_4^- + H_2O$ E = 1.44V

Many metals are oxidized by persulfate to form soluble metal sulfates, for example, copper:

$Cu + S_2O_8^{-2} \longrightarrow CuSO_4 + SO_4^{-2}$

Under certain circumstances, hydrolysis of the persulfate anion will yield the bisulfate anion and hydrogen peroxide a kinetically faster oxidant than persulfate:

$S_2O_8^{-2} + 2H_2O \xrightarrow{H+} 2HSO_4^{-2} + H_2O_2$

Another reaction of note is the acid-catalyzed hydrolysis of persulfate to form peroxymonosulfate anion. Fast, high-temperature, acid hydrolysis followed by thermal quenching will yield solutions of peroxymonosulfate:

$S_2O_8^{-2} + H_2O \longrightarrow HSO_4^- + HSO_5$

The resulting solution is a useful replacement for Caro's acid, H_2SO_5 and potassium caroate, $KHSO_5$. Reactions at different pH:

NEUTRAL (PH 3 TO 7)

$S_2O_8^{-2} + H_2O \longrightarrow 2HSO_4^- + 1/20_2$

DILUTE ACID (PH > 0.3; [H+] < 0.5M)

$S_2O_8^{-2} + 2H_2O \longrightarrow 2HSO_4^- + H_2O_2$

STRONG ACID ([H+] > 0.5M)

$S_2O_8^{-2} + H_2O \longrightarrow 2HSO_4^- + HSO_5^-$

ALKALINE (PH > 13)

$S_2O_8^{-2} + OH^- \longrightarrow HSO_4^- + SO_{4-2} + 1/20_2$

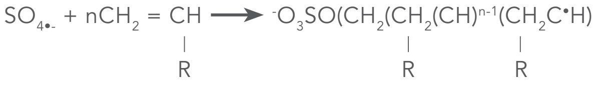
FREE RADICAL CHEMISTRY

Persulfates produce free radicals in many diverse reaction situations.

When solutions of the persulfates are heated, free radicals are formed:

$S_2O8^{-2} + Heat \longrightarrow 2SO_{4\bullet-}$

In the presence of suitable monomers, the radical anions act as polymerization initiators to produce polymer molecules:



$$SO_{4\bullet-} + nCH_2 = \underset{\underset{R}{|}}{CH} \longrightarrow {}^-O_3SO(CH_2(CH_2\underset{\underset{R}{|}}{(CH)}{}^{n-1}(CH_2\underset{\underset{R}{|}}{C^\bullet}H)$$

Free radicals suitable as polymerization initiators are also generated in the presence of reducing agents, for example, the bisulfite anion:

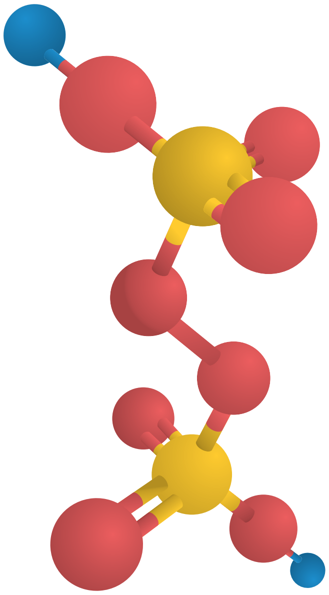
$S_2O_8^{-2} + HSO_{3-} + 1/20_2 \longrightarrow HSO_{4-} + 2SO_{4\bullet-}$

Free radicals can also be generated in the presence of transition metals:

$S_2O_8^{-2} + Fe^{+2} \longrightarrow Fe^{+3} + SO_4^{-2} + SO_{4\bullet-}$

and mercaptans:

$S_2O_8^{-2} + 2RSH \longrightarrow 2HSO_{4-} + 2RS^\bullet$



Persulfate Chemical Structure

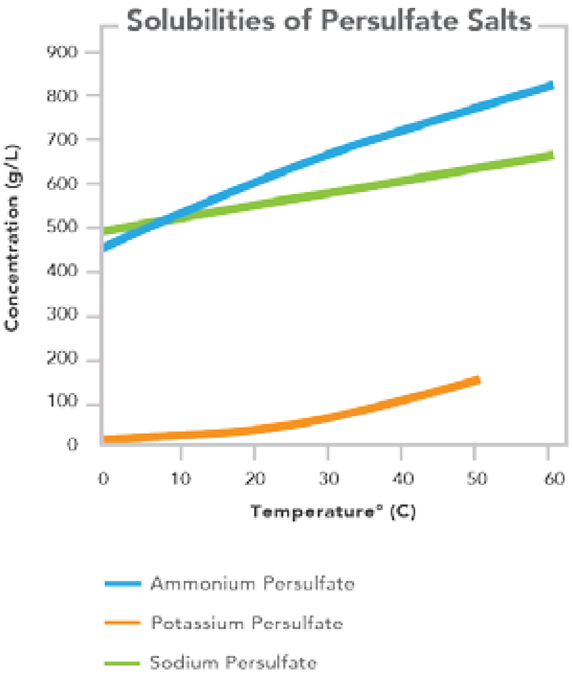
Physical & Chemical Data

PHYSICAL AND CHEMICAL PROPERTIES OF PERSULFATES

> **PeroxyChem conducted physical and chemical studies of persulfates to provide the data for this section.**

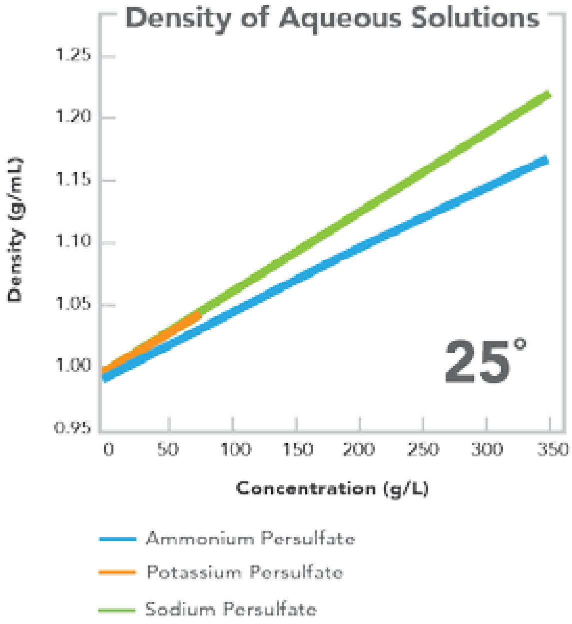
You will find the data useful for applying persulfate chemicals to various processes and products. The density, viscosity, electrical conductance, and solution heat capacity data are presented in graphic and equation form. This format enables you to view the general trend of the physical data. Then, with the aid of equations, you can calculate the correct values for your application.

Common Name	Ammonium Persulfate	Potassium Persulfate	Sodium Persulfate
Chemical Name	Ammonium Peroxydisulfate	Potassium Peroxydisulfate	Sodium Peroxydisulfate
Physical Form	Crystalline (monoclinic)	Crystalline (triclinic)	Crystalline (monoclinic)
Formula	$(NH_4)_2S_2O_8$	$K_2S_2O_8$	$Na_2S_2O_8$
Molecular Weight	228.2	270.3	238.1
Crystal Density (g/cc)	1.98	2.48	2.59
Color	Off-white	Off-white	White
Odor	None	None	None
Loose Bulk Density (g/cc)	1.05	1.30	1.12



Maximum solubility of Persulfate salts in water

Solubility (g/100g of H_2O)	Ammonium Persulfate	Potassium Persulfate	Sodium Persulfate
25° C	85	6	73
50° C	116	17	86



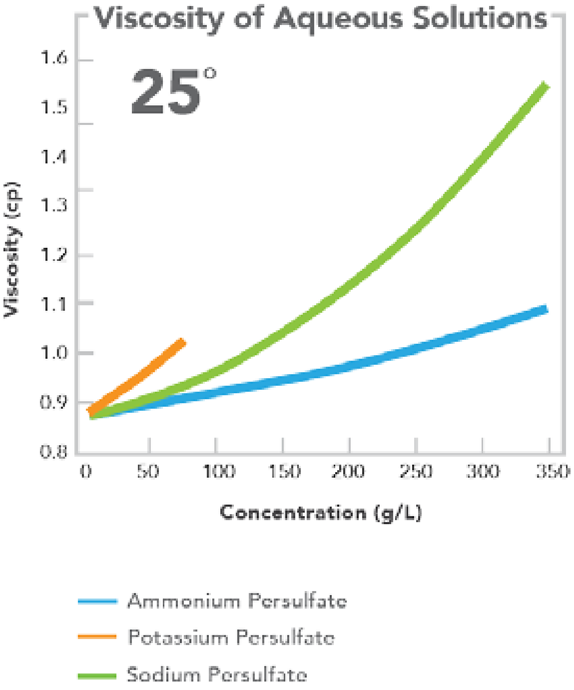
EQUATION FOR CALCULATION OF DENSITY

Density (g/mL) = density H_2O + (A/1000)X + (B/1000)$X^{1.5}$,
where X = solution concentration in grams per liter (g/L).

Salt	Constant	25° C	35° C	45° C
Ammonium	A	0.4903	0.4860	0.4789
	B	-2.6730x10^{-4}	-7.6254x10^{-4}	-5.0971x10^{-4}
Potassium	A	0.6368	0.6273	0.6294
	B	-1.4934x10^{-3}	-8.1965x10^{-4}	-1.6472x10^{-3}
Sodium	A	0.6709	0.6727	0.6610
	B	-1.4934x10^{-3}	-1.4909x10^{-3}	-1.0038x10^{-3}

DENSITY OF WATER

	25° C	35° C	45° C
Density H_2O	0.99707	0.99406	0.99025



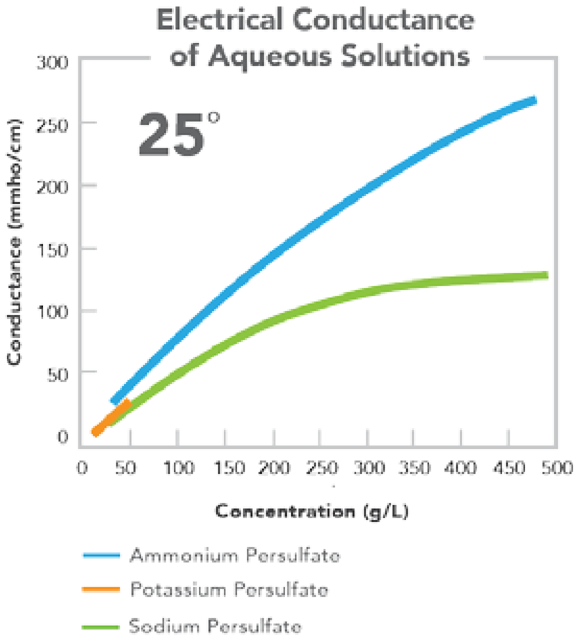
EQUATION FOR CALCULATION OF VISCOSITY

Viscosity (cp) = viscosity H_2O + CX0.5 + DX + E$X^{1.5}$,
where X = solution concentration in grams per liter (g/L).

Salt	Constant	25° C	35° C	45° C
Ammonium	C	-1.0686x10^{-3}	6.8050x10^{-3}	5.3134x10^{-3}
	D	1.7140x10^{-4}	-9.4542x10^{-4}	-5.8450x10^{-4}
	E	2.4670x10^{-5}	5.9785x10^{-5}	4.5080x10^{-5}
Potassium	C	0	5.9187x10^{-3}	3.5413x10^{-3}
	D	1.0661x10^{-3}	-1.0551x10^{-3}	-9.5623x10^{-5}
	E	9.8884x10^{-5}	1.0674x10^{-4}	1.2477x10^{-5}
Sodium	C	4.3857x10^{-3}	6.1743x10^{-3}	1.3461x10^{-2}
	D	-1.2218x10^{-3}	-4.6619x10^{-4}	-1.9741x10^{-3}
	E	1.5146x10^{-4}	8.1093x10^{-5}	1.3540x10^{-4}

VISCOSITY OF WATER

	25° C	35° C	45° C
Viscosity of H_2O	0.8904	0.7194	0.5960

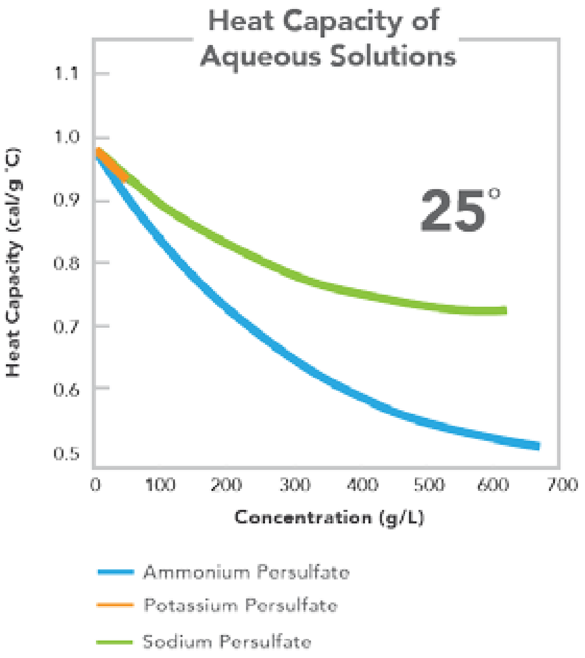


EQUATION FOR CALCULATION OF ELECTRICAL CONDUCTANCE

Conductance (mmho/cm) = $F + GX + HX^2$,

where X = solution concentration in grams per liter (g/L).

Salt	Constant	25° C	35° C	45° C
Ammonium	F	3.9016	6.6081	6.2538
	G	0.8568	0.9804	1.1578
	H	6.2904×10^{-4}	-7.1312×10^{-4}	-8.8912×10^{-4}
Potassium	F	2.9603	3.7314	4.1673
	G	0.6704	0.7972	0.9525
	H	-1.0456×10^{-3}	-1.1982×10^{-3}	-1.9173×10^{-3}
Sodium	F	5.9501	7.1826	8.1825
	G	0.5880	0.6967	0.8123
	H	-6.6193×10^{-4}	-7.5821×10^{-4}	-8.6226×10^{-4}



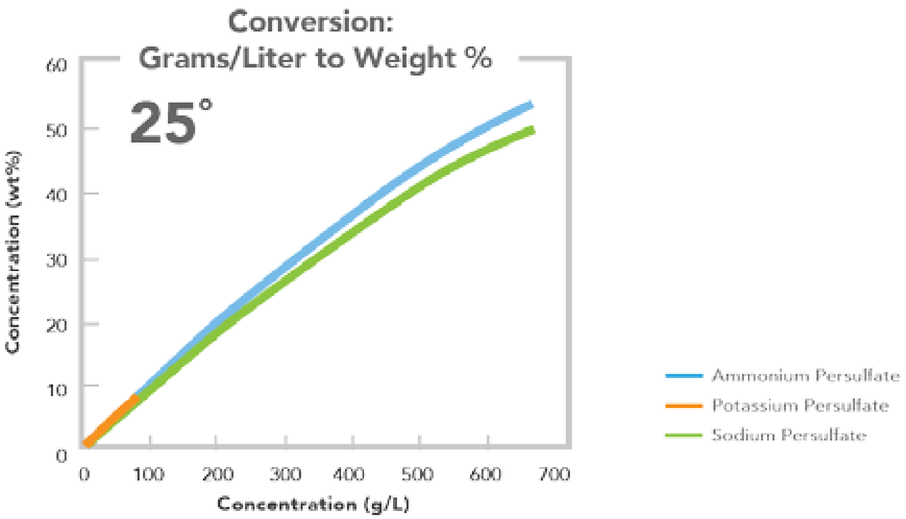
EQUATION FOR CALCULATION OF HEAT CAPACITY

Heat capacity (cal/g °C) = $K - LX + MX^{1.5}$, where

X = solution concentration in grams per liter (g/L).

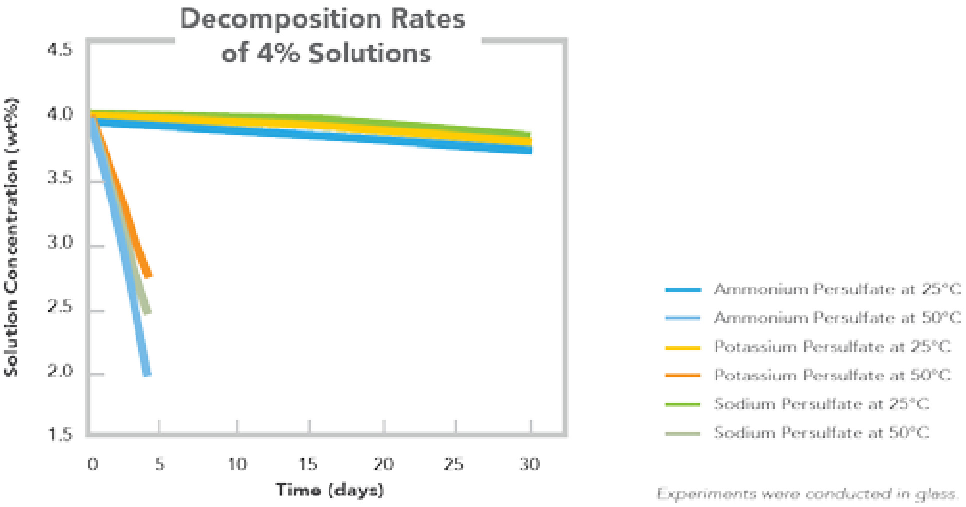
Salt	Constant	25° C
Ammonium	K	0.994
	L	-1.863×10^{-3}
	M	4.531×10^{-5}
Potassium	K	0.997
	L	1.150×10^{-3}
	M	2.670×10^{-5}
Sodium	K	0.997
	L	1.190×10^{-3}
	M	3.112×10^{-5}

Conversion $\dfrac{\text{cal/g °C = Btu/lb °F = J/g °C}}{4.184}$

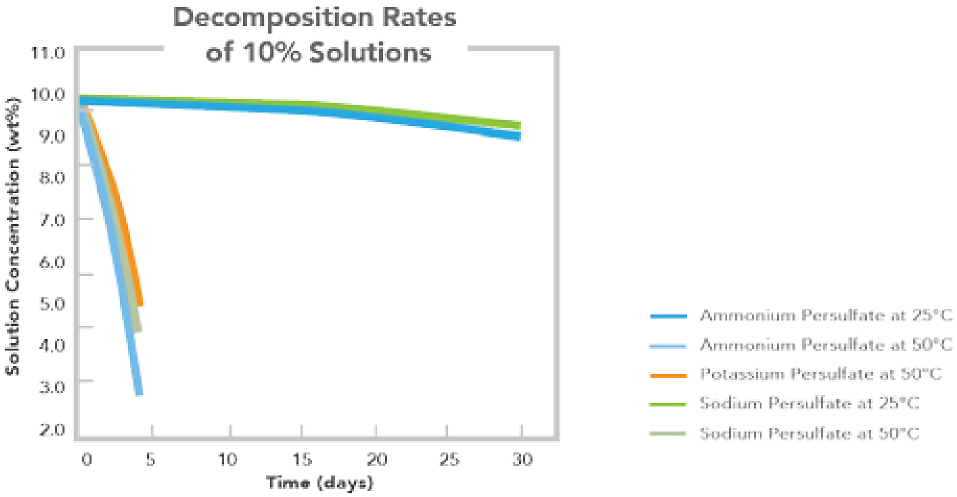


G/L	25° C	35° C	45° C	25° C	35° C	45° C	25° C	35° C	45° C
0	0	0	0	0	0	0	0	0	0
25	2.477	2.485	2.495	2.468	2.476	2.486	2.466	2.474	2.484
50	4.895	4.911	4.931	4.861	4.877	4.896	4.854	4.868	4.888
75	7.256	7.281	7.311	7.183	7.208	7.237	7.167	7.187	7.219
100	9.562	9.598	9.635	—	9.470	9.510	9.410	9.435	9.479
125	11.815	11.863	11.912	—	11.668	11.719	11.586	11.616	11.672
150	14.017	14.077	14.136	—	—	13.868	13.699	13.733	13.801
175	16.170	16.244	16.311	—	—	15.959	15.751	15.790	15.870
200	18.275	18.364	18.440	—	—	17.994	17.745	17.788	17.880
250	22.349	22.471	22.564	—	—	—	21.572	21.620	21.738
300	26.251	26.411	26.519	—	—	—	25.197	25.250	25.394
350	29.993	30.194	30.316	—	—	—	28.634	28.695	28.864
400	33.583	33.831	33.964	—	—	—	31.910	31.969	32.164
450	37.031	37.329	37.473	—	—	—	35.026	35.087	35.307
500	40.346	40.699	40.850	—	—	—	37.998	38.060	38.305
550	43.536	43.946	44.104	—	—	—	40.836	40.898	41.168
600	46.607	47.079	47.241	—	—	—	43.551	43.613	43.905
650	49.566	50.103	50.268	—	—	—	46.150	46.211	46.527
700	52.420	53.025	53.191	—	—	—	48.642	48.702	49.040

Note: Potassium persulfate is the least soluble of PeroxyChem's persulfate salts



Experiments were conducted in glass.



TYPICAL ANALYSIS OF PERSULFATES

Analysis	Ammonium persulfate	Potassium persulfate	Sodium persulfate
Purity (%)	99.5	99.5	99.4
Active oxygen (%)	6.98	5.90	6.68
Moisture (%)	0.02	0.02	0.01
Ammonium persulfate (%)	—	0.14	0.01
Sodium sulfate (%)	—	—	0.70
pH (1% solution)	5.2	6.4	6.0
Iron (ppm)	1	3	2
Insolubles (ppm)	21	18	29
Copper (ppm)	<0.3	<0.2	<0.2
Chloride (ppm)	<10	<10	<10
Heavy metals, as lead (ppm)	<1	<1	<1
Manganese (ppm)	<0.5	<0.5	<0.5
Chromium (ppm)	<0.5	<0.5	<0.5
Sodium (ppm)	20	—	—
Potassium (ppm)	50	—	—

ANALYTICAL CHEMISTRY

Persulfates or their solutions can be conveniently assayed by the methods described below. In each method, persulfate is determined by titration of a standardized potassium permanganate or ceric ammonium sulfate solution with a standardized ferrous ammonium sulfate solution, a backtitration technique.

Reagents can be purchased prestandardized or prepared from commercially available chemicals. All reagents, chemicals, and apparatus used are common, off-the-shelf items, and can be purchased from commercial supply houses.

ASSAY PROCEDURES

Solids

To a 250 mL Erlenmeyer flask, add about 1 gram of sample weighed to the nearest milligram and about 50 mL of 1N H_2SO_4. Dissolve the sample and add exactly 40 mL of 0.5 N ferrous ammonium sulfate solution. Swirl constantly while adding the ferrous ammonium sulfate solution.

Let this stand for one minute and titrate with 0.5 N $KMnO_4$ to permanent pink endpoint or with 0.5 N $Ce(SO_4)^2$ to a Ferroin indicator endpoint. The calculations require a blank titration on exactly 40 mL of ferrous ammonium sulfate solution, as used above, in 50 mL of the 1 N H_2SO_4.

$$\%\ \text{active oxygen} = \frac{(A - B)C \times 0.8}{D}$$

$$\%\ \text{ammonium persulfate} = \frac{(A - B)C \times 11.4}{D}$$

$$\%\ \text{potassium persulfate} = \frac{(A - B)C \times 13.5}{D}$$

$$\%\ \text{sodium persulfate} = \frac{(A - B)C \times 11.9}{D}$$

A = mL $KMnO_4$ or $Ce(SO_4)^2$ solution used for titrating the blank.

B = mL $KMnO_4$ or $Ce(SO_4)^2$ solution used for titrating the sample.

C = Normality of the $KMnO_4$ or $Ce(SO_4)^2$ solution used.

D = Weight of sample in grams.

Solutions

To a 250 mL Erlenmeyer flask, pipette 2-20 mL of persulfate solution (depending on the approximate solution concentration). Add about 50 mL of about 1 N H_2SO_4 solution. Add exactly 40 mL of 0.5 N ferrous ammonium sulfate solution. Swirl constantly while adding the ferrous ammonium sulfate solution.

Let stand for one minute and titrate with 0.5 N $KMnO_4$ to a permanent pink endpoint or with 0.5 N $Ce(SO_4)^2$ to a Ferroin indicator endpoint. The calculations require a blank titration on exactly 40 mL of ferrous ammonium sulfate solution, as used above, in 50 mL of the 1 N H_2SO_4.

$$\text{g/L active oxygen} = \frac{(A - B)C \times 8}{D}$$

$$\text{g/L ammonium persulfate} = \frac{(A - B)C \times 114}{D}$$

$$\text{g/L potassium persulfate} = \frac{(A - B)C \times 135}{D}$$

$$\text{g/L sodium persulfate} = \frac{(A - B)C \times 119}{D}$$

A = mL $KMnO_4$ or $Ce(SO_4)^2$ solution used for titrating the blank.

B = mL $KMnO_4$ or $Ce(SO_4)^2$ solution used for titrating the sample.

C = Normality of the $KMnO_4$ or $Ce(SO_4)^2$ solution used.

D = Volume of sample in milliliters.

General Material Information

Persulfate Handling and Safety

Persulfates are oxidizing chemicals that require careful attention to all aspects of handling and use. For more information, you may request a Safety Data Sheet (SDS) which is available from any PeroxyChem office and on our website at peroxychem.com.

Personal Protective Equipment

When handling persulfate chemicals, follow the guidelines listed here and in the SDS.

PROTECT YOUR EYES: Wear chemical-type goggles or a face mask whenever splashing, spraying, or any eye contact is possible.

PROTECT YOUR RESPIRATORY SYSTEM: Use dust respirators approved by NIOSH/MSA whenever exposure may exceed the established standard listed in the current SDS.

PROTECT YOUR HANDS: Wear general purpose neoprene gloves.

PROTECT YOURSELF WITH PROPER CLOTHING: Wear ordinary work clothes with long sleeves and full-length pants.

PROTECT YOURSELF WITH PROPER FOOTWEAR: Wear shoes with neoprene soles.

First Aid

EYE CONTACT: Flush with water for at least 15 minutes. If irritation occurs and persists, obtain medical attention.

SKIN CONTACT: Wash with plenty of soap and water. If irritation occurs and persists, obtain medical attention. Wash clothing before reuse.

INHALATION: Get fresh air. If breathing difficulty or discomfort occurs, call a physician.

INGESTION: Drink one to two glasses of water. Do not induce vomiting. Do not give anything by mouth to an unconscious individual. Call a physician immediately.

When properly handled and stored, persulfates and their solutions do not present serious health hazards. The SDS provides information concerning exposure, emergency, first aid, and disposal of persulfates.

Storage

Persulfates should be stored in accordance with the National Fire Protection Association (NFPA) 400 Hazardous Materials Code. PeroxyChem personnel can provide additional support in reviewing storage facilities.

GENERAL PRECAUTIONS: Persulfates should be kept in a cool, dry storage area, in a configuration that is appropriate for the sprinkler capacity of the building per NFPA 400.

Personnel should be trained to handle persulfates safely, properly dispose of spilled materials and prevent contamination.

If material gets wet or spills, it must be isolated and disposed of properly.

Containers and Packaging

PeroxyChem packages and ships crystalline persulfate chemicals in three different container types, according to customer requests.

Type	Construction	Persulfate wt/container	Containers per pallet	Persulfate wt/pallet
Bag	Polyethylene	55 lbs/25kg	40	2,200 lbs/1,000kg
Drum	Fiber drums, polyethylene liner	225 lbs/102kg	8	1,800 lbs/896kg
IBC*	Polypropylene sack	2,200 lbs/1,000kg	1	2,200 lbs/1,000kg

*IBC = Intermediate Bulk Container, equipped with easy opening bottom spout for discharging into tanks or hoppers.

HANDLING: To remove and transport persulfates from the shipping containers, use clean plastic or stainless steel scoops, shovels, pails, etc. Cleanliness is essential.

SOLUTION STORAGE: Aqueous solutions of ammonium persulfate are more susceptible to decomposition than the solid product. The recommended materials of construction for storage and conveyance equipment (tanks, pipelines, etc.) are 304 and 316 stainless steel. Other acceptable materials include polyvinyl chloride, polyethylene, Plexiglas® plastic (or other suitable generic), Teflon® resin (or other suitable generic), chemical stoneware, and glass. Metals other than 304 and 316 stainless steel cause decomposition of the persulfate solutions or may be corroded by them. This is particularly true of Monel, copper, brass, and iron.

Do not store or process persulfate solutions in sealed or closed containers or vessels. Normal solution decomposition will release oxygen gas which may overpressurize a sealed container and cause rupture. Storage of persulfate solutions above 25°C will accelerate the rate of decomposition. See data on decomposition hazard and decomposition prevention.

Disposal

Persulfate crystals should never be discarded to trash bins. Contact with moisture, contaminants, and/or reducing agents can initiate a chemical reaction or a persulfate decomposition. Persulfate crystals which become a waste material are classified as hazardous waste because they are oxidizers. Persulfates that are spilled on the floor, or otherwise contaminated, are best dissolved in copious quantities of water. An acceptable disposal method for spent persulfate solutions is to dilute with large quantities of water and dispose via a treatment system. Any disposal method must be in full accordance with all local, state and federal regulations.

Shipping

U.S. and international transportation regulations classify persulfates as OXIDIZERS and regulates their transport by air, water, and rail. These regulations detail the specific requirements for packaging, marking, labeling and describing persulfates for shipment.

Decomposition Hazard

Overheating or contamination of persulfates can lead to a runaway decomposition. The persulfate salt will begin to effervesce with an acid-like odor. Persulfates decompose to form solid sulfate salts and emit noxious fog or fumes of SOx and NOx.

This decomposition may form a high temperature melt. The material will flow like magma and may ignite nearby combustible materials such as wood or paper. Oxygen produced by persulfate decomposition can increase the intensity of the fire.

The only way to halt a decomposition event is to apply LARGE quantities of water to the reacting material. Eight pounds of water per pound of decomposing materials is recommended, but no less than two pounds of water should be applied. Insufficient amounts of water will intensify the reaction and increase the acid mist concentration.

Please note that carbon dioxide (CO_2) or other gas-filled extinguishers will have NO effect on decomposing persulfate. The use of water as an extinguishing agent is emphasized. Control of the melt and firefighting efforts are enhanced if persulfates are stored within containment areas.

Persulfate decomposition will require emergency responders wearing full protective rubber clothing, face and head protection, plus self-contained breathing apparatus (SCBA).

Decomposition Prevention

OBSERVE THE FOLLOWING PRECAUTIONS TO PREVENT DECOMPOSITION:

Do not expose persulfates or their containers to moisture. Moisture significantly lowers the decomposition temperature.

Do not store persulfates near incompatible materials such as reducing agents, acids, bases, halide salt solutions, organics, ammoniacal solutions, alkaline cleansers, or other oxidizers. These materials can initiate decomposition.

Do not store near point sources of heat such as steam pipes, electrical appliances, heating vents, gas flames, welding sparks, or radiant heaters. Do not store at ambient temperatures above 113°F or 45°C.

Do not return spilled or unused portions of persulfates to the original container. Dirt, metal, moisture, or other contaminants can induce the decomposition of persulfates.

Do not cross-contaminate with scoops, cups, or stirrers that may have been exposed to or used with other chemicals. Use only dedicated clean, dry plastic or stainless steel scoops and utensils for transfer.

Do not grind or dry mix in equipment or machines that develop frictional heat.

Customer Support Services

Quality Assurance

PeroxyChem persulfate products are produced under an ISO-9002 certified quality system. Statistical Process Control (SPC) and a distributed control system combine to provide consistent process control. PeroxyChem operators monitor key parameters to ensure consistent quality for all products.

All materials–raw, intermediate and final–are checked and tested in a new, modern laboratory employing the latest analytical technology. Quality test results are maintained on each batch of product. Certificates of Analysis and other end-product information can be customized to meet your system requirements.

Our production facility uses SPC methods to improve and assure the quality of persulfate chemical products. PeroxyChem operators chart key operating parameters to maintain process control; this assures that quality is built in to each customer's order.

The SPC system is designed to meet your specific quality standards. Product is analyzed and identified as it leaves the packaging areas. Product quality is maintained by batch number. The information is then stored in a computer database, enabling PeroxyChem to issue Certificates of Analysis that are specific to each batch of materials received by our customers.

PeroxyChem is the only persulfate producer that uses cutting edge technology to ensure that our products are stable for storage or transport and use. We have established new product safety standards for thermal stability to ensure a high-quality, stable persulfate.

Technical Services

All PeroxyChem customers have access to our staff of technical service representatives. These chemists and engineers are experienced in the production, sale, and distribution of peroxygen chemicals. They are fully capable of answering questions on the safe handling and usage of persulfates. In fact, PeroxyChem specialists have helped our customers pioneer many successful applications for persulfate chemicals. Our engineering services include the design and construction of storage facilities, or the safety inspection of your present warehouse or production facilities. PeroxyChem also offers a complete list of technical articles, bulletins, data sheets, and patents.

Contact Information

For more information, please contact us at:

PeroxyChem Global Headquarters

One Commerce Square
2005 Market Street
Suite 3200
Philadelphia, PA 19103
United States
Ph +1 267 422 2400

European Persulfates

RheinPerChemie GmbH
Kattrepel 2
20095 Hamburg
Germany
Ph +49 40 32 50 95-0
Email sales@RheinPerChemie.com

PeroxyChem Philippines

10/F, Net Lima
5th Ave. Cor. 26th St.
Bonifacio Global City
Taguig, Metro Manila 1634
Philippines
Ph +63 2 669 2759

PeroxyChem Mexico

Avenida Industrias No. 9
Col. Industrial Cerro Gordo
Ecatepec de Morelos
55420
Ph +52 5 776-3933 3433 4050

PeroxyChem Brasil

Rua Alvorada 1289 - Sala 310
VIla Olimpia, São Paulo/SP - Brasil
CEP 04550-004
Ph +55 11 3280 1610

Contaminants Treated

Use this guide by locating the contaminant of concern sorted by contaminant type. The technologies recommended for treatment of each contaminant are located to the right.

✓ Recommended, lab or field data available demonstrating success

▪ Recommended with site specific lab study

	ISCO	ISCR	ENHANCED ANAEROBIC BIOREMEDIATION	METALS TREATMENT	AEROBIC BIOREMEDIATION		BIOGEOCHEMICAL
	Klozur® Persulfate	**EHC® Reagent, EHC® Plus, Daramend® Reagent**	**EHC® Liquid, ELS® Microemulsion**	**MetaFix® Reagents, EHC® Metals, Daramend® Metals**	**Terramend® Reagent**	**PermeOx® Ultra**	**GeoForm™ Reagents**
CHLORINATED SOLVENTS							
Tetrachloroethene (PCE)	✓	✓	✓	✓			✓
Trichloroethene (TCE)	✓	✓	✓	✓			✓
Dichloroethene (cis and trans DCE)	✓	✓	✓	✓			✓
Trichloroethane (TCA)	✓	✓	✓	✓			✓
Dichloroethane (DCA)	✓	✓	✓	✓			✓
Carbon tetrachloride	✓	✓	✓	✓			✓
Chloroethane	✓	✓	✓	✓			✓
Chloroform	✓	✓	✓	✓			✓
Chloromethane	✓	✓	✓	✓			✓
Chlorotoluene	✓	✓	✓	✓			✓
Methylene chloride	✓	✓	✓	✓			✓
Vinyl chloride	✓	✓	✓	✓		✓	✓
Dichloropropane	✓	✓	✓	✓			✓
Dichloropropene	✓	✓	✓	✓			✓
Hexachlorobutadiene	✓	✓	✓	✓			✓
Tetrachloroethane	✓	✓	✓	✓			✓
Trichloropropane	✓	✓	▪	✓			✓
BTEX							
Benzene	✓				✓	✓	
Toluene	✓				✓	✓	
Ethylbenzene	✓				✓	✓	
Xylenes	✓				✓	✓	

Contaminants Treated

✓ Recommended, lab or field data available demonstrating success ▪ Recommended with site specific lab study

	ISCO	ISCR	ENHANCED ANAEROBIC BIOREMEDIATION	METALS TREATMENT	AEROBIC BIOREMEDIATION		BIOGEOCHEMICAL
	Klozur® Persulfate	**EHC® Reagent, EHC® Plus, Daramend® Reagent**	**EHC® Liquid, ELS® Microemulsion**	**MetaFix® Reagents, EHC® Metals, Daramend® Metals**	**Terramend® Reagent**	**PermeOx® Ultra**	**GeoForm™ Reagents**
PAHs							
Acenaphthene	✓				✓		
Acenaphthylene	✓				✓		
Anthracene	✓				✓		
Benzo(a)anthracene	✓				✓		
Benzo(a)pyrene	✓				✓		
Benzo(b)fluoranthene	✓				✓		
Benzo(ghi)perylene	✓				✓		
Chrysene	✓				✓		
Dibenzo(ah)anthracene	✓				✓		
Fluorene	✓				✓		
Naphthalene	✓				✓	✓	
Phenathrene	✓				✓		
Pyrene	✓				✓		
OXYGENATES							
Methyl tert-butyl ether (MTBE)	✓					✓	
Tert-butyl alcohol (TBA)	✓					✓	
PETROLEUM HYDROCARBONS							
GRO (gasoline range organics)	✓				✓	✓	
DRO (diesel range organics)	✓				✓	✓	
ORO (oil range organics >C20 alkanes)	✓				✓		
Creosote (coal tar)	✓				✓		
PHENOLS							
Phenol	✓				✓		
4-chloro-3-methyl phenol	✓				✓		
2-chlorophenol	✓		▪		✓		
2,4-dichlorophenol	✓		▪		✓		
2,4-dinitrophenol	✓		▪		✓		
4-nitrophenol	✓		▪		✓		
Pentachlorophenol	✓	✓	▪	✓	✓		✓

Contaminants Treated

✓ Recommended, lab or field data available demonstrating success ▪ Recommended with site specific lab study

	ISCO	ISCR	ENHANCED ANAEROBIC BIOREMEDIATION	METALS TREATMENT	AEROBIC BIOREMEDIATION		BIOGEOCHEMICAL
	Klozur® Persulfate	**EHC® Reagent, EHC® Plus, Daramend® Reagent**	**EHC® Liquid, ELS® Microemulsion**	**MetaFix® Reagents, EHC® Metals, Daramend® Metals**	**Terramend® Reagent**	**PermeOx® Ultra**	**GeoForm™ Reagents**
CHLOROBENZENES							
Chlorobenzene	✓	✓	▪	✓	✓	✓	▪
Dichlorobenzene	✓	✓	✓	✓			▪
Trichlorobenzene	✓	✓	✓	✓			▪
FLUORINATED COMPOUNDS							
Dichlorodifluoromethane	✓	✓	✓	✓			▪
Trichlorofluouromethane	✓	✓	✓	✓			▪
Trichlorotrifluoroethane	✓	✓	✓	✓			▪
PFCA/PFOA	✓						
PESTICIDES & HERBICIDES							
Chlordane	✓	✓	✓	✓			▪
Heptachlor Epoxide	✓	✓		✓			▪
Lindane (hexachlorocyclohexane)	✓	✓	✓	✓	✓		▪
DDT, DDD, DDE	✓	✓	✓	✓			▪
Toxaphene	✓	✓	✓	✓			▪
Dieldrin	✓	✓	✓	✓			▪
2,4-D	✓	✓	✓	✓	✓		▪
2,4,5-T	✓	✓	✓	✓	✓		▪
Endrin	✓	✓	✓	✓			▪
Kepone	▪	✓		✓			▪
ENERGETICS							
TNT	✓	✓	✓	✓			▪
DNT	✓	✓	✓	✓			▪
Nitroglycerine	✓	✓	✓	✓			▪
HMX	✓	✓	✓	✓			▪
RDX	✓	✓	✓	✓			▪
Perchlorate		✓	✓	✓			▪

Contaminants Treated

✓ Recommended, lab or field data available demonstrating success ▪ Recommended with site specific lab study

	ISCO	ISCR	ENHANCED ANAEROBIC BIOREMEDIATION	METALS TREATMENT	AEROBIC BIOREMEDIATION		BIOGEOCHEMICAL
	Klozur® Persulfate	EHC® Reagent, EHC® Plus, Daramend® Reagent	EHC® Liquid, ELS® Microemulsion	MetaFix® Reagents EHC® Metals, Daramend® Metals	Terramend® Reagent	PermeOx® Ultra	GeoForm™ Reagents
MISCELLANEOUS							
Acetone	✓				▪	▪	
4-methyl-2-pentanone	✓						
1,4-dioxane	✓						
Polychlorinated biphenyls (PCBs)	✓	▪		▪			
Nitrate		✓	✓	✓	✓		✓
Bis(2-ethyhexyl)phthalate	✓				✓		
Nitrobenzene	✓						
Propylbenzene	✓				▪	▪	
4-iso-propyltoluene	✓						
Styrene	✓						
Trimethylbenzene	✓				▪	▪	
n-butylbenzene	✓						
Carbon Disulfide (CS_2)	✓						
Dioxins / Furans	▪						
HEAVY METALS							
Antimony				✓			
Arsenic	✓			✓			▪
Barium				✓			
Cadmium				✓			✓
Chromium		✓	✓	✓			✓
Cobalt				✓			✓
Copper				✓			✓
Lead				✓			✓
Mercury				✓			
Nickel				✓			✓
Selenium				✓			▪
Vanadium				✓			
Zinc				✓			✓

PeroxyChem

peroxychem.com/remediation

The Contaminants Treated Guide is for guidance only. It is recommended that a suitable treatability study be performed to verify applicability to your specific contaminant and site conditions. Although the above information accurately reflects current knowledge, PeroxyChem makes no warranty or representation, expressed or inferred, and nothing herein should be construed as to guaranteeing actual results in field use, or permission or recommendation to infringe any patent. No agent, representative or employee of PeroxyChem is authorized to vary any terms of this notice. PeroxyChem is the owner or licensee under various patents and patent applications relating to the use of these activator chemistries. Daramend, EHC, ELS, Klozur, MetaFix, PermeOx, Terramend and GeoForm are trademarks of PeroxyChem.

Document 13-04-ESD-19