INTERIM REMEDIAL MEASURES WORK PLAN

for

990-1026 Rossville Avenue
Staten Island, New York
Block 7054, Lot 518

Prepared for:

Allied Rossville LLC
118-25 Queens Boulevard
16th Floor
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Prepared by:

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LANGAN

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CERTIFICATION

I, Stewart Abrams, certify that I am currently a NYS registered professional engineer and that this Interim Remedial Measures 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).

STATE OF NEW YORK
STEWART HARRIS ABRAMS
078833
LICENSED PROFESSIONAL ENGINEER

Stewart H. Abrams 3/6/2020

NYS Registered Professional Engineer Signature   Printed Name   Date

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.

1.0 INTRODUCTION

Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C. (Langan) prepared this Interim Remedial Measures Work Plan (IRMWP) on behalf of Allied Rossville LLC (the Participant) for the property at 990-1026 Rossville Avenue in the Rossville neighborhood of Staten Island, New York (the site).

This IRMWP addresses soil vapor intrusion (SVI) mitigation for the western portion of the building located on Lot 518. The IRMWP was prepared in accordance with the process and requirements of the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) and the May 2010 Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10) and is being submitted in conjunction with the Subsurface Investigation Report and BCP Application.

1.1 Site Description

The Site is located in the Rossville section of Staten Island, New York. Lot 518 is located on Block 7054 on the existing New York City Tax Map. A Site Location Plan is provided as Figure 1. The Site is an approximately 66,700-square foot parcel and is bound to the north by three residential buildings, to the east by Rossville Avenue followed by a mixed-use residential and commercial building and a residential building, to the south by Grafe Street followed by a town-house complex, and to the west by asphalt-paved recreational space associated with a town-house complex. The site contains an approximately 25,800-square foot one-story shopping center that is currently occupied by a dry cleaner, liquor store, beauty salon, karate studio, ice cream parlor, grocery store, Chinese restaurant, bagel shop, laundromat, pizzeria, and a vacant former restaurant. A partial cellar is located beneath the grocery store in the northwestern corner of the shopping center. The remaining portions of the site consists of an asphalt-paved parking lot in the southeastern portion of the site and an access road for deliveries along the western and northern perimeters of the Site. A Site plan is provided as Figure 2.

1.2 Proposed Development

At this time, it is anticipated that the site will continue to be used for commercial purposes.

1.3 Physical Conditions

1.3.1 Regional and Site Topography

The survey conducted by Langan on 12 February 2020 as part of the Subsurface Investigation (SI) activities identified the ground surface in the vicinity of the groundwater monitoring wells to be between elevation (el) 52.08± and 52.9±. Based on review of existing topographic maps provided by NETRonline.com, site grade is approximately elevation (el) 50±, which is in general agreement with the survey that was conducted to obtain well elevations. The Site slopes downward from southeast to northwest within the asphalt-paved parking lot. The surrounding local topography generally slopes down northwest of the subject property toward the Arthur Kill.

1.3.2 Regional and Site Geology

According the United States Geologic Survey Mineral Resources Online Spatial Data Viewer and the "Geologic and Geohydrologic Reconnaissance of Staten Island, New York" prepared by Julian Soren in 1988, soft bedrock underlying the site is part of the Upper Cretaceous Raritan Formation, characterized by reddish clay, silt, and sand. The Upper Cretaceous Raritan Formation at the site is shown on the maps as overlain by unconsolidated Upper Pleistocene deposits associated with the Wisconsinan glacial advance. This material is identified as ground moraine, which is characterized by a reddish-brown clayey till.

Based on the findings of Langan's SI completed in January and February 2020, the strata beneath the proposed brownfield site consists of an approximately 0- to 5-foot thick fill layer consisting of fine to coarse sand with varying amounts of gravel. The fill layer is underlain by an approximately 10- to 22.5-foot thick layer of alternating clay and dense silty sands with lenses of sand and/or silt throughout, interpreted to be ground moraine material. The clay/silty sand unit is underlain by an approximately 2- to 15-foot thick layer of reddish sand, followed by reddish clays, silts, and sands, identified as part of the Upper Cretaceous Raritan Formation.

1.3.3 Regional and Site Hydrogeology

Groundwater was encountered within shallow groundwater monitoring wells at depths ranging from about 7.5- to 17-feet bgs, corresponding with approximately el +35 and el +45. The groundwater elevation observed in the deep groundwater monitoring well, which was screened from 40.5- to 50.5-feet bgs within the sand layer, was determined to be approximately el +30. Based on groundwater elevation data collected during the SI, shallow groundwater flow is to the southeast.

1.4 Site History

The site is currently and has historically been operated as a commercial property since approximately 1990. Prior to commercial use, the subject property was generally vacant except for miscellaneous and/or residential buildings identified in the years 1910, 1917, and 1937. Current tenants within the subject property building include a dry cleaner, liquor store, beauty salon, karate studio, ice cream parlor, grocery store, restaurant, bagel shop, laundromat, pizzeria, and a vacant former restaurant. Kariss French Cleaners, an on-site dry cleaning facility, has been operating on the subject property since the building was constructed circa 1990.

1.5 Previous Environmental Reports

Environmental reports prepared for the site are summarized below and include the following:

- *Phase I Environmental Site Assessment (ESA),* prepared by EBI, dated 25 September 2019;
- *Phase II ESA,* prepared by EBI, dated 28 October 2019; and,
- *Subsurface Investigation Report,* prepared by Langan, dated March 2020.

Results of these previous investigations are summarized below.

25 September 2019 Phase I ESA, prepared by EBI

EBI conducted a Phase I ESA on behalf of NorthMarq Capital in 2019. EBI identified that since 1990, the site has been used as a commercial property. Prior to the development of the current shopping center, the site was generally vacant with unspecified and/or residential buildings identified in the years 1910, 1917, and 1937.

EBI identified The Kariss French Cleaners facility at 1002 Rossville Avenue as a Recognized Environmental Condition (REC). Facility operations include onsite dry cleaning utilizing tetrachloroethene (PCE) as a cleaning solvent since approximately 1990. Between 1999 and 2003, a closed-loop Fibrimatic 4th generation dry cleaning machine was reportedly installed. The only manifest records available for The Kariss French Cleaners facility are associated with the disposal of spent halogenated solvents and waste impacted with hazardous concentrations of chromium, PCE, and trichloroethene (TCE) in 2017. EBI recommended a subsurface investigation in the vicinity of the dry cleaning facility to determine whether current and historic dry cleaning operations have impacted the subject property.

28 October 2019 Phase II Environmental Site Assessment, prepared by EBI

A Phase II ESA dated 28 October 2019 was prepared by EBI for Muss Development, LLC. The Phase II ESA consisted of the following activities:

- Advancement of two interior soil borings (SB-2 and SB-3, within the onsite dry cleaner) and two exterior soil borings (SB-1 and SB-4, adjacent and to the east and west of the onsite dry cleaner) to a maximum depth of 24-feet bgs and collection of six soil samples for CVOC analysis;
- Installation of two temporary groundwater monitoring wells (TWP-1 and TWP-2) adjacent and to the east and west of the onsite dry cleaner and the collection of two groundwater samples for CVOC analysis; and,
- Installation of two sub-slab soil vapor sampling points (SV-1 and SV-2) within the onsite dry cleaner and the collection of two soil vapor samples for CVOC analysis.

All soil analytical results were compared to the NYSDEC 6 NYCRR Subpart 375-6 Remedial Program Soil Cleanup Objectives (SCOs). The soil analytical exceedances of the SCOs are shown on Figure 3. All groundwater analytical results were compared to the NYSDEC Title 6 NYCRR Part 703.5 and the NYSDEC Technical & Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards (collectively referred to as NYSDEC SGVs). The groundwater analytical exceedances of the SGVs are shown on Figure 4. Soil vapor analytical results were compared to New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion Matrices A through C dated October 2006 and revised in May 2017. The soil vapor analytical exceedances to the matrices are shown on Figure 5. The Phase II ESA findings and conclusions are as follows:

- Based on field observations during the advancement of soil borings, elevated photoionization detector (PID) readings were only measured in SB-4, with the highest reading (148.2 parts per million [ppm]) at 3-feet bgs.
- CVOCs (including PCE, TCE, cis-1,2-dichloroethene [cis-1,2-DCE], and vinyl chloride) were detected in five out of six soil samples at levels above the NYSDEC Unrestricted Use SCOs. Of these, vinyl chloride (14 milligrams per kilogram [mg/kg]) was detected in one out of the six soil samples at levels above the NYSDEC Commercial Use SCOs and PCE (4,700 mg/kg – 5,300 mg/kg), TCE (520 mg/kg – 660 mg/kg), cis-1,2-DCE (1,900 mg/kg – 8,400 mg/kg), and vinyl chloride (110 mg/kg – 2,700 mg/kg) were detected in two out of six soil samples at levels above the NYSDEC Industrial Use SCOs.
- PCE (23,000 micrograms per liter [µg/L]), TCE (2,500 µg/L), vinyl chloride (2,400 µg/L), and cis-1,2-DCE (18,000 µg/L) were detected in one well (TWP-2) at concentrations above the NYSDEC SGVs.
- Soil vapor results identified elevated concentrations of CVOCs in both samples that require monitoring and/or mitigation according to NYSDOH Soil Vapor Intrusion Matrices A and B including PCE (235 micrograms per cubic meter [µg/m3] – 24,800 µg/m3), TCE (5 µg/m3 – 2,560 µg/m3), and cis-1,2-DCE (161 µg/m3).

EBI recommended the implementation of vapor intrusion mitigation measures (e.g., the design and installation of a sub-slab depressurization system [SSDS]).

March 2020 Subsurface Investigation Report, prepared by Langan

A Subsurface Investigation Report dated March 2020 was prepared by Langan for Allied Rossville LLC. The subsurface investigation consisted of the following activities:

- A limited ground-penetrating radar (GPR) survey within the vicinity of soil boring locations and in limited areas across the site to investigate the location of subsurface utilities and drainage systems.
- Advancement of 10 soil borings (LSB-1 through LSB-10) and collection of 22 soil samples (including two duplicate samples) for CVOC analysis.
- Installation of eight groundwater monitoring wells (LMW-1A, LMW-1B and LMW-2 through LMW-7) and the collection of nine groundwater samples (including one duplicate sample) for CVOC analysis.
- Installation of 12 sub-slab soil vapor sampling points (LSV-1 through LSV-12) and the collection of 13 sub-slab soil vapor samples (including one duplicate sample) and 10 indoor air samples (IA-1through IA-10) for VOC analysis.
- Installation of six soil vapor sampling points (LSV-13 through LSV-18) and the collection of seven soil vapor samples (including one duplicate samples) for VOC analysis.

All soil analytical results were compared to the NYSDEC 6 NYCRR Subpart 375-6 Remedial Program SCOs. The soil analytical exceedances of the SCOs are shown on Figure 3. All groundwater analytical results were compared to the NYDEC SGVs. The groundwater analytical exceedances of the SGVs are shown on Figure 4. Soil vapor analytical results were compared to NYSDOH Final Guidance for Evaluating Soil Vapor Intrusion Matrices A through C dated October 2006 and revised in May 2017. The soil vapor analytical exceedances to the matrices are shown on Figure 5. The Subsurface Investigation findings and conclusions are as follows:

- Based on field observations during the advancement of soil borings, elevated PID readings were measured in LSB-1 and LSB-2 with the highest reading (410.8 ppm) from the 2.5- to 3-foot depth interval within LSB-1.

- CVOCs (including PCE, cis-1,2-DCE, trans-1,2-dichloroethene [trans-1,2-DCE], and vinyl chloride) were detected in two soil samples (LSB-1A and LSB-2A) at levels at least above the NYSDEC Unrestricted Use SCOs.
- CVOCs (including PCE, its daughter products, and chloroform) were detected in groundwater in six wells (LMW-1A, LMW-1B, LMW-2, LMW-3, LMW-4, and LMW-5) at concentrations above the NYSDEC SGVs.
- Co-located sub-slab soil vapor and indoor air results identified elevated concentrations of CVOCs requiring monitoring and/or mitigation according to NYSDOH Soil Vapor Intrusion Matrices A, B, and C at 4 locations (IA-04/LSV-06, IA-05/LSV-07, IA-7/LSV-8, and IA-9/LSV-9). Elevated concentrations of CVOCs (in particular, PCE) requiring mitigation according to NYSDOH Soil Vapor Intrusion Matrix B were also identified at both sub-slab soil vapor samples collected within the drycleaner space (LSV-4 and LSV-5), which were not associated with any co-located indoor air samples.
- CVOCs were detected in five exterior soil vapor samples (LSV-13, LSV-14, LSV-15, LSV-16, and LSV-17) at concentrations requiring monitoring and/or mitigation according to NYSDOH Soil Vapor Intrusion Matrices A, B, and C. Significantly elevated concentrations of PCE (4,620,000 µg/m^3), TCE (709,000 µg/m^3), cis-1,2-DCE (4,760,000 µg/m^3), and vinyl chloride (1,440,000 µg/m^3) were detected in LSV-14 located directly to the west of the dry cleaner.

Based on these findings installation of a SSDS and completion of a remedial investigation to further evaluate the extent of impacts and assess remediation options for remaining groundwater impacts is proposed.

1.6 Soil Vapor Contaminant Conditions

As identified above, CVOC impacts were confirmed in both soil vapor and indoor air at the site. The extent of the soil vapor impacts identified that require mitigation are limited to the western portion of the site in the direct vicinity and downgradient of the current dry cleaning facility. Soil vapor, indoor air, and sub-slab soil vapor sample locations and results from EBI's 2019 investigation and

Langan's 2020 investigation are presented in Figure 5. Analytical results were compared to the recommendations for monitoring or mitigation as set for in the NYSDOH Final Guidance for Evaluating Soil Vapor Intrusion Matrices A through C dated October 2006 and revised in May 2017. A summary of the findings is provided below.

The following CVOCs were detected in the sub-slab soil vapor and/or indoor air samples collected across the building:

- PCE, with sub-slab soil vapor concentrations ranging from 1.78 μg/m³ to 2,410 μg/m³ and indoor air concentrations ranging from 0.542 μg/m³ to 16.3 μg/m³;
- TCE, with sub-slab soil vapor concentrations ranging from 1.95 μg/m³ to 74.2 μg/m³ and indoor air concentrations ranging from 0.15 μg/m³ to 0.167 μg/m³;
- cis-1,2-DCE, with a sub-slab soil vapor concentration of 5 μg/m³ and indoor air concentrations ranging from 0.131 μg/m³ to 0.143 μg/m³;
- 1,1-DCE, with an indoor air concentration of 0.091 μg/m³;
- Vinyl chloride, with an indoor air concentration of 0.051 μg/m³;
- Carbon tetrachloride, with a sub-slab soil vapor concentration of 1.99 μg/m³ and indoor air concentrations ranging from 0.39 μg/m³ to 0.912 μg/m³; and,
- Methylene chloride, with a sub-slab soil vapor concentration of 3.1 μg/m³.

The locations of the samples collected in each tenant space and the outcome of comparing their corresponding results to the NYSDOH Soil Vapor Intrusion Matrices are provided in the table below:

Portion of Building	Tenant Space	Indoor Air/Sub-Slab Soil Vapor Sample	Comparison to NYSDOH Matrices
Western	Dry Cleaner*	SV-1	Mitigate
		SV-2	Mitigate
		LSV-4	Mitigate
		LSV-5	Mitigate
	Liquor Store	IA-9/LSV-9	Monitor
	Hair Salon	IA-4/LSV-6	Mitigate
	Karate Studio	IA-5/LSV-7	Mitigate
	Ice Cream Parlor	IA-7/LSV-8	Mitigate
Northwestern Corner	Grocery Store	IA-10/LSV-11	No Further Action
Northern	Pizzeria	IA-1/LSV-1	No Further Action
	Laundromat	IA-2/LSV-2	No Further Action
	Bagel Shop	IA-3/LSV-3	No Further Action
	Chinese Restaurant	IA-6/LSV-10	No Further Action
	Vacant Former Restaurant	IA-8/LSV-11	No Further Action

* = samples collected within the dry cleaner are not associated with any collocated indoor air samples

The following CVOCs were detected in exterior soil vapor samples collected across the site:

- PCE ranging from 235 to 4,620,000 μg/m^3;
- TCE ranging from 5 to 709,000 μg/m^3;
- Cis-1,2-DCE ranging from161 to 4,760,000 μg/m^3;
- 1,1-DCE 6.98 μg/m^3; and,
- Vinyl chloride ranging from 9,590 to 1,440,000 μg/m^3.

The locations of the exterior soil vapor samples and the outcome of comparing their corresponding results to the NYSDOH Soil Vapor Intrusion Matrices are provided in the table below:

Sample Location	Soil Vapor Sample	Comparison to NYSDOH Matrices
North of vacant former restaurant	LSV-16	Mitigate
North of grocery store	LSV-13	Mitigate
West of grocery store	LSV-17	Mitigate
West of dry cleaner	LSV-14	Mitigate
East of dry cleaner	LSV-15	Mitigate
Southeastern portion of the site	LSV-18	No Further Action

Particularly elevated concentrations of PCE (4,620,000 $\mu g/m^3$), TCE (709,000 $\mu g/m^3$), cis-1,2-DCE (4,760,000 $\mu g/m^3$), and vinyl chloride (1,440,000 $\mu g/m^3$) were detected in soil vapor sampling point LSV-14 located directly to the west of the dry cleaner.

The indoor air/sub-slab soil vapor and exterior soil vapor analytical results reveal that CVOC impacts in soil vapor are limited to the western portion of the site, primarily in the vicinity and downgradient of the dry cleaners. As shown on Figures 3 and 4, CVOC impacts in soil and groundwater are also limited to the areas adjacent to and downgradient of the dry cleaners. Based on the soil gas and indoor air results and extent of the groundwater impacts, SVI mitigation is required for the tenant spaces located in the western portion of the building (i.e., the dry cleaners, liquor store, hair salon, karate studio, and ice cream parlor) and is not required for the tenant spaces in the northern portion of the building (i.e., the pizzeria, laundromat, bagel shop, restaurant, vacant former restaurant, and the grocery store). Although elevated concentrations of PCE and TCE in the sub-slab soil vapor/indoor air samples collected within the grocery store were not detected, elevated concentrations of CVOCs were detected in the exterior soil vapor samples collected to the north and west of this tenant space. As such, the SVI mitigation system (i.e. the SSDS) has also been designed to mitigate any potential vapor intrusion conditions in the grocery store as well. Compounds requiring monitoring and/or mitigation according to NYSDOH Soil Vapor Intrusion Matrices A, B, and C and as detailed above are proposed to be mitigated by the installation of the SSDS as detailed in the below sections of the IRMWP.

2.0 SUMMARY OF INTERIM REMEDIAL MEASURES

This IRMWP includes the following tasks to support SVI mitigation within the western portion of the building including the current grocery store, dry cleaner, liquor store, hair salon, karate studio, and Carvel ice cream parlor tenant spaces:

1. Development and implementation of a site-specific Construction Health and Safety Plan (CHASP) for the protection of on-site remediation workers and tenants, and the nearby community during remediation activities;

2. Design and installation of an SVI mitigation system;

3. Performance of confirmatory testing to determine the effectiveness of the mitigation system; and,

4. Preparation of a Construction Completion Report (CCR) to document SVI mitigation and satisfactory implementation of this IRMWP – The CCR will include an Interim Site Management Plan (ISMP) for short-term management of the SVI mitigation system prior to site-wide remedial activities.

These tasks are further described in the ensuing sections.

2.1 Objectives and Rationale

The objective of the IRMWP is to mitigate the SVI conditions identified during previous investigations in the areas of the existing grocery store basement and the remaining tenant spaces in the western portion of the on-site building. As described in Section 1.6, monitoring and mitigation are the recommended NYSDOH Decision Matrices actions for PCE and TCE concentrations in sub-slab vapor/indoor air within western portion of the Lot 518 building. Although elevated concentrations of PCE and TCE in sub-slab vapor/indoor air samples collected within the grocery store were not identified, elevated concentrations of CVOCs were identified in exterior soil vapor sample locations north and east of the tenant space. As such, an SVI mitigation system will be installed to prevent intrusion of contaminated vapors into the western portion of the Lot 518 building including the grocery store, dry cleaner, liquor store, hair salon, karate studio, and Carvel ice cream store tenant spaces.

Additionally, a forthcoming remedial investigation work plan will be submitted to the NYSDEC to further evaluate the extent of impacts and assess remediation options for groundwater impacts.

2.2 Technical Description of SVI Mitigation

IRMWP implementation includes installation of the SVI mitigation system. SVI mitigation system design is based on pilot testing and pneumatic modeling results as discussed below.

Pilot Testing

A SSDS pilot test was completed by Langan on 23 January 2020, during which Langan derived information related to sub-slab characteristics and the design criteria of the full-scale SSDS, including the air intrinsic permeability of the sub-slab mitigation area.

The test consisted of installation of one vapor extraction point (VEP) and seven vacuum monitoring points (VMP) beneath the slab in the existing dry cleaner and adjacent tenant spaces. The extraction point was constructed by completing a 6-inch core through the existing building slab and installing an approximately 1-foot deep pit backfilled with clean ¾-inch gravel to the bottom of the existing building slab. The pit was completed with a polyethylene liner and a grout seal to existing grade. The VMPs, installed via a hammer drill, were spaced at varying distances and in varying directions from the VEP, consisted of an approximately ½-inch hole which penetrated completely through the existing building slab. Each point was completed with polyethylene tubing a clay seal. A pilot test well layout is provided as Figure 6.

A series of step tests were performed by connecting a Rotron EN454 regenerative blower to the VEP. These tests consisted of extraction of sub-slab air from the VEP at multiple air extraction flow rates and vacuums, and the subsequent monitoring of vacuum influence at the nearby VMPs. The tests were performed at increasing rates at each test well, with the lowest air extraction flow rate and vacuum condition tested initially and then increased systematically until the maximum air extraction flow rate and vacuum condition of the blower was achieved. Between steps, vacuum readings were allowed to stabilize at nearby VMPs, indicating equilibrium with the changed test condition. Below is a summary of the results of the step testing that was conducted and a summary of the testing results is provided in Table 1 of Appendix A.

Test Well	Extraction Interval (feet bgs)	Air Extraction Flow Rate (scfm)	Vacuum (IWC)	Monitoring Points (feet from test well)						
				VMP - 1	VMP - 2	VMP - 3	VMP - 4	VMP - 5	VMP - 6	VMP-7
VEP - 1	0.5 - 1.5	9	-1.7	5	10	20	15	50	20	15
		14	-4.8							
		14	-4.8							
		20	-10.3							
		28	-20.7							
		45	-56.1							
		39	-33.0							
		26	-15.5							

All extracted air was discharged to the atmosphere outside the building extents at approximately 10-feet above ground surface. Vacuum influence at a distance from the extraction well was consistently observed during each testing condition. As expected, an increase in the air extraction flow rate and vacuum at the VEP resulted in an increase in induced vacuum at each VMP, with the exception of the VMP located in the adjacent grocery store tenant space. The grocery store tenant space includes a 10-feet basement. Vacuum influence in the grocery store space, as the result of extracting from the sub-slab in the dry cleaner tenant space was not anticipated, due to the difference in elevation; however the testing was completed to confirm these conditions. A VMP was also installed in the liquor store tenant space to determine how the structural elements between tenant spaces may affect vacuum influence. Based on the results, the vacuum influence observed in the liquor store tenant space was comparable to that in the dry cleaner tenant space, suggesting that there are not structural foundation elements between the tenant spaces that will influence the effectiveness of the system. Equipment specifications and a summary of the pilot test data are included in Appendix A.

The results of the pilot test were tabulated and used as input into a two-dimensional (2D) computational pneumatic model, MDFIT, as discussed herein.

Pneumatic Modeling Results

Pneumatic modeling was performed to determine the air intrinsic permeability of the sub-slab material. The 2D computational pneumatic model, MDFIT, allows for the estimation and calibration of the site-specific air intrinsic permeability, based on the air extraction flow rate – vacuum relationships observed during pilot testing. The model provides the platform required to scale the results from the pilot-scale testing to full-scale design. Utilizing the calibrated site-specific air intrinsic permeability, the model allows for the prediction of full-scale system performance.

Based on the observed vacuum influence, an initial estimation of air intrinsic permeability for the target mitigation area and existing confining layer (i.e., building slab) was calculated. Single well modeling simulations, using this estimated air intrinsic permeability values, were then run at air extraction flow rates achieved during the pilot test – the outputs of these modeling simulations being a vacuum versus distance relationship (i.e., vacuum influence). The vacuum influence observed during the pilot test was compared to the modeled vacuum influence at specific air extraction flow rates. The air intrinsic permeability of both the mitigation area and the confining layer was then adjusted to allow for "calibration" of the model such that the modeled vacuum influence closely mimicked the observed vacuum influence. The calibrated air intrinsic permeability for the target mitigation area and confining layer was calculated to be 2.38E-07 cm^2 and 8.14E-08 cm^2, respectively, corresponding to a silty sand and a leaky concrete slab, respectively, as expected.

Single well design modeling simulations were completed using the calibrated air intrinsic permeability values. Varying air extraction flow rate conditions were modeled to determine the required wellhead vacuum and the resultant approximate vacuum influence associated with each respective flow condition. Outputs from these simulations are provided in Appendix A.

The required air extraction flow rate and resultant wellhead vacuum and radius of influence (ROI) of each mitigation point were then determined, using the following considerations:

- A minimum vacuum of 0.015 IWC shall be achieved throughout the sub-slab within the mitigation area.
- Balance between the total number of wells and the total air extraction flow rate and vacuum capacity of the system. The ROI of each well can be increased with an increase in the air extraction flow rate, which may potentially reduce the total number of wells required; however, the increase in ROI (and potential decrease in the number of wells) is not always enough to offset the increase in total air extraction flow rate and vacuum capacity of the system.
- The 2D model simulates one extraction well at one time – the estimated vacuum influence will be enhanced when multiple wells are operating at one time within the mitigation area.

Based upon these considerations, the estimated effective ROI of each mitigation point is 15 feet, assuming an air extraction flow rate and wellhead vacuum at each extraction well of approximately 30 scfm and 35 IWC, respectively. The single well modeling outputs for the 30 scfm modeling simulation indicate a vacuum influence of approximately 0.0113 IWC at a distance of 15-feet from the extraction point. However, the model does not account for the enhanced vacuum propagation that will result from operating multiple mitigation points at one time. The pilot test results also indicated that a vacuum influence greater than 0.015 IWC can be achieved at 15-feet from the extraction point at 30 scfm.

Design

Based on the results of the supplemental onsite investigation activities completed by Langan on 21 and 22 January 2020, concentrations of PCE, TCE, cis-1,2-DCE, and vinyl chloride were detected in indoor air in excess of the USEPA vapor intrusion screening level for commercial/industrial indoor air, prompting the need for vapor mitigation in the western wing of the existing building, including the Carvel, karate studio, hair salon, liquor store, dry cleaner and grocery store tenant spaces. Analytical results for indoor air, sub-slab soil vapor, and soil vapor samples are provided in Figure 5. Based on the proposed mitigation area and the estimated ROI of each mitigation point, 29 full-scale VEPs are required to mitigate. The location of each VEP, as shown in Figure 7 and 8, has been co-located with building walls, to the extent possible, to minimize trenching during construction and disturbance to normal business operations following system installation. The proposed locations are subject to change based on observed field conditions (i.e., above ground and/or below grade building elements) during installation; however, the placement of wells will consider the achievable ROI of each mitigation point and the overall mitigation area to allow for complete mitigation throughout the entirety of the mitigation area. The construction of the full-scale VEPs will be similar to that of the pilot test VEP.

The proposed VEP locations are to be piped vertically, where possible, via 2-inch individual lines. In some cases, the 2-inch individual VEP line may need to first be trenched beneath the existing building slab to the nearest building wall and then transitioned to vertical. Each individual VEP line will be equipped with a vacuum gauge, gate valve, and sample port for monitoring and performance adjustments. The well-specific instrumentation will be located above ground and will be accessible for future access. Each 2-inch individual VEP line, once run to the ceiling of the building, will manifold into a 4-inch sub-header line which will run along the interior of the building at ceiling level. Each 4-inch sub-header line will manifold five or six VEP locations (this may change based on final well layout). The 4-inch sub-header line will exit the building roof and will be piped to roof-mounted process equipment. Prior to the process equipment, the sub-header lines will manifold into a 6-inch main header line on the roof. Any below grade or above ground exterior piping will be constructed of schedule 40 polyvinyl chloride (SCH40 PVC) – exterior piping will also be equipped with insulation. Any above ground interior piping will be constructed of metal. The manifold piping has been designed such that if in the future it is determined that active operation of the full-scale SSDS is no longer necessary, the system can be converted to passive operation (each 4-inch sub-header line can be equipped with a discharge stack and turbine). All SSDS manifold piping must be clearly labeled. Refer to Figure 8 for the proposed manifold piping layout.

The SSDS process equipment will be installed on the roof of the existing building in a noise and weather proofed enclosure. The process equipment will consist of dual blower configuration, each capable of 475 scfm at 45 IWC at the blower inlet. The dual blower configuration helps to reduce the size of the required process equipment and provides operational flexibility – in the event a blower goes down, some level of mitigation can still be maintained through the operation of the other blower. In addition, the reduction in system operation can be evaluated and achieved in future years, as appropriate, with the dual blower configuration. The process equipment will be equipped with flow, vacuum, pressure, and temperature instrumentation and interlocks and an associated remote telemetry for operation and monitoring of system performance. The discharge stack will be installed such that it meets the following criteria:

- Above the eave of the roof (preferably, above the highest eave of the building at least 12 inches above the surface of the roof)
- At least 10-feet above ground level
- At least 10 feet away from any opening that is less than 2 feet below the exhaust point
- 10-feet from any adjoining or adjacent buildings, or HVAC intakes or supply registers.

In addition to the proposed 29 full-scale VEP locations, a total of 16 permanent VMP locations are proposed to be installed throughout the mitigation area. The VMPs are to be installed via standard sub-slab probe construction methods as detailed in the NYSDOH for Evaluating Soil Vapor Intrusion in The State of New York dated October 2006. The VMPs will fully penetrate the slab, finish flush to the existing building slab, and be fitted with a male NPT threaded cap. The purpose of these VMPs, in addition to monitoring sub-slab soil vapor concentrations, is to allow the monitoring of system performance (i.e., vacuum influence) throughout the mitigation area – adjustments to system performance can be made accordingly. These adjustments may include increasing or decreasing extraction flow rates at individual VEPs based on observed vacuum influence nearby.

Installation

Installation activities will be observed and documented by Langan personnel under the oversight of the Remedial Engineer (RE). During installation of the full-scale SSDS, any observed cracks and/or penetrations through the building slab, which may present a pathway for vapor intrusion, will be repaired and sealed.

This also includes the walls of the basement within the grocery store tenant space, as they interface with subsurface material.

During system start up, balance and optimization activities, vacuum readings will be collected at the VMPs to determine if the minimum required vacuum is being propagated across the proposed mitigation area. If it is determined that appropriate vacuum is not being achieved, additional VEPs will be installed within the proposed mitigation area to achieve the minimum required vacuum. Final results of installation identifying the minimum required vacuum will be submitted as part of the CCR.

Vacuum readings will subsequently be also collected from the VMPs to confirm system mitigation effectiveness approximately one month following system start-up. Concurrently, indoor air samples and sub-slab soil vapor samples will be collected and analyzed for VOCs via USEPA method TO-15 to confirm system effectiveness within the mitigated tenant spaces and to assess soil vapor and indoor air conditions within the unmitigated tenant spaces. Indoor air samples will be collected from each tenant space. Sub-slab soil vapor samples will be collected from the VMPs and/or SSDS samples ports within the mitigated tenant spaces along the western portion of the building. Along the northern portion of the building, temporary sub-slab soil vapor sampling points will be installed in each unmitigated tenant space and sub-slab soil vapor samples will be collected. Samples will be collected in accordance with the Quality Assurance Project Plan (QAPP) described in Section 2.7.

2.3 Remedial Activity Oversight

The RE, Stewart Abrams, P.E. of Langan, will oversee implementation of this IRMWP. The RE is responsible for documenting that the Contractor performs the work as specified in this IRMWP and for providing required documentation to the NYSDEC as part of the CCR described below in Section 4.2. A Langan representative, under the supervision of the RE, will provide oversight during implementation of this IRMWP. Work conducted in accordance with this IRMWP will be documented in daily field reports and in the CCR.

2.4 Soil/Materials Management

Soil/materials management activities in this IRMWP are limited to the potential excavation for sub-slab pit(s) or trenching and import of gravel. This section describes the approach to handling, transportation/disposal, and import of materials during IRMWP implementation. A Langan representative will monitor and document handling of fill material and/or native soil exported from the site to be transported and disposed of in accordance with applicable laws and regulations. Excavated material will be screened by visual and olfactory methods and with a PID, to identify if soil is impacted with VOCs. All excavated material will be directly placed in United Nations/Department of Transportation (UN/DOT)-approved 55-gallon drums. Drums will be labeled and staged in area of the site that will not be impacted by vehicular traffic on the subject property.

2.4.1 Waste Characterization

Representative waste characterization soil samples will be collected from excavated material in accordance with general disposal facility requirements and DER-10 Section 5.4 (including Table 5.4(e)10) to characterize material subject to off-site disposal. Analytical soil sample results will be used to obtain pre-approval at select disposal facilities. Samples may be collected from 55-gallon drum(s) following the completion of excavation.

Laboratory analysis for waste stream characterization will typically include all or a subset of the following list:

- Extractable petroleum hydrocarbons (EPH);
- Target Compound List (TCL) VOCs, SVOCs, PCBs, pesticides and herbicides;
- Target Analyte List (TAL) Metals including hexavalent chromium;
- Total cyanide;
- TCLP VOCs, SVOCs, pesticides, herbicides and metals; and,
- RCRA characteristics, including ignitability, corrosivity, and reactivity.

Waste characterization samples collected will be submitted to a NYSDOH Environmental Laboratory Approval Program (ELAP)-approved laboratory for analysis in accordance with the QAPP provided in Appendix B. Analytical reports will be included in the CCR.

2.4.2 Soil Excavation

Excavation for sub-slab pit(s) or trenches will likely be conducted using hand tools or compact hydraulic excavation machinery. Excavated soil will be directly placed into UN/DOT-approved 55-gallon drums.

2.4.3 Soil Screening Methods

During excavation, visual, olfactory, and instrumental soil screening will be performed by a Langan using a PID equipped with a 10.6 electron volt (eV) bulb that will be calibrated daily.

2.4.4 Material Off-Site Disposal

Submittals for proposed disposal facilities will be reviewed by Langan before any materials leave the site to verify that the facility has the proper permits and to review their acceptance requirements. Waste characterization will be performed for material to be disposed of off-site in accordance with receiving facility requirements and in conformance with applicable permits. Sampling and analytical methods, sampling frequency, analytical results and quality assurance/quality control (QA/QC) methods as documented in the QAPP will be reported in the CCR upon completion of the IRMWP implementation. Waste characterization data available for excavated material to be disposed of at a given facility will be submitted to the disposal facility with suitable explanation prior to shipment and receipt. A letter from the disposal facility stating it is in receipt of the correspondence and is approved to accept the material shall be provided before any material is transported.

The waste removal contractor will provide the appropriate permits, certifications, and written commitments from disposal facilities to accept the material throughout the duration of the project. Contaminated material will be transported by a waste removal contactor who possesses a valid New York State Part 364 Waste Transporter Permit.

Excavated material will be disposed of in UN/DOT-approved 55-gallon drums. Waste manifests will be used to track the material that is transported off-site. Haulers will be appropriately licensed and trucks will be properly placarded.

2.4.5 Material Import to the Site

Imported gravel will be needed to backfill the sub-slab pit(s). Clean fill and recycled concrete aggregate (RCA) will not be imported. Virgin stone (gravel) will be imported from compliant facilities containing less than 10% by weight passing a No. 80 sieve will not require chemical testing, unless required by NYSDEC under the terms for operation of the facility. Prior to material import, Langan will review documentation from each import facility, including the facility name, address, permit/registration, and site history, if necessary, in accordance with DER-10. Approval for material import will be requested from NYSDEC.

2.5 Dust, Odor, Vapor, and Nuisance Control Plan

Ground-intrusive activities (excluding backfill of gravel) during IRWMP implementation will be continuously monitored for dust, odors, and VOCs by a Langan representative. Continuous monitoring at the work zone for odor, total VOCs, and dust will be required during ground-intrusive work such as soil excavation and handling. The work zone is defined as the general area in which machinery is operating in support of remediation. Community air monitoring is not required during IRMWP implementation as all ground intrusive work is to be conducted within interior tenant spaces. A hand-held PID will be used to monitor the work zone during hot spot excavation. Particulate levels will be monitored continuously with real-time field instruments capable of measuring particulate matter less than 10 micrometers in size (PM10). Action levels for site worker respiratory use are set forth in the CHASP included as Appendix C. Action levels for the protection of visitors are detailed below.

Work practices to minimize odors and organic vapors include limiting the time that excavations remain open and/or minimizing the handling of impacted soil. Offending odor and organic vapor controls may include the limiting the time that excavations are left open or the placement of plastic sheathing over the areas of excavation such that the installation of the system can be achieved and the floor repaired.

Total VOCs will be monitored with a hand-held PID. If the action level is exceeded and adequate ventilation cannot be provided, work will cease and the potential affected portion of the work area will be evacuated until adequate mechanical ventilation can be implemented to control the hazard. The following actions will be taken based on total VOC levels measured:

- If total VOC levels exceed 5 ppm above background for the 15-minute average at the work zone, work will be temporarily halted and monitoring continued. If levels readily decrease (per instantaneous readings) below 5 ppm above background, work will resume with continued monitoring.
- If total VOC levels at work zone persist at levels in excess of 5 ppm above background but less than 25 ppm, work will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work will resume provided that the total VOC level is below 5 ppm above background for the 15-minute average within the work zone.
- If the total VOC level is above 25 ppm in the work zone, excavation will be stopped and a re-evaluation of activities will be initiated. The source of vapors will be identified, corrective actions will be taken to abate emissions, and monitoring will continue. After these steps, work will resume provided that the total VOC level is below 5 ppm above background for the 15-minute average within the work zone.

The following actions will be taken based on visual observations and measured dust levels using a quantitative meter:

- If the work zone particulate level is 100 μg/m³ greater than background for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression must be employed. Work may continue with dust suppression techniques provided that work zone particulate levels do not exceed 150 μg/m³ above the background level and provided that no visible dust is migrating from the work area.
- If, after implementation of dust suppression techniques, work zone particulate levels are greater than 150 μg/m³ above the background level, work must be stopped and a re-evaluation of activities initiated. Work

can resume provided that dust suppression measures and other controls are successful in reducing the work zone particulate concentration to within 150 µg/m³ of the background level and in preventing visible dust migration.

If nuisance odors or vapors are identified outside of the building structure or off-site, work will be halted and the source of odors will be identified and corrected. Work will not resume until nuisance odors or vapors have been abated. NYSDEC and NYSDOH will be notified of all odor and vapor events and of all other complaints about the project. Implementation of odor and vapor controls, including halting work, will be the responsibility of the Contractor under the oversight of the RE. Implementation of odor and vapor controls will be the responsibility of the Contractor.

2.6 Construction Health and Safety Plan

The RE oversaw preparation of a site-specific CHASP, which is provided in Appendix C. The CHASP provides a mechanism for establishing on-site safe working conditions, safety organization, procedures, and personal protective equipment requirements. The CHASP meets the requirements of 29 CFR 1910 and 29 CFR 1926 (which includes 29 CFR 1910.120 and 29 CFR 1926.65, respectively). The CHASP includes, but is not limited to, the following components listed below:

- Organization and identification of key personnel
- Training requirements
- Medical surveillance requirements
- List of site hazards
- Excavation safety
- Work zone descriptions and monitoring procedures
- Personal safety equipment and protective clothing requirements
- Decontamination requirements
- Standard operating procedures
- Contingency plan
- Safety data sheets

2.7 Quality Assurance Project Plan

The RE oversaw the preparation of a QAPP, which includes proposed sampling procedures and analytical methods for samples to be collected during IRMWP implementation. The QAPP is provided in Appendix B.

3.0 SCHEDULE

Following NYSDEC approval of this IRMWP and system design, the system is expected to take approximately 3 months to install and initiate operations. Equipment fabrication will take approximately 9-10 weeks to complete - system installation activities will be completed concurrently. This schedule assumes that site access in tenant space is made available. Approximately one month following system start up, confirmatory sub-slab soil vapor and indoor air sampling will be completed. Within 90 days after completing on-site remedial activities, a CCR will be submitted to the NYSDEC as described in Section 4.2. A schedule for IRMWP implementation is included in Appendix D. Following completion of the IRM, the remainder of the site will be remediated at a later time pursuant to an NYSDEC-approved RAWP.

3.1 Notification

The NYSDEC will be notified prior to commencement of work related to the IRMWP. A pre-construction meeting will be coordinated between the RE, the Contractor, and the NYSDEC. This meeting must take place prior to the implementation of this IRMWP.

4.0 REPORTING

Upon completion of the IRMWP implementation, a CCR will be prepared and submitted to the NYSDEC. The RE responsible for certifying the CCR will be an individual licensed to practice engineering in the State of New York. Stewart Abrams, P.E. of Langan will have this responsibility. Should Mr. Abrams become unable to fulfill this responsibility, another suitably qualified New York State professional engineer will take his place. All project reports will be submitted to the NYSDEC electronically. Soil vapor and indoor air laboratory analytical data will be submitted in an electronic data deliverable (EDD) format that complies with the NYSDEC's electronic data warehouse standards.

4.1 Daily Reports

Daily reports will be prepared for the project file and for review by the NYSDEC Project Manager. The daily reports will include:

- An update of progress made during the reporting day
- Locations of work and quantities of material imported to and exported from the Site
- References to a site plan
- A summary of any and all complaints with relevant details (names, phone numbers, etc.)
- A summary of work zone air monitoring findings, including exceedances
- An explanation of notable site conditions

Daily reports are not intended to be the mode of communication for notifying the NYSDEC of emergencies (e.g., accidents, spills, etc.), requests for changes to this IRMWP, and/or other sensitive or time critical information; however, such conditions will also be included in the daily reports. Emergency conditions, changes, and/or any deviations to this IRMWP will be addressed directly to the NYSDEC Project Manager via telephone or email. If site conditions warrant, the RE may request to change from daily to weekly reports that include the above information.

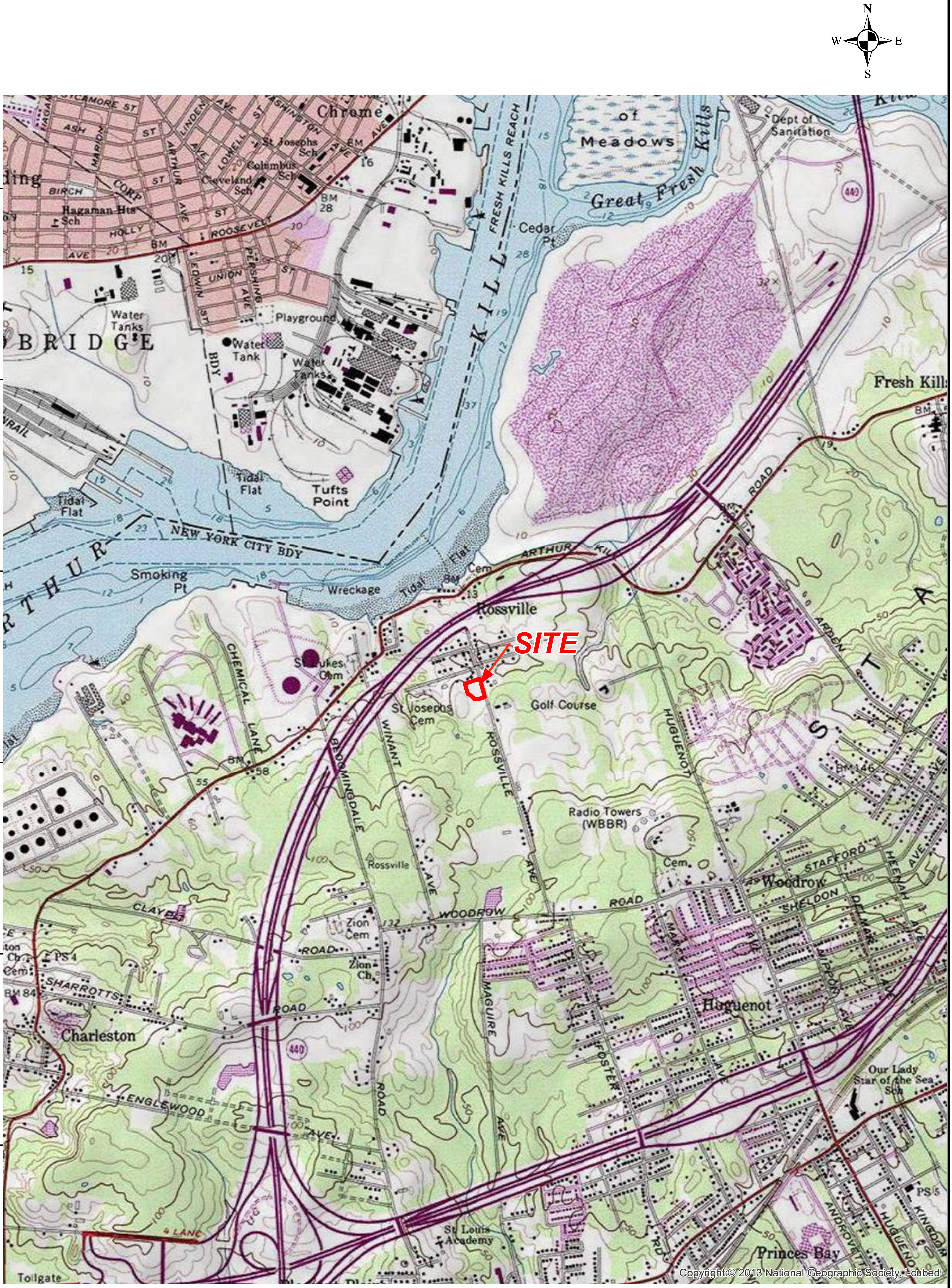
4.2 Construction Completion Report

A CCR will be submitted to the NYSDEC Project Manager within 90 days of completing the interim remedial action. The CCR will document the implementation of the remedial action undertaken as an interim remedial measure. The CCR will include an Operation, Monitoring, and Maintenance (OMM) plan that will describe the operation, maintenance and periodic inspection requirements of the SVI mitigation system. The CCR will provide the following information:

1. The RE will certify that:
    a. Data generated was useable and met the remedial requirements
    b. The remedial work conformed to the IRMWP

   c. Dust, odor, and vapor control measures were implemented during invasive work and conformed with the IRMWP
   d. Remediation waste was transported and disposed in accordance with the IRMWP
   e. Source approval and sampling of imported acceptable fill (not anticipated) was completed in a manner consistent with the methodology of the IRMWP
2. Description of problems encountered and their resolutions
3. Description of changes in the interim remedial measures from the elements provided in the IRMWP and associated design documents and the reasons for them
4. Description of the deviations from the approved IRMWP
5. "As-built" drawings of the SVI mitigation system
6. Listing of waste streams, quantity of materials disposed, and where they were disposed
7. List of the remediation standards applied to the remedial actions
8. Description of source and quality of imported material
9. A tabular summary of all sampling results and all material characterization results and other sampling and chemical analysis performed under the IRMWP
10. Written and photographic documentation of all remedial work performed under this remedy
11. Copies of all the submitted progress reports
12. Certifications, manifests, and bills of lading for excavated materials transported off-site
13. An accounting of the destination of all material removed from the site, including excavated soil, historic fill material, solid waste, hazardous waste, and non-regulated material
14. 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

FIGURES



Notes:
1. USGS Topographic basemap is provided through Langan's Esri ArcGIS software licensing and ArcGIS Online.
2. Parcel information from MapPLUTO 18v2 copyrighted by the New York City Department of Planning, last updated 2018.

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NJ CERTIFICATE OF AUTHORIZATION No. 24GA27996400

Project
990-1026
ROSSVILLE AVENUE
BLOCK No. 7054, LOT No. 518
CITY OF STATEN ISLAND
RICHMOND COUNTY NEW YORK

Drawing Title
USGS SITE LOCATION MAP

Project No.	Figure
100849501	1
Date: 2/28/2020	
Scale: 1 " = 2,000 '	
Drawn By: KMB	

Notes:
1. Aerial imagery provided through Langan's subscription to NearMap, imagery dated September 27, 2019.
2. Parcel information from MapPLUTO 20v1 copyrighted by the New York City Department of Planning.
3. Langan Sample locations and locations of catch basins and dry wells shown are approximate and based on field measurements.
4. EBI Sample locations taken from Figure 3 - Sample Location Map provided in the Phase II Environmental Site Assessment dated 28 October 2019.

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Langan International LLC
Collectively known as Langan

NJ CERTIFICATE OF AUTHORIZATION No. 24GA27996400

Project 990-1026 ROSSVILLE AVENUE BLOCK No. 7054, LOT No. 518 STATEN ISLAND NEW YORK	Drawing Title SITE PLAN AND SAMPLE LOCATION MAP	Project No. 100849501 Date 3/5/2020 Scale 1 " = 50 ' Drawn By IHB	Figure 2

Path: \\langan.com\data\PAR\data5\100849501\Project Data\ArcGIS\Export\PDF\Env_Figures\2020-02 IRMWP\Figure 3 - Areas of Concern and Sample Location Map.mxd Date: 3/5/2020 User: ibaker Time: 2:58:40 PM

Sample ID:	SB-4 (6.5 - 7)
Sample Date:	10/21/2019
Sample Depth (feet bgs):	6.5-7
VOCs (mg/kg)	
Cis-1,2-Dichloroethene	**8.4**
Tetrachloroethene (PCE)	**4.7**
Trichloroethene (TCE)	**0.66**
Vinyl Chloride	**2.7**

Sample ID	039_LSB-1A	027_LSB-1B
Sample Date	1/30/2020	1/27/2020
Sample Depth (feet bgs)	2.5-3	25.5-26
VOCs (mg/kg)		
Cis-1,2-Dichloroethene	**120**	NE
Tetrachloroethene (PCE)	**1.4**	NE
Trans-1,2-Dichloroethene	**0.36** J	ND
Vinyl Chloride	**10**	NE

Sample ID:	SB-3 (7-7.5)
Sample Date:	10/21/2019
Sample Depth (feet bgs):	7-7.5
VOCs (mg/kg)	
Cis-1,2-Dichloroethene	**1.9**
Tetrachloroethene (PCE)	**5.3**
Trichloroethene (TCE)	**0.52**
Vinyl Chloride	**0.11**

Sample ID	036_LSB-2A	037_LSB-2B
Sample Date	1/30/2020	1/30/2020
Sample Depth (feet bgs)	18-18.5	22.5-30
VOCs (mg/kg)		
Cis-1,2-Dichloroethene	**0.81**	NE
Tetrachloroethene (PCE)	**1.8**	NE

Notes:

1. Soil sample analytical results are compared to the New York State Department of Environmental Conservation (NYSDEC) Title 6 of the Official Compilation of New York Codes, Rules, and Regulations (NYCRR) Part 375 Unrestricted Use, Restricted Use Residential, and Restricted Use Restricted-Residential Soil Cleanup Objectives (SCO).

2. Only analytes above regulatory criteria are shown in the figure.
3. Detected analytical results above Unrestricted Use SCOs are bolded.
4. Detected analytical results above Restricted Use Residential SCOs are shaded.
5. Detected analytical results above Restricted Use Restricted-Residential SCOs are underlined.
6. Detected analytical results above Restricted Use Commercial SCOs are jagged bordered.
7. Detected analytical results above Restricted Use Industrial SCOs are bordered.
8. Analytical results with reporting limits (RL) above the lowest applicable criteria are italicized.
9. bgs = below grade surface
10. mg/kg = milligrams per kilogram
11. NE = The analyte was analyzed, but does not exceed the NYSDEC Part 375 SCOs
12. ND = The analyte was analyzed for, but was not detected at a level greater than or equal to the reporting limit

Qualifiers:
J = The analyte was detected above the Method Detection Limit (MDL), but below the RL; therefore, the result is an estimated concentration.

Analyte	CAS Number	NYSDEC Part 375 Unrestricted Use SCOs	NYSDEC Part 375 Restricted Use Residential SCOs	NYSDEC Part 375 Restricted Use Restricted-Residential SCOs	NYSDEC Part 375 Commercial SCOs	NYSDEC Part 375 Industrial SCOs
VOCs (mg/kg)						
Cis-1,2-Dichloroethene	156-59-2	0.25	59	100	500	1,000
Tetrachloroethene (PCE)	127-18-4	1.3	5.5	19	150	300
Trans-1,2-Dichloroethene	156-60-5	0.19	100	100	500	1,000
Trichloroethene (TCE)	79-01-6	0.47	10	21	200	400
Vinyl Chloride	75-01-4	0.02	0.21	0.9	13	27

Legend

- Site Boundary
- Tenant Areas
- Catch Basin
- Dry Well
- Langan Soil Boring Location (2020)
- EBI Soil Boring Location (2019)

Notes:
1. Aerial imagery provided through Langan's subscription to NearMap, imagery dated September 27, 2019.
2. Parcel information from MapPLUTO 20v1 copyrighted by the New York City Department of Planning.
3. Langan Soil Boring locations and locations of catch basins and dry wells shown are approximate and based on field measurements.
4. EBI Soil Boring locations taken from Figure 3 - Sample Location Map provided in the Phase II Environmental Site Assessment dated 28 October 2019.

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Project

990-1026 ROSSVILLE AVENUE

BLOCK No. 7054, LOT No. 518

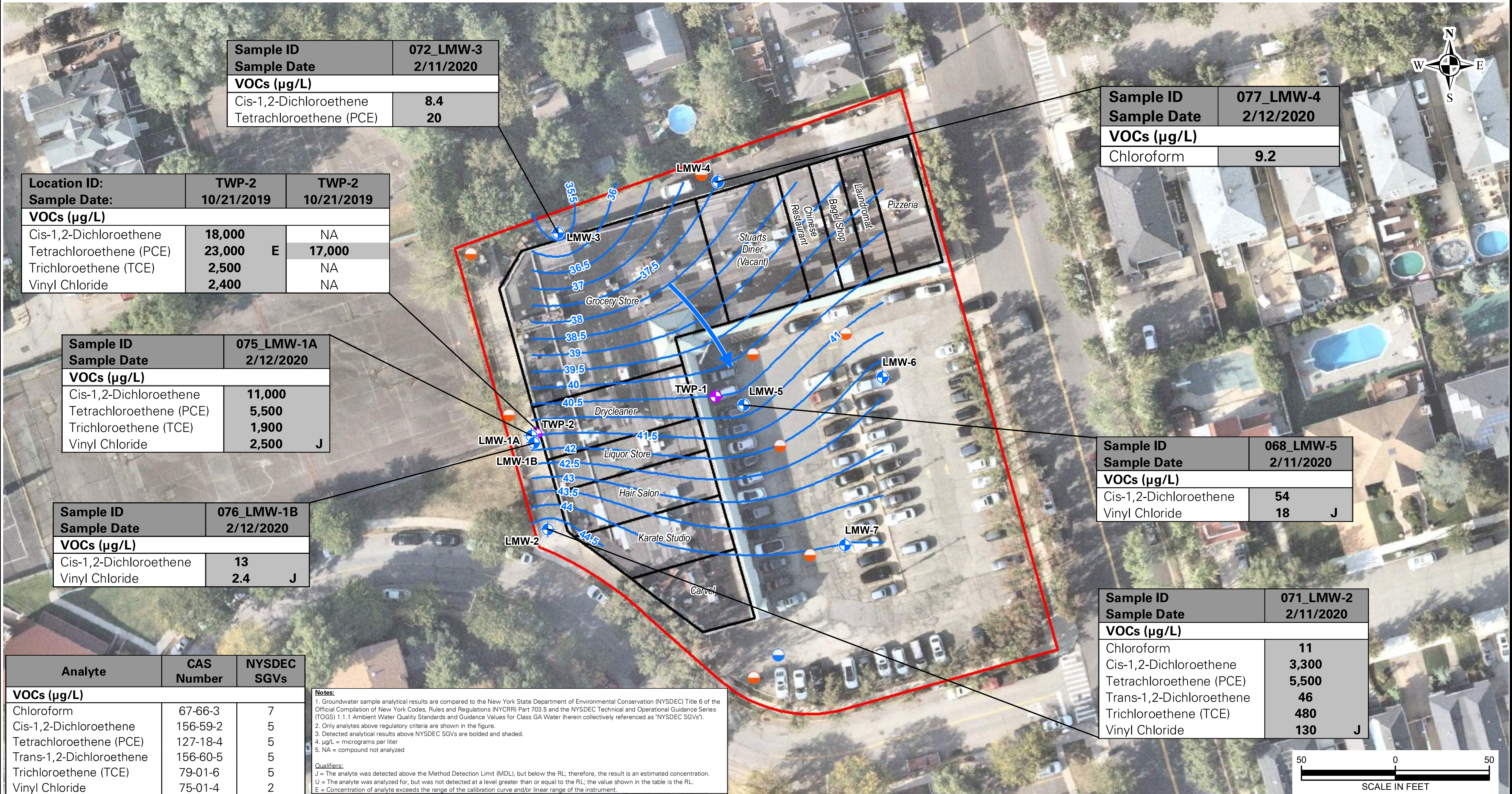
STATEN ISLAND NEW YORK

Drawing Title

SOIL ANALYTICAL RESULTS

Project No.	100849501
Date	3/5/2020
Scale	1 " = 50 '
Drawn By	IHB
Figure	3

Path: \\langan.com\data\PAR\data5\100849501\Project Data\ArcGIS\Export\PDF\Env_Figures\2020-02 IRMWP\Figure 3 - Soil Analytical Results.mxd Date: 3/5/2020 User: ibaker Time: 3:03:35 PM



Sample ID	072_LMW-3
Sample Date	2/11/2020
VOCs (µg/L)	
Cis-1,2-Dichloroethene	8.4
Tetrachloroethene (PCE)	20

Sample ID	077_LMW-4
Sample Date	2/12/2020
VOCs (µg/L)	
Chloroform	9.2

Location ID:	TWP-2	TWP-2
Sample Date:	10/21/2019	10/21/2019
VOCs (µg/L)		
Cis-1,2-Dichloroethene	18,000	NA
Tetrachloroethene (PCE)	23,000 E	17,000
Trichloroethene (TCE)	2,500	NA
Vinyl Chloride	2,400	NA

Sample ID	075_LMW-1A
Sample Date	2/12/2020
VOCs (µg/L)	
Cis-1,2-Dichloroethene	11,000
Tetrachloroethene (PCE)	5,500
Trichloroethene (TCE)	1,900
Vinyl Chloride	2,500 J

Sample ID	068_LMW-5
Sample Date	2/11/2020
VOCs (µg/L)	
Cis-1,2-Dichloroethene	54
Vinyl Chloride	18 J

Sample ID	076_LMW-1B
Sample Date	2/12/2020
VOCs (µg/L)	
Cis-1,2-Dichloroethene	13
Vinyl Chloride	2.4 J

Sample ID	071_LMW-2
Sample Date	2/11/2020
VOCs (µg/L)	
Chloroform	11
Cis-1,2-Dichloroethene	3,300
Tetrachloroethene (PCE)	5,500
Trans-1,2-Dichloroethene	46
Trichloroethene (TCE)	480
Vinyl Chloride	130 J

Analyte	CAS Number	NYSDEC SGVs
VOCs (µg/L)		
Chloroform	67-66-3	7
Cis-1,2-Dichloroethene	156-59-2	5
Tetrachloroethene (PCE)	127-18-4	5
Trans-1,2-Dichloroethene	156-60-5	5
Trichloroethene (TCE)	79-01-6	5
Vinyl Chloride	75-01-4	2

Notes:

1. Groundwater sample analytical results are compared to the New York State Department of Environmental Conservation (NYSDEC) Title 6 of the Official Compilation of New York Codes, Rules and Regulations (NYCRR) Part 703.5 and the NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards and Guidance Values for Class GA Water (herein collectively referenced as "NYSDEC SGVs").
2. Only analytes above regulatory criteria are shown in the figure.
3. Detected analytical results above NYSDEC SGVs are bolded and shaded.
4. µg/L = micrograms per liter
5. NA = compound not analyzed

Qualifiers:

J = The analyte was detected above the Method Detection Limit (MDL), but below the RL; therefore, the result is an estimated concentration.
U = The analyte was analyzed for, but was not detected at a level greater than or equal to the RL; the value shown in the table is the RL.
E = Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

Legend

- Site Boundary
- Tenant Areas
- Groundwater Flow Direction
- Groundwater Contour
- Langan Monitoring Well Location (2020)
- EBI Monitoring Well Location (2019)
- Catch Basin
- Dry Well

Notes:

1. Aerial imagery provided through Langan's subscription to NearMap, imagery dated September 27, 2019.
2. Parcel information from MapPLUTO 20v1 copyrighted by the New York City Department of Planning.
3. Langan Monitoring Well locations and locations of catch basins and dry wells are based on locations surveyed by a licensed surveyor.
4. EBI Monitoring Well locations taken from Figure 3 - Sample Location Map provided in the Phase II Environmental Site Assessment dated 28 October 2019.

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Project

990-1026 ROSSVILLE AVENUE

BLOCK No. 7054, LOT No. 518

STATEN ISLAND NEW YORK

Drawing Title

GROUNDWATER CONTOURS AND ANALYTICAL RESULTS

Project No.	100849501
Date	3/5/2020
Scale	1 " = 50 '
Drawn By	IHB
Figure	4

Path: \\langan.com\data\PAR\data5\100849501\Project Data\ArcGIS\Export\PDF\Env_Figures\2020-02 IRMWP\Figure 4 - Groundwater Analytical Results.mxd Date: 3/5/2020 User: ibaker Time: 3:10:01 PM

Location	IA-10\LSV-12				
Sample ID	019_IA-10		023_LSV-12		NYSDOH DECISION MATRIX RECOMMENDED ACTION
Sample Date	1/22/2020		1/22/2020		
Sample Type	AI		AS		
VOCs (µg/m³)					
1,1,1-Trichloroethane	0.109	U	1.09	U	No further action
1,1-Dichloroethene	0.079	U	0.793	U	No further action
Carbon Tetrachloride	0.535		1.26	U	No further action
Cis-1,2-Dichloroethene	0.079	U	0.793	U	No further action
Methylene Chloride	1.74	U	3.1		No further action
Tetrachloroethene (PCE)	6.28		8.54		No further action
Trichloroethene (TCE)	0.167		1.07	U	No further action
Vinyl Chloride	0.051	U	0.511	U	No further action

Location	LSV-13			
Sample ID	058_LSV-13		059_DUP-2	
Sample Date	2/4/2020		2/4/2020	
Sample Type	AS		AS	
VOCs (µg/m³)				
1,1,1-Trichloroethane	1.09	U	1.09	U
1,1-Dichloroethene	0.793	U	0.793	U
Carbon Tetrachloride	1.26	U	1.26	U
Cis-1,2-Dichloroethene	3.14		3.37	
Methylene Chloride	1.74	U	1.74	U
Tetrachloroethene (PCE)	9.56		9.7	
Trichloroethene (TCE)	**6.5**		**6.5**	
Vinyl Chloride	0.511	U	0.511	U

Location	LSV-16	
Sample ID	064_LSV-16	
Sample Date	2/5/2020	
Sample Type	AS	
VOCs (µg/m³)		
1,1,1-Trichloroethane	5.46	U
1,1-Dichloroethene	**6.98**	
Carbon Tetrachloride	6.29	U
Cis-1,2-Dichloroethene	3.96	U
Methylene Chloride	8.69	U
Tetrachloroethene (PCE)	53.7	
Trichloroethene (TCE)	5.37	U
Vinyl Chloride	2.74	

Location	IA-02\LSV-02				
Sample ID	002_IA-2		006_LSV-2		NYSDOH DECISION MATRIX RECOMMENDED ACTION
Sample Date	1/21/2020		1/21/2020		
Sample Type	AI		AS		
VOCs (µg/m³)					
1,1,1-Trichloroethane	0.109	U	1.09	U	No further action
1,1-Dichloroethene	0.079	U	0.793	U	No further action
Carbon Tetrachloride	0.912		1.26	U	No further action
Cis-1,2-Dichloroethene	0.079	U	0.793	U	No further action
Methylene Chloride	1.74	U	1.74	U	No further action
Tetrachloroethene (PCE)	1.01		1.78		No further action
Trichloroethene (TCE)	0.107	U	1.07	U	No further action
Vinyl Chloride	0.051	U	0.511	U	No further action

Location	IA-01\LSV-01				
Sample ID	001_IA-1		005_LSV-1		NYSDOH DECISION MATRIX RECOMMENDED ACTION
Sample Date	1/21/2020		1/21/2020		
Sample Type	AI		AS		
VOCs (µg/m³)					
1,1,1-Trichloroethane	0.109	U	1.09	U	No further action
1,1-Dichloroethene	0.079	U	0.793	U	No further action
Carbon Tetrachloride	0.403		1.26	U	No further action
Cis-1,2-Dichloroethene	0.079	U	0.793	U	No further action
Methylene Chloride	1.74	U	1.74	U	No further action
Tetrachloroethene (PCE)	0.542		1.36	U	No further action
Trichloroethene (TCE)	0.107	U	1.07	U	No further action
Vinyl Chloride	0.051	U	0.511	U	No further action

Location	IA-06\LSV-10				
Sample ID	013_IA-6		021_LSV-10		NYSDOH DECISION MATRIX RECOMMENDED ACTION
Sample Date	1/22/2020		1/22/2020		
Sample Type	AI		AS		
VOCs (µg/m³)					
1,1,1-Trichloroethane	0.109	U	1.09	U	No further action
1,1-Dichloroethene	0.079	U	0.793	U	No further action
Carbon Tetrachloride	0.491		1.26	U	No further action
Cis-1,2-Dichloroethene	0.079	U	0.793	U	No further action
Methylene Chloride	1.74	U	1.74	U	No further action
Tetrachloroethene (PCE)	2.01		3.05		No further action
Trichloroethene (TCE)	0.107	U	1.07	U	No further action
Vinyl Chloride	0.051	U	0.511	U	No further action

Location	IA-03\LSV-03				
Sample ID	003_IA-3		007_LSV-3		NYSDOH DECISION MATRIX RECOMMENDED ACTION
Sample Date	1/21/2020		1/21/2020		
Sample Type	AI		AS		
VOCs (µg/m³)					
1,1,1-Trichloroethane	0.109	U	1.09	U	No further action
1,1-Dichloroethene	0.091		0.793	U	No further action
Carbon Tetrachloride	0.39		1.26	U	No further action
Cis-1,2-Dichloroethene	0.079	U	0.793	U	No further action
Methylene Chloride	1.74	U	1.74	U	No further action
Tetrachloroethene (PCE)	2.26		2.83		No further action
Trichloroethene (TCE)	0.107	U	1.07	U	No further action
Vinyl Chloride	0.051		0.511	U	No further action

Location	IA-08\LSV-11				
Sample ID	015_IA-8		022_LSV-11		NYSDOH DECISION MATRIX RECOMMENDED ACTION
Sample Date	1/22/2020		1/22/2020		
Sample Type	AI		AS		
VOCs (µg/m³)					
1,1,1-Trichloroethane	0.109	U	1.09	U	No further action
1,1-Dichloroethene	0.079	U	0.793	U	No further action
Carbon Tetrachloride	0.528		1.26	U	No further action
Cis-1,2-Dichloroethene	0.131		0.793	U	No further action
Methylene Chloride	1.74	U	1.74	U	No further action
Tetrachloroethene (PCE)	1.39		8.48		No further action
Trichloroethene (TCE)	0.107	U	1.07	U	No further action
Vinyl Chloride	0.051	U	0.511	U	No further action

Location	LSV-15	
Sample ID	063_LSV-15	
Sample Date	2/5/2020	
Sample Type	AS	
VOCs (µg/m³)		
1,1,1-Trichloroethane	1.09	U
1,1-Dichloroethene	0.793	U
Carbon Tetrachloride	1.26	U
Cis-1,2-Dichloroethene	0.793	U
Methylene Chloride	1.74	U
Tetrachloroethene (PCE)	81.4	
Trichloroethene (TCE)	**8.81**	
Vinyl Chloride	2.23	

Location	IA-09\LSV-09				
Sample ID	018_IA-9		024_LSV-9		NYSDOH DECISION MATRIX RECOMMENDED ACTION
Sample Date	1/22/2020		1/22/2020		
Sample Type	AI		AS		
VOCs (µg/m³)					
1,1,1-Trichloroethane	0.109	U	1.21	U	No further action
1,1-Dichloroethene	0.079	U	0.88	U	No further action
Carbon Tetrachloride	0.472		1.4	U	No further action
Cis-1,2-Dichloroethene	0.143	J	0.88	U	No further action
Methylene Chloride	1.74	U	1.93	U	No further action
Tetrachloroethene (PCE)	**7.39**		**490**		Monitor
Trichloroethene (TCE)	0.15		1.19	U	No further action
Vinyl Chloride	0.051	U	0.567	U	No further action

Location	LSV-05	
Sample ID	009_LSV-5	
Sample Date	1/21/2020	
Sample Type	AS	
VOCs (µg/m³)		
1,1,1-Trichloroethane	1.09	U
1,1-Dichloroethene	0.793	U
Carbon Tetrachloride	1.99	
Cis-1,2-Dichloroethene	0.793	U
Methylene Chloride	1.74	U
Tetrachloroethene (PCE)	**325**	
Trichloroethene (TCE)	1.07	U
Vinyl Chloride	0.511	U

Location	LSV-17	
Sample ID	065_LSV-17	
Sample Date	2/5/2020	
Sample Type	AS	
VOCs (µg/m³)		
1,1,1-Trichloroethane	50.8	U
1,1-Dichloroethene	36.9	U
Carbon Tetrachloride	58.6	U
Cis-1,2-Dichloroethene	**4,160**	
Methylene Chloride	80.9	U
Tetrachloroethene (PCE)	**726**	
Trichloroethene (TCE)	**93**	
Vinyl Chloride	**9,590**	

Sample ID	SV-1	
Sample Date	10/21/2019	
Sample Type	Sub-Slab SV	
VOCs (µg/m³)		
1,1,1-Trichloroethane	52.4	U
1,1-Dichloroethene	38.1	U
Carbon Tetrachloride	NA	
Cis-1,2-Dichloroethene	**161**	
Tetrachloroethene (PCE)	**24,800**	
Methylene Chloride	NA	
Trichloroethene (TCE)	**2,560**	
Vinyl Chloride	24.5	U

Location	LSV-14	
Sample ID	060_LSV-14	
Sample Date	2/4/2020	
Sample Type	AS	
VOCs (µg/m³)		
1,1,1-Trichloroethane	13600	U
1,1-Dichloroethene	9910	U
Carbon Tetrachloride	15700	U
Cis-1,2-Dichloroethene	**4,760,000**	
Methylene Chloride	21700	U
Tetrachloroethene (PCE)	**4,620,000**	
Trichloroethene (TCE)	**709,000**	
Vinyl Chloride	**1,440,000**	

Sample ID	SV-2	
Sample Date	10/21/2019	
Sample Type	Sub-Slab SV	
VOCs (µg/m³)		
1,1,1-Trichloroethane	1.09	U
1,1-Dichloroethene	0.793	U
Carbon Tetrachloride	NA	
Cis-1,2-Dichloroethene	1.85	
Tetrachloroethene (PCE)	**235**	
Methylene Chloride	NA	
Trichloroethene (TCE)	4.99	
Vinyl Chloride	0.511	U

Location	LSV-04	
Sample ID	008_LSV-4	
Sample Date	1/21/2020	
Sample Type	AS	
VOCs (µg/m³)		
1,1,1-Trichloroethane	1.09	U
1,1-Dichloroethene	0.793	U
Carbon Tetrachloride	1.26	U
Cis-1,2-Dichloroethene	0.793	U
Methylene Chloride	1.74	U
Tetrachloroethene (PCE)	**552**	
Trichloroethene (TCE)	1.95	
Vinyl Chloride	0.511	U

Location	LSV-18	
Sample ID	066_LSV-18	
Sample Date	2/5/2020	
Sample Type	AS	
VOCs (µg/m³)		
1,1,1-Trichloroethane	1.09	U
1,1-Dichloroethene	0.793	U
Carbon Tetrachloride	1.26	U
Cis-1,2-Dichloroethene	0.793	U
Methylene Chloride	18.9	
Tetrachloroethene (PCE)	67.3	
Trichloroethene (TCE)	1.07	U
Vinyl Chloride	0.511	U

Location	AMBIENT-1	
Sample ID	011_AMBIENT-1	
Sample Date	1/22/2020	
Sample Type	AO	
VOCs (µg/m³)		
1,1,1-Trichloroethane	0.109	U
1,1-Dichloroethene	0.079	U
Carbon Tetrachloride	0.478	
Cis-1,2-Dichloroethene	0.079	U
Methylene Chloride	1.74	U
Tetrachloroethene (PCE)	0.136	U
Trichloroethene (TCE)	0.107	U
Vinyl Chloride	0.051	U

Location	AMBIENT-2	
Sample ID	057_AMBIENT-2	
Sample Date	2/4/2020	
Sample Type	AO	
VOCs (µg/m³)		
1,1,1-Trichloroethane	1.09	U
1,1-Dichloroethene	0.793	U
Carbon Tetrachloride	1.26	U
Cis-1,2-Dichloroethene	0.793	U
Methylene Chloride	1.74	U
Tetrachloroethene (PCE)	1.36	U
Trichloroethene (TCE)	1.07	U
Vinyl Chloride	0.511	U

Location	AMBIENT-3	
Sample ID	061_AMBIENT-3	
Sample Date	2/5/2020	
Sample Type	AO	
VOCs (µg/m³)		
1,1,1-Trichloroethane	1.09	U
1,1-Dichloroethene	0.793	U
Carbon Tetrachloride	1.26	U
Cis-1,2-Dichloroethene	0.793	U
Methylene Chloride	3.72	
Tetrachloroethene (PCE)	2.67	
Trichloroethene (TCE)	1.07	U
Vinyl Chloride	0.511	U

Location	IA-04\LSV-06				
Sample ID	004_IA-4		010_LSV-6		NYSDOH DECISION MATRIX RECOMMENDED ACTION
Sample Date	1/21/2020		1/21/2020		
Sample Type	AI		AS		
VOCs (µg/m³)					
1,1,1-Trichloroethane	0.109	U	2.73	U	No further action
1,1-Dichloroethene	0.079	U	1.98	U	No further action
Carbon Tetrachloride	0.478		3.15	U	No further action
Cis-1,2-Dichloroethene	0.079	U	1.98	U	No further action
Methylene Chloride	1.74	U	4.34	U	No further action
Tetrachloroethene (PCE)	**16.3**		**1,490**		Mitigate
Trichloroethene (TCE)	0.107	U	2.69	U	No further action
Vinyl Chloride	0.051	U	1.28	U	No further action

Location	IA-05\LSV-07						
Sample ID	012_IA-5		016_LSV-7		017_DUP-1		NYSDOH DECISION MATRIX RECOMMENDED ACTION
Sample Date	1/22/2020		1/22/2020		1/22/2020		
Sample Type	AI		AS		AS		
VOCs (µg/m³)							
1,1,1-Trichloroethane	0.109	U	5.46	U	5.46	U	No further action
1,1-Dichloroethene	0.079	U	3.96	U	3.96	U	No further action
Carbon Tetrachloride	0.503		6.29	U	6.29	U	No further action
Cis-1,2-Dichloroethene	0.079	U	3.96	U	3.96	U	No further action
Methylene Chloride	1.74	U	8.69	U	8.69	U	No further action
Tetrachloroethene (PCE)	**3.55**		**2,410**		**2,310**		Mitigate
Trichloroethene (TCE)	0.107	U	32.1		32.1		No further action
Vinyl Chloride	0.051	U	2.56	U	2.56	U	No further action

Location	IA-07\LSV-08				
Sample ID	014_IA-7		020_LSV-8		NYSDOH DECISION MATRIX RECOMMENDED ACTION
Sample Date	1/22/2020		1/22/2020		
Sample Type	AI		AS		
VOCs (µg/m³)					
1,1,1-Trichloroethane	0.171	U	3.64	U	No further action
1,1-Dichloroethene	0.124	U	2.64	U	No further action
Carbon Tetrachloride	0.524		4.2	U	No further action
Cis-1,2-Dichloroethene	0.124	U	5		No further action
Methylene Chloride	2.73	U	5.8	U	No further action
Tetrachloroethene (PCE)	**4.92**		**1,590**		Mitigate
Trichloroethene (TCE)	**0.169**	**U**	**74.2**		Mitigate
Vinyl Chloride	0.08	U	1.71	U	No further action

Analyte	CAS Number	NYSDOH Decision Matrices Minimum Concentrations
VOCs (µg/m³)		
1,1,1-Trichloroethane	71-55-6	100
1,1-Dichloroethene	75-35-4	6
Carbon Tetrachloride	75-00-3	6
Cis-1,2-Dichloroethene	156-59-2	6
Methylene Chloride	127-18-4	100
Tetrachloroethene (PCE)	156-60-5	100
Trichloroethene (TCE)	79-01-6	6
Vinyl Chloride	75-01-4	6

Notes:
1. Soil vapor sample analytical results are compared to the minimum soil vapor concentrations recommending mitigation as set forth in the New York State Department of Health (NYSDOH) October 2006 Guidance for Evaluating Soil Vapor Intrusion in the State of New York Decision Matrices for Sub-Slab Vapor and Indoor Air and subsequent updates (2017).
2. Co-located sub-slab vapor and indoor air sample analytical results are evaluated using the New York State Department of Health (NYSDOH) October 2006 Guidance for Evaluating Soil Vapor Intrusion in the State of New York Decision Matrices for Sub-Slab Vapor and Indoor Air and subsequent updates (2017).
3. Ambient air sample analytical results are shown for reference only.
4. Reporting limit exceedances are not shown in this figure.
5. Detected soil vapor analytical results above the minimum soil vapor concentrations recommending mitigation are bolded and shaded.
6. Detected indoor air/sub-slab soil vapor analytical results above the minimum threshold for which monitoring is recommended are bolded.
7. Detected air/sub-slab soil vapor analytical results above the minimum threshold for which identification of source(s) and resampling or mitigation is recommended are shaded.
8. Detected air/sub-slab soil vapor analytical results above the minimum threshold for which mitigation is recommended are bolded and shaded.
9. µg/m³ = micrograms per cubic meter
10. AA = Ambient Air
11. SV = Soil Vapor

Qualifiers:
U = The analyte was analyzed for, but was not detected at a level greater than or equal to the RL; the value shown in the table is the RL.

50 0 50
SCALE IN FEET

Legend

- Site Boundary
- Tenant Areas
- Langan Exterior Soil Vapor Point (2020)
- Langan Indoor Air Sample/Sub-Slab Soil Vapor Point (2020)
- Langan Sub-Slab Soil Vapor Point (2020)
- EBI Sub-Slab Soil Vapor Point (2019)
- Catch Basin
- Dry Well

Notes:
1. Aerial imagery provided through Langan's subscription to NearMap, imagery dated September 27, 2019.
2. Parcel information from MapPLUTO 20v1 copyrighted by the New York City Department of Planning.
3. Langan Soil Vapor Points, Indoor Air/Sub-Slab Soil Vapor Points, and Sub-Slab Soil Vapor Points and locations of catch basins and dry wells shown are approximate and based on field measurements.
4. EBI Soil Vapor Points taken from Figure 3 - Sample Location Map provided in the Phase II Environmental Site Assessment dated 28 October 2019.
5. No ambient air or indoor air samples were collected during the 2019 EBI Investigation.

LANGAN
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Langan Engineering & Environmental Services, Inc.
Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C.
Langan International LLC
Collectively known as Langan
NJ CERTIFICATE OF AUTHORIZATION No. 24GA27996400

Project
990-1026 ROSSVILLE AVENUE
BLOCK No. 7054, LOT No. 518
STATEN ISLAND NEW YORK

Drawing Title
SUB-SLAB SOIL VAPOR/ INDOOR AIR AND EXTERIOR SOIL VAPOR ANALYTICAL RESULTS

Project No. 100849501
Date 3/5/2020
Scale 1 " = 50 '
Drawn By IHB
Figure 5

Path: \\langan.com\data\PAR\data5\100849501\Project Data\ArcGIS\Export\PDF\Env_Figures\2020-02 IRMWP\Figure 5 - Soil Vapor Analytical Results.mxd Date: 3/5/2020 User: ibaker Time: 3:17:09 PM

LEGEND:

- PROPERTY LINE
- EXISTING BUILDING OUTLINE
- INTERIOR WALL
- VEP-1 SSDS PILOT TEST VEP
- VMP-1 SSDS PILOT TEST VMP
- APPROXIMATE PARTIAL BASEMENT EXTENTS

NOTES:

SSDS - SUB-SLAB DEPRESSURIZATION SYSTEM
VEP - VAPOR EXTRACTION POINT
VMP - VACUUM MONITORING POINT

1. THE SSDS PILOT TEST VEP AND VMP LOCATIONS ARE APPROXIMATE BASED ON FIELD MEASUREMENTS.
2. THE VEP AND VMP LOCATIONS WERE SELECTED WITHIN THE DRY CLEANER AND THE ADJACENT LIQUOR STORE AND GROCERY STORE TENANT SPACES.
3. THE VMP LOCATIONS WERE SELECTED SUCH THAT VACUUM PROPAGATION COULD BE MONITORED AT DIFFERENT DISTANCES AND IN DIFFERENT DIRECTIONS FROM THE RESPECTIVE VEP.
4. THE SSDS PILOT TEST VMP AND VEP LOCATIONS WERE ABANDONED FOLLOWING THE TESTING.

40 0 10 25 40
SCALE: 1 INCH = 40 FEET

WARNING: IT IS A VIOLATION OF THE NYS EDUCATION LAW ARTICLE 145 FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS ITEM IN ANY WAY.

SIGNATURE / DATE SIGNED	LANGAN	Project	Drawing Title	Project No. / Date / Drawn By / Checked By	Drawing No.
STEWART ABRAMS PROFESSIONAL ENGINEER NY LIC. No. 078833-1	Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C. 300 Kimball Drive Parsippany, NJ 07054 T: 973.560.4900 F: 973.560.4901 www.langan.com NJ Certificate of Authorization No.24GA27996400	990-1026 ROSSVILLE AVENUE BLOCK No. 7054, LOT No. 518 STATEN ISLAND NEW YORK	SSDS PILOT TEST LOCATIONS	Project No. 100849501 Date 02/28/2020 Drawn By AC Checked By BR	6

Filename: \\langan.com\data\PAR\data5\100849501\Project Data\CAD\01\SheetFiles\Environmental\FG06-100849501-ND101-0101.dwg Date: 2/28/2020 Time: 08:55 User: acofrancesco Style Table: Langan.stb Layout: ANSIB-BL

LEGEND:

PROPERTY LINE
EXISTING BUILDING OUTLINE
INTERIOR WALL
VEP-1 SSDS FULL-SCALE VEP
VMP-1 SSDS FULL-SCALE VMP
PROPOSED SSDS MITIGATION AREA
APPROXIMATE BASEMENT EXTENTS
ESTIMATED RADIUS OF INFLUENCE OF 15 FT.

NOTES:

SSDS - SUB-SLAB DEPRESSURIZATION SYSTEM
VEP - VAPOR EXTRACTION POINT
VMP - VACUUM MONITORING POINT

1. THE PROPOSED MITIGATION AREA IS BASED ON THE RESULTS OF THE INDOOR AIR SAMPLING COMPLETED BY LANGAN ON 21 AND 22 JANUARY 2020. THE INDOOR AIR ANALYTICAL RESULTS IDENTIFIED CONCENTRATIONS OF TETRACHLOROETHENE (PCE), TRICHLOROETHENE (TCE), CIS-1,2-DICHLOROETHENE (DCE), AND VINYL CHLORIDE IN EXCESS OF THE USEPA VAPOR INTRUSION SCREENING LEVEL FOR COMMMERCIAL/INDUSTRIAL INDOOR AIR WITHIN THE PROPOSED MITIGATION AREA.
2. THE PROPOSED FULL-SCALE VEP AND VMP LOCATIONS ARE SUBJECT TO CHANGE BASED ON THE OBSERVED FIELD CONDITIONS (I.E., ABOVE GROUND AND/OR BELOW GRADE BUILDING ELEMENTS).
3. THE PROPOSED FULL-SCALE VEP LOCATIONS HAVE BEEN CO-LOCATED WITH BUILDING WALLS, TO THE EXTENT POSSIBLE, TO MINIMIZE TRENCHING DURING CONSTRUCTION AND DISTURBANCE TO NORMAL BUSINESS OPERATIONS FOLLOWING SYSTEM INSTALLATION.
4. THE WESTERN PORTION OF THE EXISTING BUILDING INCLUDING THE CARVEL, KARATE STUDIO, HAIR SALON, LIQUOR STORE, DRY CLEANER, AND GROCERY STORE BASEMENT (PROPOSED MITIGATION AREA) ARE TO BE MITIGATED VIA THE PROPOSED SSDS.
5. VISUAL DAMAGE AND/OR DEFECTS TO THE EXISTING NORTH BUILDING SLAB (I.E., CRACKS) WHICH MAY COMPROMISE THE INTEGRITY AND CONFINING NATURE OF THE SLAB MUST BE REPAIRED, AS REQUIRED.

40 0 10 25 40
SCALE: 1 INCH = 40 FEET

SIGNATURE DATE SIGNED
STEWART ABRAMS
PROFESSIONAL ENGINEER NY LIC. No. 078833-1

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Project
990-1026 ROSSVILLE AVENUE
BLOCK No. 7054, LOT No. 518
STATEN ISLAND NEW YORK

Drawing Title
FULL-SCALE SSDS WELL LAYOUT

Project No. 100849501
Date 02/28/2020
Drawn By AC
Checked By BR
Drawing No. **7**

Filename: \\langan.com\data\PAR\data5\100849501\Project Data\CAD\01\SheetFiles\Environmental\FG07-100849501-ND101-0101.dwg Date: 2/28/2020 Time: 08:57 User: acofrancesco Style Table: Langan.stb Layout: ARCHB-BL

LEGEND:

- PROPERTY LINE
- EXISTING BUILDING OUTLINE
- INTERIOR WALL
- VEP-1 SSDS FULL-SCALE VEP
- VMP-1 SSDS FULL-SCALE VMP
- PROPOSED SSDS MITIGATION AREA
- APPROXIMATE BASEMENT EXTENTS
- INDIVIDUAL BELOW GRADE WELL LINE (SCH40 PVC)
- INDIVIDUAL ABOVE GROUND WELL LINE (2-INCH METAL)
- INTERIOR SUBHEADER LINE (4-INCH METAL)
- EXTERIOR SUBHEADER LINE (4-INCH SCH40 PVC)
- EXTERIOR MAIN HEADER LINE (6-INCH SCH40 PVC)
- ROOF PENETRATION LOCATION

NOTES:

PVC - POLYVINYL CHLORIDE
SCH - SCHEDULE
SSDS - SUB-SLAB DEPRESSURIZATION SYSTEM
VEP - VAPOR EXTRACTION POINT
VMP - VACUUM MONITORING POINT

1. THE PROPOSED MITIGATION AREA IS BASED ON THE RESULTS OF THE INDOOR AIR SAMPLING COMPLETED BY LANGAN ON 21 AND 22 JANUARY 2020. THE INDOOR AIR ANALYTICAL RESULTS IDENTIFIED CONCENTRATIONS OF TETRACHLOROETHENE (PCE), TRICHLOROETHENE (TCE), CIS-1,2-DICHLOROETHENE (DCE), AND VINYL CHLORIDE IN EXCESS OF THE USEPA VAPOR INTRUSION SCREENING LEVEL FOR COMMERCIAL/INDUSTRIAL INDOOR AIR WITHIN THE PROPOSED MITIGATION AREA.
2. THE PROPOSED FULL-SCALE VEP, VMP, AND SYSTEM MANIFOLD PIPING LOCATIONS ARE SUBJECT TO CHANGE BASED ON THE OBSERVED FIELD CONDITIONS (I.E., ABOVE GROUND AND/OR BELOW GRADE BUILDING ELEMENTS).
3. THE PROPOSED VEP LOCATIONS AND ASSOCIATED MANIFOLD PIPING HAVE BEEN CO-LOCATED WITH BUILDING WALLS, TO THE EXTENT POSSIBLE, TO MINIMIZE TRENCHING AND DISTURBANCE TO NORMAL BUSINESS OPERATIONS FOLLOWING SYSTEM INSTALLATION.
4. THE PROPOSED VEP LOCATIONS ARE TO BE PIPED VERTICALLY VIA 2-INCH INDIVIDUAL LINES. IN SOME CASES, THE 2-INCH INDIVIDUAL VEP LINE MAY NEED TO FIRST BE TRENCHED BENEATH THE EXISTING BUILDING SLAB TO THE NEAREST BUILDING WALL AND THEN TRANSITION TO VERTICAL. EACH 2-INCH INDIVIDUAL VEP LINE, ONCE RUN TO THE CEILING OF THE BUILDING, WILL MANIFOLD INTO A 4-INCH SUBHEADER LINE WHICH WILL RUN ALONG THE INTERIOR OF THE BUILDING AT CEILING LEVEL. EACH 4-INCH SUBHEADER LINE WILL MANIFOLD FIVE OR SIX VEP LOCATIONS (THIS MAY CHANGE BASED ON FINAL WELL LAYOUT). THE 4-INCH SUBHEADER LINE WILL EXIT THE BUILDING ROOF AND WILL BE PIPED TO ROOF-MOUNTED PROCESS EQUIPMENT. PRIOR TO THE PROCESS EQUIPMENT, THE SUBHEADER LINES WILL MANIFOLD INTO A 6-INCH MAIN HEADER LINE ON THE ROOF. ANY BELOW GRADE OR ABOVE GROUND EXTERIOR PIPING WILL BE CONSTRUCTED OF SCH40 PVC. EXTERIOR PIPING WILL ALSO BE EQUIPPED WITH INSULATION. ANY ABOVE GROUND INTERIOR PIPING WILL BE CONSTRUCTED OF METAL.
5. THE MANIFOLD PIPING HAS BEEN DESIGNED SUCH THAT IF IN THE FUTURE IT IS DETERMINED THAT ACTIVE OPERATION OF THE FULL-SCALE SSDS IS NO LONGER NECESSARY, THE SYSTEM CAN BE CONVERTED TO PASSIVE OPERATION (EACH 4-INCH SUBHEADER LINE CAN BE EQUIPPED WITH A DISCHARGE STACK AND TURBINE.
6. ALL SSDS MANIFOLD PIPING MUST BE CLEARLY LABELED.
7. SSDS EXHAUST TO MAINTAIN MINIMUM 10-FOOT CLEARANCE OF ANY WINDOW, DOOR OR INTAKE.
8. EACH INDIVIDUAL VEP LINE WILL BE EQUIPPED WITH A VACUUM GAUGE GATE VALE, AND SAMPLE PORT FOR MONITORING AND PERFORMANCE ADJUSTMENTS. THE WELL-SPECIFIC INSTRUMENTATION WILL BE LOCATED ABOVE-GROUND AND WILL BE ACCESSIBLE FOR FUTURE ACCESS.
9. THE SSDS PROCESS EQUIPMENT WILL BE INSTALLED ON THE ROOF OF THE EXISTING BUILDING IN A NOISE AND WEATHER-PROOF ENCLOSURE.
10. VISUAL DAMAGE AND/OR DEFECTS TO THE EXISTING NORTH BUILDING SLAB [I.E., CRACKS] WHICH MAY COMPROMISE THE INTEGRITY AND CONFINING NATURE OF THE SLAB MUST BE REPAIRED, AS REQUIRED.

40 0 10 25 40

SCALE: 1 INCH = 40 FEET

SIGNATURE DATE SIGNED
STEWART ABRAMS
PROFESSIONAL ENGINEER NY LIC. No. 078833-1

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Project
990-1026 ROSSVILLE AVENUE
BLOCK No. 7054, LOT No. 518
STATEN ISLAND NEW YORK

Drawing Title
FULL-SCALE SSDS MANIFOLD LAYOUT

Project No. 100849501
Date 02/28/2020
Drawn By AC
Checked By BR
Drawing No. 8

Filename: \\langan.com\data\PAR\data5\100849501\Project Data\CAD\01\SheetFiles\Environmental\FG08-100849501-ND101-0101.dwg Date: 2/28/2020 Time: 09:03 User: acofrancesco Style Table: Langan.stb Layout: ARCHB-BL

APPENDIX A

SSDS TESTING AND MODELING

Attachment 1
Sub-Slab Depressurization System Pneumatic Modeling Results
Rossville Shopping Center
Staten Island, New York
Langan Project No.: 100849501

Approach

- The January 2020 sub-slab depressurization (SSDS) pilot test data was used as input to a subsurface pneumatic computer model (MDFIT) to determine design parameters for the proposed SSDS to mitigate potential migration of soil gas vapors into the overlying building.

Objectives

- Predict air flow rate and vacuum distribution in the subsurface
- Predict a system's performance under varying subsurface conditions
- Determine system design and operational parameters

Output Results

- Air intrinsic permeability, K_i
- Design air flow rates
- Vacuum propagation in the subsurface
- SSDS radius of influence (ROI)
- Process equipment sizing

MDFIT Modeling Simulation Procedures

Step 1 – K_i Estimation in x, y, z directions for existing subsurface material
Step 2 – K_i Calibration for existing subsurface material
Step 3 – Single well vacuum simulation for existing subsurface **(Design Basis)**

MDFIT Modeling Simulation Results

Step 1: Air Intrinsic Permeability Estimation
Model Runs

(Select model simulation results are provided herein. A complete set of model runs can be provided upon request)

(Refer to the January 2020 SSDS pilot testing results summary)

MDFIT Modeling Simulation Results
Step 1: Air Intrinsic Permeability Estimation
Rossville Shopping Center
Staten Island, New York
Langan Project No.: 100849501

Flow Condition (scfm)	K_R=K_Z (cm^2)	K_C/B_C (cm)	K_C (cm^2)
Test Area 1 [VEP-1]			
8.95	3.81E-06	1.44E-09	1.44E-08
13.41	2.27E-06	1.40E-12	1.40E-11
14.15	2.35E-06	4.25E-12	4.25E-11
20.25	2.03E-06	6.41E-17	6.41E-16
29.09	5.16E-06	5.61E-45	5.61E-44
51.65	3.53E-06	5.61E-45	5.61E-44
41.08	4.64E-06	5.61E-45	5.61E-44
26.06	6.16E-06	5.61E-45	5.61E-44
AVERAGE	**3.81E-06**	**1.44E-09**	**4.83E-09**

CALIBRATED	**2.38E-07**	**8.14E-09**	**8.14E-08**

Notes:

K_R = Horizontal Air Intrinsic Permeability of Existing Soils

K_Z = Vertical Air Intrinsic Permeability of Existing Soils

K_C = Air Intrinsic Permeability of Surface Layer [Confining Layer]

B_C = Model assumed thickness of Surface Layer [Confining Layer] = 10 cm

scfm = standard cubic feet per minute

cm^2 = square centimeters

Permeability

******************* INPUT INFORMATION ************

Test information:

Depth to the top of screen (ft)	=	.5000E+00
Depth to the bottom of screen (ft)	=	.1500E+01
Depth to the groundwater table (ft)	=	.1000E+02
Radius of the test well (in.)	=	.2000E+01
Temperature of the soil (C)	=	.2000E+02
Flow rate of pumping/injection well(cfm)	=	.8950E+01

SCENARIO ------ 1

Simulated permabilities information and results:

```
KR=KZ=    .5261E-05 Kc/Bc=    .2003E-16
KR=KZ=    .1261E-04 Kc/Bc=
KR=KZ=    .4010E-05 Kc/Bc=    .3447E-10
KR=KZ=    .1365E-05 Kc/Bc=
KR=KZ=    .3807E-05 Kc/Bc=    .1443E-08
KR=KZ=    .1636E-06 Kc/Bc=
```

SCENARIO ------ 2

Simulated permabilities information and results:

```
KR=KZ=    .5261E-05 Kc/Bc=    .7969E-29
KR=KZ=    .2429E-03 Kc/Bc=
KR=KZ=    .3027E-05 Kc/Bc=    .6473E-17
KR=KZ=    .1020E-03 Kc/Bc=
KR=KZ=    .2274E-05 Kc/Bc=    .1396E-11
KR=KZ=    .2223E-04 Kc/Bc=



   SCENARIO ------     3


 Simulated permabilities information and results:



KR=KZ=    .5261E-05 Kc/Bc=    .2579E-27
KR=KZ=    .2312E-03 Kc/Bc=
KR=KZ=    .3057E-05 Kc/Bc=    .4803E-16
KR=KZ=    .8936E-04 Kc/Bc=
KR=KZ=    .2345E-05 Kc/Bc=    .4247E-11
KR=KZ=    .1728E-04 Kc/Bc=



   SCENARIO ------     4


 Simulated permabilities information and results:



KR=KZ=    .5846E-05 Kc/Bc=    .1564E-39
KR=KZ=    .1401E-02 Kc/Bc=
KR=KZ=    .3263E-05 Kc/Bc=    .1319E-24
KR=KZ=    .9192E-03 Kc/Bc=
KR=KZ=    .2031E-05 Kc/Bc=    .6411E-16
KR=KZ=    .3834E-03 Kc/Bc=
```

SCENARIO ------ 5

Simulated permabilities information and results:

```
KR=KZ=    .4735E-05 Kc/Bc=    .5605E-44
KR=KZ=    .5819E-02 Kc/Bc=
KR=KZ=    .5231E-05 Kc/Bc=    .5605E-44
KR=KZ=    .5817E-02 Kc/Bc=
KR=KZ=    .5158E-05 Kc/Bc=    .5605E-44
KR=KZ=    .5817E-02 Kc/Bc=
```

SCENARIO ------ 6

Simulated permabilities information and results:

```
KR=KZ=    .3107E-05 Kc/Bc=    .5605E-44
KR=KZ=    .3908E-01 Kc/Bc=
KR=KZ=    .3571E-05 Kc/Bc=    .5605E-44
KR=KZ=    .3906E-01 Kc/Bc=
KR=KZ=    .3528E-05 Kc/Bc=    .5605E-44
KR=KZ=    .3906E-01 Kc/Bc=
```

SCENARIO ------ 7

Simulated permabilities information and results:

```
KR=KZ=    .4262E-05 Kc/Bc=    .5605E-44
```

```
KR=KZ=    .1436E-01 Kc/Bc=
KR=KZ=    .4707E-05 Kc/Bc=    .5605E-44
KR=KZ=    .1435E-01 Kc/Bc=
KR=KZ=    .4642E-05 Kc/Bc=    .5605E-44
KR=KZ=    .1435E-01 Kc/Bc=
```

SCENARIO ------ 8

Simulated permabilities information and results:

```
KR=KZ=    .5846E-05 Kc/Bc=    .5605E-44
KR=KZ=    .3321E-02 Kc/Bc=
KR=KZ=    .6205E-05 Kc/Bc=    .5605E-44
KR=KZ=    .3315E-02 Kc/Bc=
KR=KZ=    .6156E-05 Kc/Bc=    .5605E-44
KR=KZ=    .3315E-02 Kc/Bc=
```

MDFIT Modeling Simulation Results

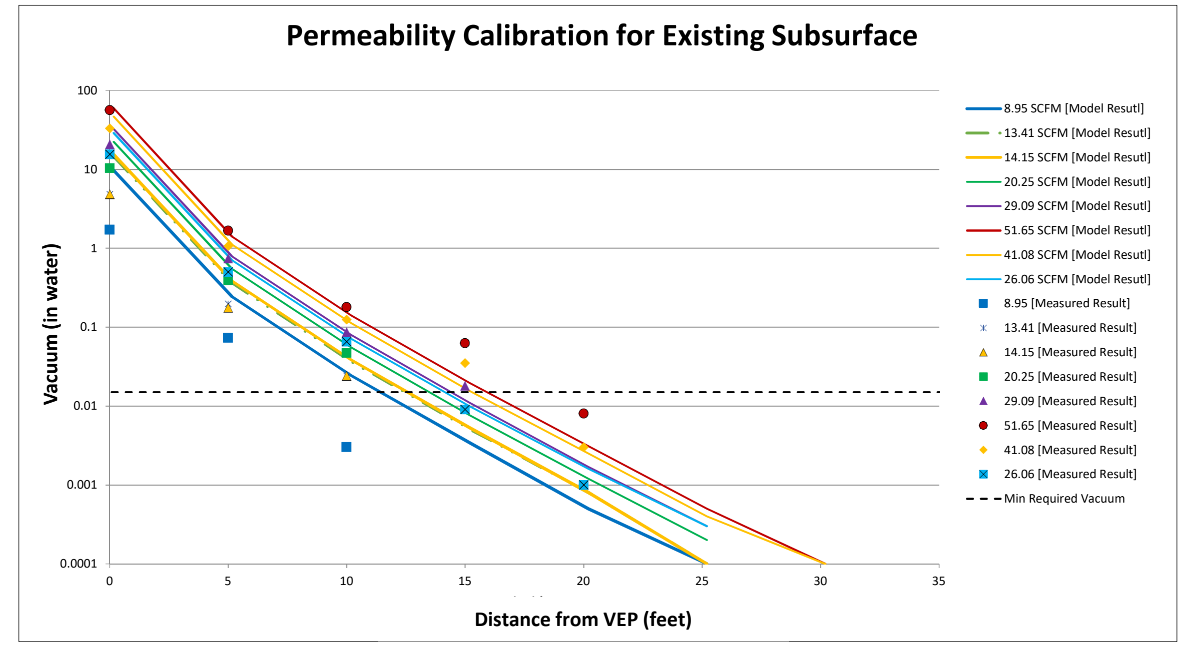
Step 2: Air Intrinsic Permeability Calibration
Model Runs

(Select model simulation results are provided herein. A complete set of model runs can be provided upon request)

MDFIT Modeling Simulation Results
Step 2: Air Intrinsic Permeability Calibration
Rossville Shopping Center
Staten Island, New York
Langan Project No.: 100849501

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESSURE (atm)	PRESSURE (inH_2O)	VELOCITY (ft/s)	RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESSURE (atm)	PRESSURE (inH_2O)	VELOCITY (ft/s)
8.95 SCFM [Model Resutl]						**29.09 SCFM [Model Resutl]**					
5.08E+00	1.67E-01	5.00E-01	0.9762	9.6791	3.44E-01	5.08E+00	1.67E-01	5.00E-01	0.9205	32.373	1.19E+00
1.57E+02	5.17E+00	5.00E-01	0.9994	0.242	1.66E-03	1.57E+02	5.17E+00	5.00E-01	0.9981	0.7872	5.39E-03
3.10E+02	1.02E+01	5.00E-01	0.9999	0.0243	1.46E-04	3.10E+02	1.02E+01	5.00E-01	0.9998	0.0789	4.73E-04
4.62E+02	1.52E+01	5.00E-01	1	0.0034	1.86E-05	4.62E+02	1.52E+01	5.00E-01	1	0.011	6.04E-05
6.15E+02	2.02E+01	5.00E-01	1	0.0005	2.79E-06	6.15E+02	2.02E+01	5.00E-01	1	0.0017	9.06E-06
7.67E+02	2.52E+01	5.00E-01	1	0.0001	4.58E-07	7.67E+02	2.52E+01	5.00E-01	1	0.0003	1.49E-06
9.19E+02	3.02E+01	5.00E-01	1	0	7.96E-08	9.19E+02	3.02E+01	5.00E-01	1	0	2.59E-07
1.07E+03	3.52E+01	5.00E-01	1	0	1.43E-08	1.07E+03	3.52E+01	5.00E-01	1	0	4.64E-08
1.22E+03	4.02E+01	5.00E-01	1	0	2.62E-09	1.22E+03	4.02E+01	5.00E-01	1	0	8.52E-09
1.38E+03	4.52E+01	5.00E-01	1	0	4.87E-10	1.38E+03	4.52E+01	5.00E-01	1	0	1.58E-09
1.53E+03	5.02E+01	5.00E-01	1	0	9.15E-11	1.53E+03	5.02E+01	5.00E-01	1	0	2.97E-10
1.68E+03	5.52E+01	5.00E-01	1	0	1.73E-11	1.68E+03	5.52E+01	5.00E-01	1	0	5.62E-11
1.83E+03	6.02E+01	5.00E-01	1	0	3.29E-12	1.83E+03	6.02E+01	5.00E-01	1	0	1.07E-11
1.99E+03	6.52E+01	5.00E-01	1	0	6.28E-13	1.99E+03	6.52E+01	5.00E-01	1	0	2.04E-12
2.14E+03	7.02E+01	5.00E-01	1	0	1.20E-13	2.14E+03	7.02E+01	5.00E-01	1	0	3.91E-13
2.29E+03	7.52E+01	5.00E-01	1	0	2.31E-14	2.29E+03	7.52E+01	5.00E-01	1	0	7.50E-14
2.44E+03	8.02E+01	5.00E-01	1	0	4.44E-15	2.44E+03	8.02E+01	5.00E-01	1	0	1.44E-14
2.60E+03	8.52E+01	5.00E-01	1	0	8.57E-16	2.60E+03	8.52E+01	5.00E-01	1	0	2.79E-15
2.75E+03	9.02E+01	5.00E-01	1	0	1.66E-16	2.75E+03	9.02E+01	5.00E-01	1	0	5.38E-16
2.90E+03	9.52E+01	5.00E-01	1	0	3.21E-17	2.90E+03	9.52E+01	5.00E-01	1	0	1.04E-16
13.41 SCFM [Model Resutl]						**51.65 SCFM [Model Resutl]**					
5.08E+00	1.67E-01	5.00E-01	0.9642	14.5915	5.22E-01	5.08E+00	1.67E-01	5.00E-01	0.8537	59.5489	2.27E+00
1.57E+02	5.17E+00	5.00E-01	0.9991	0.3627	2.48E-03	1.57E+02	5.17E+00	5.00E-01	0.9966	1.3987	9.59E-03
3.10E+02	1.02E+01	5.00E-01	0.9999	0.0364	2.18E-04	3.10E+02	1.02E+01	5.00E-01	0.9997	0.1401	8.41E-04
4.62E+02	1.52E+01	5.00E-01	1	0.0051	2.78E-05	4.62E+02	1.52E+01	5.00E-01	1	0.0195	1.07E-04
6.15E+02	2.02E+01	5.00E-01	1	0.0008	4.18E-06	6.15E+02	2.02E+01	5.00E-01	1	0.0031	1.61E-05
7.67E+02	2.52E+01	5.00E-01	1	0.0001	6.87E-07	7.67E+02	2.52E+01	5.00E-01	1	0.0005	2.65E-06
9.19E+02	3.02E+01	5.00E-01	1	0	1.19E-07	9.19E+02	3.02E+01	5.00E-01	1	0.0001	4.59E-07
1.07E+03	3.52E+01	5.00E-01	1	0	2.14E-08	1.07E+03	3.52E+01	5.00E-01	1	0	8.25E-08
1.22E+03	4.02E+01	5.00E-01	1	0	3.93E-09	1.22E+03	4.02E+01	5.00E-01	1	0	1.51E-08
1.38E+03	4.52E+01	5.00E-01	1	0	7.30E-10	1.38E+03	4.52E+01	5.00E-01	1	0	2.81E-09
1.53E+03	5.02E+01	5.00E-01	1	0	1.37E-10	1.53E+03	5.02E+01	5.00E-01	1	0	5.28E-10
1.68E+03	5.52E+01	5.00E-01	1	0	2.59E-11	1.68E+03	5.52E+01	5.00E-01	1	0	9.98E-11
1.83E+03	6.02E+01	5.00E-01	1	0	4.93E-12	1.83E+03	6.02E+01	5.00E-01	1	0	1.90E-11
1.99E+03	6.52E+01	5.00E-01	1	0	9.40E-13	1.99E+03	6.52E+01	5.00E-01	1	0	3.62E-12
2.14E+03	7.02E+01	5.00E-01	1	0	1.80E-13	2.14E+03	7.02E+01	5.00E-01	1	0	6.94E-13
2.29E+03	7.52E+01	5.00E-01	1	0	3.46E-14	2.29E+03	7.52E+01	5.00E-01	1	0	1.33E-13
2.44E+03	8.02E+01	5.00E-01	1	0	6.66E-15	2.44E+03	8.02E+01	5.00E-01	1	0	2.56E-14
2.60E+03	8.52E+01	5.00E-01	1	0	1.28E-15	2.60E+03	8.52E+01	5.00E-01	1	0	4.95E-15
2.75E+03	9.02E+01	5.00E-01	1	0	2.48E-16	2.75E+03	9.02E+01	5.00E-01	1	0	9.56E-16
2.90E+03	9.52E+01	5.00E-01	1	0	4.80E-17	2.90E+03	9.52E+01	5.00E-01	1	0	1.85E-16
14.15 SCFM [Model Resutl]						**41.08 SCFM [Model Resutl]**					
5.08E+00	1.67E-01	5.00E-01	0.9621	15.4126	5.52E-01	5.08E+00	1.67E-01	5.00E-01	0.8856	46.5611	1.74E+00
1.57E+02	5.17E+00	5.00E-01	0.9991	0.3827	2.62E-03	1.57E+02	5.17E+00	5.00E-01	0.9973	1.112	7.62E-03
3.10E+02	1.02E+01	5.00E-01	0.9999	0.0384	2.30E-04	3.10E+02	1.02E+01	5.00E-01	0.9997	0.1114	6.68E-04
4.62E+02	1.52E+01	5.00E-01	1	0.0053	2.94E-05	4.62E+02	1.52E+01	5.00E-01	1	0.0155	8.53E-05
6.15E+02	2.02E+01	5.00E-01	1	0.0008	4.41E-06	6.15E+02	2.02E+01	5.00E-01	1	0.0025	1.28E-05
7.67E+02	2.52E+01	5.00E-01	1	0.0001	7.25E-07	7.67E+02	2.52E+01	5.00E-01	1	0.0004	2.10E-06
9.19E+02	3.02E+01	5.00E-01	1	0	1.26E-07	9.19E+02	3.02E+01	5.00E-01	1	0.0001	3.65E-07
1.07E+03	3.52E+01	5.00E-01	1	0	2.26E-08	1.07E+03	3.52E+01	5.00E-01	1	0	6.56E-08
1.22E+03	4.02E+01	5.00E-01	1	0	4.14E-09	1.22E+03	4.02E+01	5.00E-01	1	0	1.20E-08
1.38E+03	4.52E+01	5.00E-01	1	0	7.70E-10	1.38E+03	4.52E+01	5.00E-01	1	0	2.24E-09
1.53E+03	5.02E+01	5.00E-01	1	0	1.45E-10	1.53E+03	5.02E+01	5.00E-01	1	0	4.20E-10
1.68E+03	5.52E+01	5.00E-01	1	0	2.74E-11	1.68E+03	5.52E+01	5.00E-01	1	0	7.94E-11
1.83E+03	6.02E+01	5.00E-01	1	0	5.20E-12	1.83E+03	6.02E+01	5.00E-01	1	0	1.51E-11
1.99E+03	6.52E+01	5.00E-01	1	0	9.92E-13	1.99E+03	6.52E+01	5.00E-01	1	0	2.88E-12
2.14E+03	7.02E+01	5.00E-01	1	0	1.90E-13	2.14E+03	7.02E+01	5.00E-01	1	0	5.52E-13
2.29E+03	7.52E+01	5.00E-01	1	0	3.65E-14	2.29E+03	7.52E+01	5.00E-01	1	0	1.06E-13
2.44E+03	8.02E+01	5.00E-01	1	0	7.02E-15	2.44E+03	8.02E+01	5.00E-01	1	0	2.04E-14
2.60E+03	8.52E+01	5.00E-01	1	0	1.36E-15	2.60E+03	8.52E+01	5.00E-01	1	0	3.93E-15
2.75E+03	9.02E+01	5.00E-01	1	0	2.62E-16	2.75E+03	9.02E+01	5.00E-01	1	0	7.60E-16
2.90E+03	9.52E+01	5.00E-01	1	0	5.07E-17	2.90E+03	9.52E+01	5.00E-01	1	0	1.47E-16
20.25 SCFM [Model Resutl]						**26.06 SCFM [Model Resutl]**					
5.08E+00	1.67E-01	5.00E-01	0.9454	22.2472	8.04E-01	5.08E+00	1.67E-01	5.00E-01	0.9291	28.8717	1.05E+00
1.57E+02	5.17E+00	5.00E-01	0.9987	0.5478	3.75E-03	1.57E+02	5.17E+00	5.00E-01	0.9983	0.7051	4.83E-03
3.10E+02	1.02E+01	5.00E-01	0.9999	0.0549	3.29E-04	3.10E+02	1.02E+01	5.00E-01	0.9998	0.0707	4.24E-04
4.62E+02	1.52E+01	5.00E-01	1	0.0076	4.20E-05	4.62E+02	1.52E+01	5.00E-01	1	0.0099	5.41E-05
6.15E+02	2.02E+01	5.00E-01	1	0.0012	6.31E-06	6.15E+02	2.02E+01	5.00E-01	1	0.0016	8.12E-06
7.67E+02	2.52E+01	5.00E-01	1	0.0002	1.04E-06	7.67E+02	2.52E+01	5.00E-01	1	0.0003	1.34E-06
9.19E+02	3.02E+01	5.00E-01	1	0	1.80E-07	9.19E+02	3.02E+01	5.00E-01	1	0	2.32E-07
1.07E+03	3.52E+01	5.00E-01	1	0	3.23E-08	1.07E+03	3.52E+01	5.00E-01	1	0	4.16E-08
1.22E+03	4.02E+01	5.00E-01	1	0	5.93E-09	1.22E+03	4.02E+01	5.00E-01	1	0	7.63E-09
1.38E+03	4.52E+01	5.00E-01	1	0	1.10E-09	1.38E+03	4.52E+01	5.00E-01	1	0	1.42E-09
1.53E+03	5.02E+01	5.00E-01	1	0	2.07E-10	1.53E+03	5.02E+01	5.00E-01	1	0	2.66E-10
1.68E+03	5.52E+01	5.00E-01	1	0	3.91E-11	1.68E+03	5.52E+01	5.00E-01	1	0	5.04E-11
1.83E+03	6.02E+01	5.00E-01	1	0	7.44E-12	1.83E+03	6.02E+01	5.00E-01	1	0	9.57E-12
1.99E+03	6.52E+01	5.00E-01	1	0	1.42E-12	1.99E+03	6.52E+01	5.00E-01	1	0	1.83E-12
2.14E+03	7.02E+01	5.00E-01	1	0	2.72E-13	2.14E+03	7.02E+01	5.00E-01	1	0	3.50E-13
2.29E+03	7.52E+01	5.00E-01	1	0	5.22E-14	2.29E+03	7.52E+01	5.00E-01	1	0	6.72E-14
2.44E+03	8.02E+01	5.00E-01	1	0	1.01E-14	2.44E+03	8.02E+01	5.00E-01	1	0	1.29E-14
2.60E+03	8.52E+01	5.00E-01	1	0	1.94E-15	2.60E+03	8.52E+01	5.00E-01	1	0	2.50E-15
2.75E+03	9.02E+01	5.00E-01	1	0	3.75E-16	2.75E+03	9.02E+01	5.00E-01	1	0	4.82E-16
2.90E+03	9.52E+01	5.00E-01	1	0	7.26E-17	2.90E+03	9.52E+01	5.00E-01	1	0	9.34E-17

Measured Vacuum		
Flow	Vacuum	Distance
Test Area 1 [VEP-1]		
8.95 [Measured Result]	1.7	0
	0.073	5
	0.003	10
	0	15
	0	20
	0.000	50
	0	20
13.41 [Measured Result]	4.8	0
	0.195	5
	0.024	10
	0	15
	0	20
	0	50
	0	20
14.15 [Measured Result]	4.8	0
	0.175	5
	0.024	10
	0	15
	0.000	20
	0	50
	0.000	20
20.25 [Measured Result]	10.3	0
	0.39	5
	0.047	10
	0	15
	0.000	20
	0.001	50
	0.000	20
29.09 [Measured Result]	20.7	0
	0.74	5
	0.086	10
	0.018	15
	0.001	20
	0.000	50
	0.001	20
51.65 [Measured Result]	56.1	0
	1.662	5
	0.178	10
	0.062	15
	0.008	20
	0.000	50
	0.008	20
41.08 [Measured Result]	33	0
	1.063	5
	0.124	10
	0.035	15
	0.003	20
	0.000	50
	0.003	20
26.06 [Measured Result]	15.5	0
	0.499	5
	0.065	10
	0.009	15
	0.001	20
	0.000	50
	0.001	20



INPUT PARAMETERS		
Depth to the top of screen (ft)	=	5.00E-01
Depth to the bottom of screen (ft)	=	1.50E+00
Depth to the groundwater table (ft)	=	1.00E+01
Depth to the simulated elevation(ft)	=	5.00E-01
Radius of the simulating well (in.)	=	2.00E+00
Temperature of the soil (C)	=	2.00E+01
Flow rate of pumping/injection well(cfm)	=	Variable
Soil porosity(Dimensionless)	=	2.50E-01
Peameability for R direction (cm**2)	=	2.38E-07
Peameability for Z direction (cm**2)	=	2.38E-07
Peameability Kc/Bc	=	8.14E-09

Calibration

----- Simulated Scenario ----- 1

Simulating information:

Depth to the top of screen (ft)	=	.5000E+00
Depth to the bottom of screen (ft)	=	.1500E+01
Depth to the groundwater table (ft)	=	.1000E+02
Depth to the simulated elevation(ft)	=	.5000E+00
Radius of the simulating well (in.)	=	.2000E+01
Temperature of the soil (C)	=	.2000E+02
Flow rate of pumping/injection well(cfm)	=	.8950E+01
Soil porosity(Dimensionless)	=	.2500E+00
Peameability for R direction (cm**2)	=	.2381E-06
Peameability for Z direction (cm**2)	=	.2381E-06
Peameability Kc/Bc	=	.8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************ OUTPUT ********************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.9762	9.6791	.3442E+00
.157E+03	.517E+01	.500E+00	.9994	.2420	.1657E-02
.310E+03	.102E+02	.500E+00	.9999	.0243	.1456E-03
.462E+03	.152E+02	.500E+00	1.0000	.0034	.1858E-04
.615E+03	.202E+02	.500E+00	1.0000	.0005	.2789E-05
.767E+03	.252E+02	.500E+00	1.0000	.0001	.4584E-06
.919E+03	.302E+02	.500E+00	1.0000	.0000	.7958E-07
.107E+04	.352E+02	.500E+00	1.0000	.0000	.1429E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.2620E-08
.138E+04	.452E+02	.500E+00	1.0000	.0000	.4873E-09
.153E+04	.502E+02	.500E+00	1.0000	.0000	.9149E-10
.168E+04	.552E+02	.500E+00	1.0000	.0000	.1730E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.3288E-11
.199E+04	.652E+02	.500E+00	1.0000	.0000	.6275E-12
.214E+04	.702E+02	.500E+00	1.0000	.0000	.1202E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.2308E-13
.244E+04	.802E+02	.500E+00	1.0000	.0000	.4443E-14
.260E+04	.852E+02	.500E+00	1.0000	.0000	.8571E-15
.275E+04	.902E+02	.500E+00	1.0000	.0000	.1656E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.3206E-16

----- Simulated Scenario ----- 2

Simulating information:

Depth to the top of screen (ft) = .5000E+00

Depth to the bottom of screen (ft) = .1500E+01

Depth to the groundwater table (ft) = .1000E+02

Depth to the simulated elevation(ft) = .5000E+00

Radius of the simulating well (in.) = .2000E+01

Temperature of the soil (C) = .2000E+02

Flow rate of pumping/injection well(cfm)= .1341E+02

Soil porosity(Dimensionless) = .2500E+00

Peameability for R direction (cm**2) = .2381E-06

Peameability for Z direction (cm**2) = .2381E-06

Peameability Kc/Bc = .8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************ OUTPUT ********************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.9642	14.5915	.5221E+00
.157E+03	.517E+01	.500E+00	.9991	.3627	.2484E-02
.310E+03	.102E+02	.500E+00	.9999	.0364	.2182E-03
.462E+03	.152E+02	.500E+00	1.0000	.0051	.2783E-04
.615E+03	.202E+02	.500E+00	1.0000	.0008	.4178E-05
.767E+03	.252E+02	.500E+00	1.0000	.0001	.6868E-06
.919E+03	.302E+02	.500E+00	1.0000	.0000	.1192E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.2141E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.3926E-08
.138E+04	.452E+02	.500E+00	1.0000	.0000	.7301E-09
.153E+04	.502E+02	.500E+00	1.0000	.0000	.1371E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.2592E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.4926E-11
.199E+04	.652E+02	.500E+00	1.0000	.0000	.9402E-12
.214E+04	.702E+02	.500E+00	1.0000	.0000	.1801E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.3458E-13
.244E+04	.802E+02	.500E+00	1.0000	.0000	.6657E-14
.260E+04	.852E+02	.500E+00	1.0000	.0000	.1284E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.2482E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.4804E-16

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   ----- Simulated Scenario -----    3


Simulating information:

Depth to the top of screen (ft)           =          .5000E+00

Depth to the bottom of screen (ft)        =          .1500E+01

Depth to the groundwater table (ft)       =          .1000E+02

Depth to the simulated elevation(ft)      =          .5000E+00

Radius of the simulating well (in. )      =          .2000E+01

Temperature of the soil ( C )             =          .2000E+02

Flow rate of pumping/injection well( cfm )=          .1415E+02

Soil porosity( Dimensionless )            =          .2500E+00

Peameability for R direction ( cm**2 )    =          .2381E-06

Peameability for Z direction ( cm**2 )    =          .2381E-06

Peameability  Kc/Bc                       =          .8144E-08



 Aquifer geological structure properties



 1:  Aquifer is isotropic.
 2:  There is a upper confining unit.




************************* OUTPUT *********************************
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RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.9621	15.4126	.5521E+00
.157E+03	.517E+01	.500E+00	.9991	.3827	.2621E-02
.310E+03	.102E+02	.500E+00	.9999	.0384	.2302E-03
.462E+03	.152E+02	.500E+00	1.0000	.0053	.2937E-04
.615E+03	.202E+02	.500E+00	1.0000	.0008	.4409E-05
.767E+03	.252E+02	.500E+00	1.0000	.0001	.7247E-06
.919E+03	.302E+02	.500E+00	1.0000	.0000	.1258E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.2259E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.4142E-08
.138E+04	.452E+02	.500E+00	1.0000	.0000	.7704E-09
.153E+04	.502E+02	.500E+00	1.0000	.0000	.1446E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.2735E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.5198E-11
.199E+04	.652E+02	.500E+00	1.0000	.0000	.9921E-12
.214E+04	.702E+02	.500E+00	1.0000	.0000	.1900E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.3649E-13
.244E+04	.802E+02	.500E+00	1.0000	.0000	.7024E-14
.260E+04	.852E+02	.500E+00	1.0000	.0000	.1355E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.2619E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.5069E-16

----- Simulated Scenario ----- 4

Simulating information:

Depth to the top of screen (ft) = .5000E+00

Depth to the bottom of screen (ft) = .1500E+01

Depth to the groundwater table (ft) = .1000E+02

Depth to the simulated elevation(ft) = .5000E+00

Radius of the simulating well (in.) = .2000E+01

Temperature of the soil (C) = .2000E+02

Flow rate of pumping/injection well(cfm)= .2025E+02

Soil porosity(Dimensionless) = .2500E+00

Peameability for R direction (cm**2) = .2381E-06

Peameability for Z direction (cm**2) = .2381E-06

Peameability Kc/Bc = .8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************ OUTPUT ********************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.9454	22.2472	.8041E+00
.157E+03	.517E+01	.500E+00	.9987	.5478	.3752E-02
.310E+03	.102E+02	.500E+00	.9999	.0549	.3294E-03
.462E+03	.152E+02	.500E+00	1.0000	.0076	.4203E-04
.615E+03	.202E+02	.500E+00	1.0000	.0012	.6309E-05
.767E+03	.252E+02	.500E+00	1.0000	.0002	.1037E-05
.919E+03	.302E+02	.500E+00	1.0000	.0000	.1801E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.3233E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.5928E-08
.138E+04	.452E+02	.500E+00	1.0000	.0000	.1102E-08
.153E+04	.502E+02	.500E+00	1.0000	.0000	.2070E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.3914E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.7439E-11
.199E+04	.652E+02	.500E+00	1.0000	.0000	.1420E-11
.214E+04	.702E+02	.500E+00	1.0000	.0000	.2719E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.5222E-13
.244E+04	.802E+02	.500E+00	1.0000	.0000	.1005E-13
.260E+04	.852E+02	.500E+00	1.0000	.0000	.1939E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.3748E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.7255E-16

----- Simulated Scenario ----- 5

Simulating information:

Depth to the top of screen (ft)	=	.5000E+00
Depth to the bottom of screen (ft)	=	.1500E+01
Depth to the groundwater table (ft)	=	.1000E+02
Depth to the simulated elevation(ft)	=	.5000E+00
Radius of the simulating well (in.)	=	.2000E+01
Temperature of the soil (C)	=	.2000E+02
Flow rate of pumping/injection well(cfm)	=	.2909E+02
Soil porosity(Dimensionless)	=	.2500E+00
Peameability for R direction (cm**2)	=	.2381E-06
Peameability for Z direction (cm**2)	=	.2381E-06
Peameability Kc/Bc	=	.8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************ OUTPUT ********************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)

.508E+01	.167E+00	.500E+00	.9205	32.3730	.1186E+01
.157E+03	.517E+01	.500E+00	.9981	.7872	.5393E-02
.310E+03	.102E+02	.500E+00	.9998	.0789	.4733E-03
.462E+03	.152E+02	.500E+00	1.0000	.0110	.6038E-04
.615E+03	.202E+02	.500E+00	1.0000	.0017	.9064E-05
.767E+03	.252E+02	.500E+00	1.0000	.0003	.1490E-05
.919E+03	.302E+02	.500E+00	1.0000	.0000	.2587E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.4644E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.8516E-08
.138E+04	.452E+02	.500E+00	1.0000	.0000	.1584E-08
.153E+04	.502E+02	.500E+00	1.0000	.0000	.2974E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.5622E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.1069E-10
.199E+04	.652E+02	.500E+00	1.0000	.0000	.2040E-11
.214E+04	.702E+02	.500E+00	1.0000	.0000	.3906E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.7501E-13
.244E+04	.802E+02	.500E+00	1.0000	.0000	.1444E-13
.260E+04	.852E+02	.500E+00	1.0000	.0000	.2786E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.5384E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.1042E-15

----- Simulated Scenario ----- 6

Simulating information:

Depth to the top of screen (ft)	=	.5000E+00
Depth to the bottom of screen (ft)	=	.1500E+01
Depth to the groundwater table (ft)	=	.1000E+02
Depth to the simulated elevation(ft)	=	.5000E+00
Radius of the simulating well (in.)	=	.2000E+01
Temperature of the soil (C)	=	.2000E+02
Flow rate of pumping/injection well(cfm)	=	.5165E+02
Soil porosity(Dimensionless)	=	.2500E+00
Peameability for R direction (cm**2)	=	.2381E-06
Peameability for Z direction (cm**2)	=	.2381E-06
Peameability Kc/Bc	=	.8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************ OUTPUT ********************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.8537	59.5489	.2271E+01
.157E+03	.517E+01	.500E+00	.9966	1.3987	.9590E-02
.310E+03	.102E+02	.500E+00	.9997	.1401	.8405E-03
.462E+03	.152E+02	.500E+00	1.0000	.0195	.1072E-03
.615E+03	.202E+02	.500E+00	1.0000	.0031	.1609E-04
.767E+03	.252E+02	.500E+00	1.0000	.0005	.2645E-05
.919E+03	.302E+02	.500E+00	1.0000	.0001	.4592E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.8245E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.1512E-07
.138E+04	.452E+02	.500E+00	1.0000	.0000	.2812E-08
.153E+04	.502E+02	.500E+00	1.0000	.0000	.5280E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.9983E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.1897E-10
.199E+04	.652E+02	.500E+00	1.0000	.0000	.3621E-11
.214E+04	.702E+02	.500E+00	1.0000	.0000	.6935E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.1332E-12
.244E+04	.802E+02	.500E+00	1.0000	.0000	.2564E-13
.260E+04	.852E+02	.500E+00	1.0000	.0000	.4946E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.9559E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.1850E-15

----- Simulated Scenario ----- 7

Simulating information:

Depth to the top of screen (ft)	=	.5000E+00
Depth to the bottom of screen (ft)	=	.1500E+01
Depth to the groundwater table (ft)	=	.1000E+02
Depth to the simulated elevation(ft)	=	.5000E+00
Radius of the simulating well (in.)	=	.2000E+01
Temperature of the soil (C)	=	.2000E+02
Flow rate of pumping/injection well(cfm)	=	.4108E+02
Soil porosity(Dimensionless)	=	.2500E+00
Peameability for R direction (cm**2)	=	.2381E-06
Peameability for Z direction (cm**2)	=	.2381E-06
Peameability Kc/Bc	=	.8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************ OUTPUT ******************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.8856	46.5611	.1741E+01
.157E+03	.517E+01	.500E+00	.9973	1.1120	.7622E-02
.310E+03	.102E+02	.500E+00	.9997	.1114	.6684E-03

.462E+03	.152E+02	.500E+00	1.0000	.0155	.8527E-04
.615E+03	.202E+02	.500E+00	1.0000	.0025	.1280E-04
.767E+03	.252E+02	.500E+00	1.0000	.0004	.2104E-05
.919E+03	.302E+02	.500E+00	1.0000	.0001	.3653E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.6558E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.1203E-07
.138E+04	.452E+02	.500E+00	1.0000	.0000	.2237E-08
.153E+04	.502E+02	.500E+00	1.0000	.0000	.4199E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.7940E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.1509E-10
.199E+04	.652E+02	.500E+00	1.0000	.0000	.2880E-11
.214E+04	.702E+02	.500E+00	1.0000	.0000	.5516E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.1059E-12
.244E+04	.802E+02	.500E+00	1.0000	.0000	.2039E-13
.260E+04	.852E+02	.500E+00	1.0000	.0000	.3934E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.7603E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.1472E-15

----- Simulated Scenario ----- 8

Simulating information:

Depth to the top of screen (ft) = .5000E+00

Depth to the bottom of screen (ft) = .1500E+01

Depth to the groundwater table (ft) = .1000E+02

Depth to the simulated elevation(ft) = .5000E+00

Radius of the simulating well (in.) = .2000E+01

Temperature of the soil (C) = .2000E+02

Flow rate of pumping/injection well(cfm)= .2606E+02

Soil porosity(Dimensionless) = .2500E+00

Peameability for R direction (cm**2) = .2381E-06

Peameability for Z direction (cm**2) = .2381E-06

Peameability Kc/Bc = .8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

*********************** OUTPUT *******************************

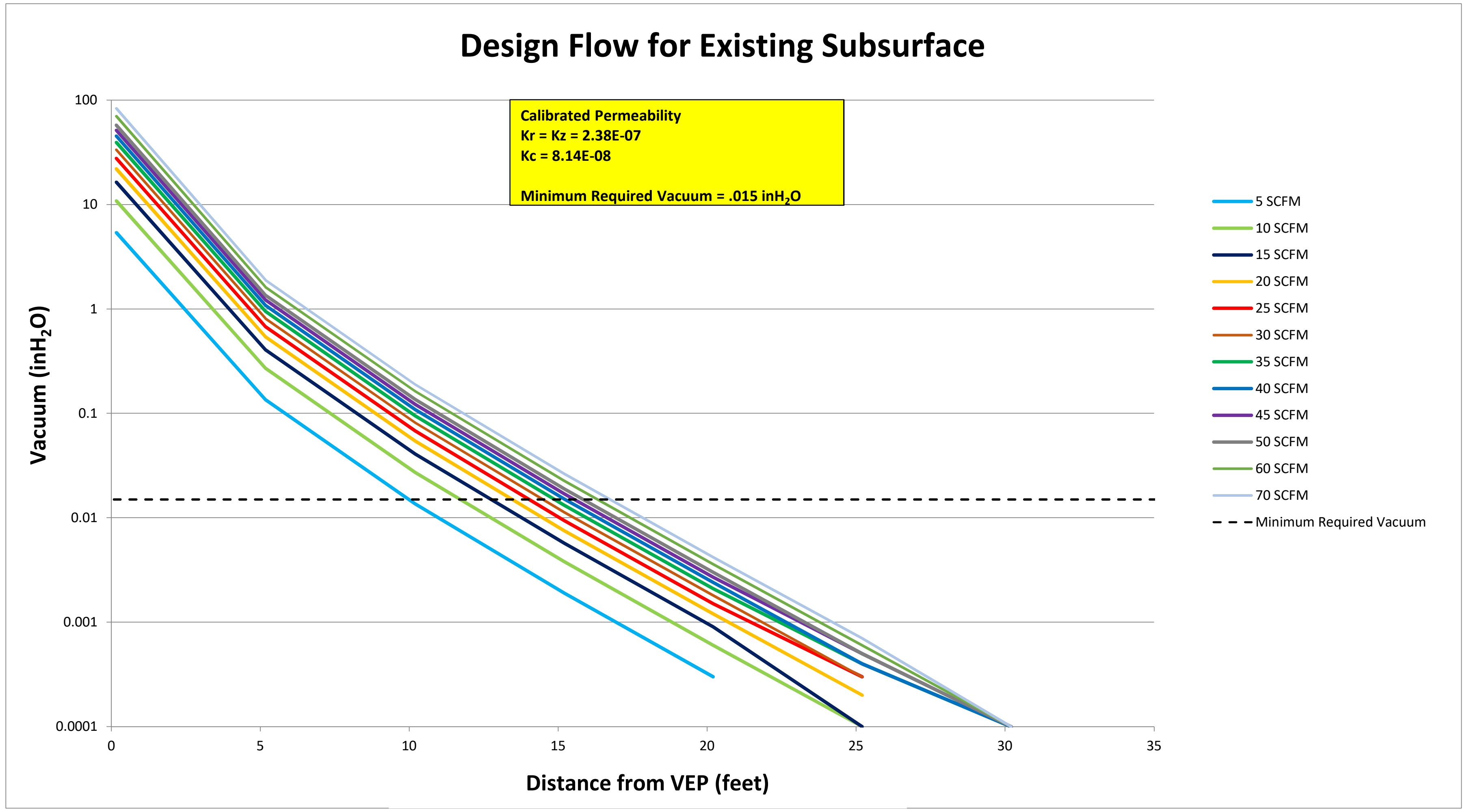
RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.9291	28.8717	.1053E+01
.157E+03	.517E+01	.500E+00	.9983	.7051	.4830E-02
.310E+03	.102E+02	.500E+00	.9998	.0707	.4240E-03
.462E+03	.152E+02	.500E+00	1.0000	.0099	.5409E-04
.615E+03	.202E+02	.500E+00	1.0000	.0016	.8120E-05
.767E+03	.252E+02	.500E+00	1.0000	.0003	.1335E-05
.919E+03	.302E+02	.500E+00	1.0000	.0000	.2317E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.4160E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.7629E-08
.138E+04	.452E+02	.500E+00	1.0000	.0000	.1419E-08
.153E+04	.502E+02	.500E+00	1.0000	.0000	.2664E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.5037E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.9573E-11
.199E+04	.652E+02	.500E+00	1.0000	.0000	.1827E-11
.214E+04	.702E+02	.500E+00	1.0000	.0000	.3499E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.6720E-13
.244E+04	.802E+02	.500E+00	1.0000	.0000	.1294E-13
.260E+04	.852E+02	.500E+00	1.0000	.0000	.2496E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.4823E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.9336E-16

---------- Simulation finished ----------

<u>**MDFIT Modeling Simulation Results**</u>

Step 3: Design Subsurface Vacuum Propagation
Model Runs

(Select model simulation results are provided herein. A complete set of model runs can be provided upon request)



Parameters		
Depth to the top of screen (ft)	=	5.00E-01
Depth to the bottom of screen (ft)	=	1.50E+00
Depth to the groundwater table (ft)	=	1.00E+01
Depth to the simulated elevation(ft)	=	5.00E-01
Radius of the simulating well (in.)	=	2.00E+00
Temperature of the soil (C)	=	2.00E+01
Flow rate of pumping/injection well(cfm)	=	Variable
Soil porosity(Dimensionless)	=	2.50E-01
Permeability for R direction (cm**2)	=	2.38E-07
Permeability for Z direction (cm**2)	=	2.38E-07
Permeability Kc/Bc	=	8.14E-09

MDFIT Modeling Simulation Results
Step 3: Design Subsurface Vacuum Propagation
Rossville Shopping Center
Staten Island, New York
Langan Project No.: 100849501

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESSURE (atm)	PRESSURE (inH$_2$O)	VELOCITY (ft/s)	Pore Volume Exchanges (per year)	RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESSURE (atm)	PRESSURE (inH$_2$O)	VELOCITY (ft/s)	Pore Volume Exchanges (per year)
5 SCFM							35 SCFM						
5.08E+00	1.67E-01	5.00E-01	0.9868	5.3786	1.90E-01	0.00E+00	5.08E+00	1.67E-01	5.00E-01	0.9035	39.298	1.45E+00	0.00E+00
1.57E+02	5.17E+00	5.00E-01	0.9997	0.1352	9.26E-04	5.83E+05	1.57E+02	5.17E+00	5.00E-01	0.9977	0.9473	6.49E-03	4.46E+06
3.10E+02	1.02E+01	5.00E-01	1	0.0136	8.13E-05	1.56E+03	3.10E+02	1.02E+01	5.00E-01	0.9998	0.0949	5.70E-04	1.10E+04
4.62E+02	1.52E+01	5.00E-01	1	0.0019	1.04E-05	9.54E+01	4.62E+02	1.52E+01	5.00E-01	1	0.0132	7.27E-05	6.68E+02
6.15E+02	2.02E+01	5.00E-01	1	0.0003	1.56E-06	9.33E+00	6.15E+02	2.02E+01	5.00E-01	1	0.0021	1.09E-05	6.53E+01
7.67E+02	2.52E+01	5.00E-01	1	0	2.56E-07	1.14E+00	7.67E+02	2.52E+01	5.00E-01	1	0.0004	1.79E-06	7.96E+00
9.19E+02	3.02E+01	5.00E-01	1	0	4.45E-08	1.60E-01	9.19E+02	3.02E+01	5.00E-01	1	0.0001	3.11E-07	1.10E+00
1.07E+03	3.52E+01	5.00E-01	1	0	7.98E-09	2.00E-02	1.07E+03	3.52E+01	5.00E-01	1	0	5.59E-08	1.60E-01
1.22E+03	4.02E+01	5.00E-01	1	0	1.46E-09	0.00E+00	1.22E+03	4.02E+01	5.00E-01	1	0	1.03E-08	3.00E-02
1.38E+03	4.52E+01	5.00E-01	1	0	2.72E-10	0.00E+00	1.38E+03	4.52E+01	5.00E-01	1	0	1.91E-09	0.00E+00
1.53E+03	5.02E+01	5.00E-01	1	0	5.11E-11	0.00E+00	1.53E+03	5.02E+01	5.00E-01	1	0	3.58E-10	0.00E+00
1.68E+03	5.52E+01	5.00E-01	1	0	9.66E-12	0.00E+00	1.68E+03	5.52E+01	5.00E-01	1	0	6.77E-11	0.00E+00
1.83E+03	6.02E+01	5.00E-01	1	0	1.84E-12	0.00E+00	1.83E+03	6.02E+01	5.00E-01	1	0	1.29E-11	0.00E+00
1.99E+03	6.52E+01	5.00E-01	1	0	3.51E-13	0.00E+00	1.99E+03	6.52E+01	5.00E-01	1	0	2.45E-12	0.00E+00
2.14E+03	7.02E+01	5.00E-01	1	0	6.71E-14	0.00E+00	2.14E+03	7.02E+01	5.00E-01	1	0	4.70E-13	0.00E+00
2.29E+03	7.52E+01	5.00E-01	1	0	1.29E-14	0.00E+00	2.29E+03	7.52E+01	5.00E-01	1	0	9.03E-14	0.00E+00
2.44E+03	8.02E+01	5.00E-01	1	0	2.48E-15	0.00E+00	2.44E+03	8.02E+01	5.00E-01	1	0	1.74E-14	0.00E+00
2.60E+03	8.52E+01	5.00E-01	1	0	4.79E-16	0.00E+00	2.60E+03	8.52E+01	5.00E-01	1	0	3.35E-15	0.00E+00
2.75E+03	9.02E+01	5.00E-01	1	0	9.25E-17	0.00E+00	2.75E+03	9.02E+01	5.00E-01	1	0	6.48E-16	0.00E+00
2.90E+03	9.52E+01	5.00E-01	1	0	1.79E-17	0.00E+00	2.90E+03	9.52E+01	5.00E-01	1	0	1.25E-16	0.00E+00
10 SCFM							40 SCFM						
5.08E+00	1.67E-01	5.00E-01	0.9734	10.8301	3.86E-01	0.00E+00	5.08E+00	1.67E-01	5.00E-01	0.8888	45.2603	1.69E+00	0.00E+00
1.57E+02	5.17E+00	5.00E-01	0.9993	0.2704	1.85E-03	1.18E+06	1.57E+02	5.17E+00	5.00E-01	0.9973	1.0828	7.42E-03	5.18E+06
3.10E+02	1.02E+01	5.00E-01	0.9999	0.0271	1.63E-04	3.12E+03	3.10E+02	1.02E+01	5.00E-01	0.9997	0.1085	6.51E-04	1.25E+04
4.62E+02	1.52E+01	5.00E-01	1	0.0038	2.08E-05	1.91E+02	4.62E+02	1.52E+01	5.00E-01	1	0.0151	8.30E-05	7.63E+02
6.15E+02	2.02E+01	5.00E-01	1	0.0006	3.12E-06	1.87E+01	6.15E+02	2.02E+01	5.00E-01	1	0.0024	1.25E-05	7.47E+01
7.67E+02	2.52E+01	5.00E-01	1	0.0001	5.12E-07	2.27E+00	7.67E+02	2.52E+01	5.00E-01	1	0.0004	2.05E-06	9.09E+00
9.19E+02	3.02E+01	5.00E-01	1	0	8.89E-08	3.10E-01	9.19E+02	3.02E+01	5.00E-01	1	0.0001	3.56E-07	1.26E+00
1.07E+03	3.52E+01	5.00E-01	1	0	1.60E-08	5.00E-02	1.07E+03	3.52E+01	5.00E-01	1	0	6.39E-08	1.90E-01
1.22E+03	4.02E+01	5.00E-01	1	0	2.93E-09	1.00E-02	1.22E+03	4.02E+01	5.00E-01	1	0	1.17E-08	3.00E-02
1.38E+03	4.52E+01	5.00E-01	1	0	5.44E-10	0.00E+00	1.38E+03	4.52E+01	5.00E-01	1	0	2.18E-09	0.00E+00
1.53E+03	5.02E+01	5.00E-01	1	0	1.02E-10	0.00E+00	1.53E+03	5.02E+01	5.00E-01	1	0	4.09E-10	0.00E+00
1.68E+03	5.52E+01	5.00E-01	1	0	1.93E-11	0.00E+00	1.68E+03	5.52E+01	5.00E-01	1	0	7.73E-11	0.00E+00
1.83E+03	6.02E+01	5.00E-01	1	0	3.67E-12	0.00E+00	1.83E+03	6.02E+01	5.00E-01	1	0	1.47E-11	0.00E+00
1.99E+03	6.52E+01	5.00E-01	1	0	7.01E-13	0.00E+00	1.99E+03	6.52E+01	5.00E-01	1	0	2.81E-12	0.00E+00
2.14E+03	7.02E+01	5.00E-01	1	0	1.34E-13	0.00E+00	2.14E+03	7.02E+01	5.00E-01	1	0	5.37E-13	0.00E+00
2.29E+03	7.52E+01	5.00E-01	1	0	2.58E-14	0.00E+00	2.29E+03	7.52E+01	5.00E-01	1	0	1.03E-13	0.00E+00
2.44E+03	8.02E+01	5.00E-01	1	0	4.96E-15	0.00E+00	2.44E+03	8.02E+01	5.00E-01	1	0	1.99E-14	0.00E+00
2.60E+03	8.52E+01	5.00E-01	1	0	9.58E-16	0.00E+00	2.60E+03	8.52E+01	5.00E-01	1	0	3.83E-15	0.00E+00
2.75E+03	9.02E+01	5.00E-01	1	0	1.85E-16	0.00E+00	2.75E+03	9.02E+01	5.00E-01	1	0	7.40E-16	0.00E+00
2.90E+03	9.52E+01	5.00E-01	1	0	3.58E-17	0.00E+00	2.90E+03	9.52E+01	5.00E-01	1	0	1.43E-16	0.00E+00
15 SCFM							45 SCFM						
5.08E+00	1.67E-01	5.00E-01	0.9598	16.3578	5.87E-01	0.00E+00	5.08E+00	1.67E-01	5.00E-01	0.8739	51.3225	1.93E+00	0.00E+00
1.57E+02	5.17E+00	5.00E-01	0.999	0.4057	2.78E-03	1.80E+06	1.57E+02	5.17E+00	5.00E-01	0.997	1.2183	8.35E-03	5.92E+06
3.10E+02	1.02E+01	5.00E-01	0.9999	0.0407	2.44E-04	4.69E+03	3.10E+02	1.02E+01	5.00E-01	0.9997	0.1221	7.32E-04	1.41E+04
4.62E+02	1.52E+01	5.00E-01	1	0.0057	3.11E-05	2.86E+02	4.62E+02	1.52E+01	5.00E-01	1	0.017	9.34E-05	8.58E+02
6.15E+02	2.02E+01	5.00E-01	1	0.0009	4.67E-06	2.80E+01	6.15E+02	2.02E+01	5.00E-01	1	0.0027	1.40E-05	8.40E+01
7.67E+02	2.52E+01	5.00E-01	1	0.0001	7.68E-07	3.41E+00	7.67E+02	2.52E+01	5.00E-01	1	0.0005	2.31E-06	1.02E+01
9.19E+02	3.02E+01	5.00E-01	1	0	1.33E-07	4.70E-01	9.19E+02	3.02E+01	5.00E-01	1	0.0001	4.00E-07	1.41E+00
1.07E+03	3.52E+01	5.00E-01	1	0	2.40E-08	7.00E-02	1.07E+03	3.52E+01	5.00E-01	1	0	7.18E-08	2.10E-01
1.22E+03	4.02E+01	5.00E-01	1	0	4.39E-09	1.00E-02	1.22E+03	4.02E+01	5.00E-01	1	0	1.32E-08	3.00E-02
1.38E+03	4.52E+01	5.00E-01	1	0	8.17E-10	0.00E+00	1.38E+03	4.52E+01	5.00E-01	1	0	2.45E-09	1.00E-02
1.53E+03	5.02E+01	5.00E-01	1	0	1.53E-10	0.00E+00	1.53E+03	5.02E+01	5.00E-01	1	0	4.60E-10	0.00E+00
1.68E+03	5.52E+01	5.00E-01	1	0	2.90E-11	0.00E+00	1.68E+03	5.52E+01	5.00E-01	1	0	8.70E-11	0.00E+00
1.83E+03	6.02E+01	5.00E-01	1	0	5.51E-12	0.00E+00	1.83E+03	6.02E+01	5.00E-01	1	0	1.65E-11	0.00E+00
1.99E+03	6.52E+01	5.00E-01	1	0	1.05E-12	0.00E+00	1.99E+03	6.52E+01	5.00E-01	1	0	3.16E-12	0.00E+00
2.14E+03	7.02E+01	5.00E-01	1	0	2.01E-13	0.00E+00	2.14E+03	7.02E+01	5.00E-01	1	0	6.04E-13	0.00E+00
2.29E+03	7.52E+01	5.00E-01	1	0	3.87E-14	0.00E+00	2.29E+03	7.52E+01	5.00E-01	1	0	1.16E-13	0.00E+00
2.44E+03	8.02E+01	5.00E-01	1	0	7.45E-15	0.00E+00	2.44E+03	8.02E+01	5.00E-01	1	0	2.23E-14	0.00E+00
2.60E+03	8.52E+01	5.00E-01	1	0	1.44E-15	0.00E+00	2.60E+03	8.52E+01	5.00E-01	1	0	4.31E-15	0.00E+00
2.75E+03	9.02E+01	5.00E-01	1	0	2.78E-16	0.00E+00	2.75E+03	9.02E+01	5.00E-01	1	0	8.33E-16	0.00E+00
2.90E+03	9.52E+01	5.00E-01	1	0	5.37E-17	0.00E+00	2.90E+03	9.52E+01	5.00E-01	1	0	1.61E-16	0.00E+00
20 SCFM							50 SCFM						
5.08E+00	1.67E-01	5.00E-01	0.946	21.9647	7.94E-01	0.00E+00	5.08E+00	1.67E-01	5.00E-01	0.8588	57.4897	2.19E+00	0.00E+00
1.57E+02	5.17E+00	5.00E-01	0.9987	0.541	3.71E-03	2.43E+06	1.57E+02	5.17E+00	5.00E-01	0.9967	1.3539	9.28E-03	6.70E+06
3.10E+02	1.02E+01	5.00E-01	0.9999	0.0543	3.25E-04	6.25E+03	3.10E+02	1.02E+01	5.00E-01	0.9997	0.1357	8.14E-04	1.57E+04
4.62E+02	1.52E+01	5.00E-01	1	0.0075	4.15E-05	3.81E+02	4.62E+02	1.52E+01	5.00E-01	1	0.0189	1.04E-04	9.54E+02
6.15E+02	2.02E+01	5.00E-01	1	0.0012	6.23E-06	3.73E+01	6.15E+02	2.02E+01	5.00E-01	1	0.003	1.56E-05	9.33E+01
7.67E+02	2.52E+01	5.00E-01	1	0.0002	1.02E-06	4.55E+00	7.67E+02	2.52E+01	5.00E-01	1	0.0005	2.56E-06	1.14E+01
9.19E+02	3.02E+01	5.00E-01	1	0	1.78E-07	6.30E-01	9.19E+02	3.02E+01	5.00E-01	1	0.0001	4.45E-07	1.57E+00
1.07E+03	3.52E+01	5.00E-01	1	0	3.19E-08	9.00E-02	1.07E+03	3.52E+01	5.00E-01	1	0	7.98E-08	2.40E-01
1.22E+03	4.02E+01	5.00E-01	1	0	5.86E-09	1.00E-02	1.22E+03	4.02E+01	5.00E-01	1	0	1.46E-08	4.00E-02
1.38E+03	4.52E+01	5.00E-01	1	0	1.09E-09	0.00E+00	1.38E+03	4.52E+01	5.00E-01	1	0	2.72E-09	1.00E-02
1.53E+03	5.02E+01	5.00E-01	1	0	2.05E-10	0.00E+00	1.53E+03	5.02E+01	5.00E-01	1	0	5.11E-10	0.00E+00
1.68E+03	5.52E+01	5.00E-01	1	0	3.87E-11	0.00E+00	1.68E+03	5.52E+01	5.00E-01	1	0	9.66E-11	0.00E+00
1.83E+03	6.02E+01	5.00E-01	1	0	7.35E-12	0.00E+00	1.83E+03	6.02E+01	5.00E-01	1	0	1.84E-11	0.00E+00
1.99E+03	6.52E+01	5.00E-01	1	0	1.40E-12	0.00E+00	1.99E+03	6.52E+01	5.00E-01	1	0	3.51E-12	0.00E+00
2.14E+03	7.02E+01	5.00E-01	1	0	2.69E-13	0.00E+00	2.14E+03	7.02E+01	5.00E-01	1	0	6.71E-13	0.00E+00
2.29E+03	7.52E+01	5.00E-01	1	0	5.16E-14	0.00E+00	2.29E+03	7.52E+01	5.00E-01	1	0	1.29E-13	0.00E+00
2.44E+03	8.02E+01	5.00E-01	1	0	9.93E-15	0.00E+00	2.44E+03	8.02E+01	5.00E-01	1	0	2.48E-14	0.00E+00
2.60E+03	8.52E+01	5.00E-01	1	0	1.92E-15	0.00E+00	2.60E+03	8.52E+01	5.00E-01	1	0	4.79E-15	0.00E+00
2.75E+03	9.02E+01	5.00E-01	1	0	3.70E-16	0.00E+00	2.75E+03	9.02E+01	5.00E-01	1	0	9.25E-16	0.00E+00
2.90E+03	9.52E+01	5.00E-01	1	0	7.17E-17	0.00E+00	2.90E+03	9.52E+01	5.00E-01	1	0	1.79E-16	0.00E+00
25 SCFM							60 SCFM						
5.08E+00	1.67E-01	5.00E-01	0.9321	27.6545	1.01E+00	0.00E+00	5.08E+00	1.67E-01	5.00E-01	0.8277	70.1627	2.72E+00	0.00E+00
1.57E+02	5.17E+00	5.00E-01	0.9983	0.6764	4.63E-03	3.09E+06	1.57E+02	5.17E+00	5.00E-01	0.996	1.6252	1.12E-02	8.34E+06
3.10E+02	1.02E+01	5.00E-01	0.9998	0.0678	4.07E-04	7.82E+03	3.10E+02	1.02E+01	5.00E-01	0.9996	0.1628	9.76E-04	1.88E+04
4.62E+02	1.52E+01	5.00E-01	1	0.0094	5.19E-05	4.77E+02	4.62E+02	1.52E+01	5.00E-01	0.9999	0.0226	1.25E-04	1.14E+03
6.15E+02	2.02E+01	5.00E-01	1	0.0015	7.79E-06	4.67E+01	6.15E+02	2.02E+01	5.00E-01	1	0.0036	1.87E-05	1.12E+02
7.67E+02	2.52E+01	5.00E-01	1	0.0003	1.28E-06	5.68E+00	7.67E+02	2.52E+01	5.00E-01	1	0.0006	3.07E-06	1.36E+01
9.19E+02	3.02E+01	5.00E-01	1	0	2.22E-07	7.90E-01	9.19E+02	3.02E+01	5.00E-01	1	0.0001	5.34E-07	1.89E+00
1.07E+03	3.52E+01	5.00E-01	1	0	3.99E-08	1.20E-01	1.07E+03	3.52E+01	5.00E-01	1	0	9.58E-08	2.80E-01
1.22E+03	4.02E+01	5.00E-01	1	0	7.32E-09	2.00E-02	1.22E+03	4.02E+01	5.00E-01	1	0	1.76E-08	4.00E-02
1.38E+03	4.52E+01	5.00E-01	1	0	1.36E-09	0.00E+00	1.38E+03	4.52E+01	5.00E-01	1	0	3.27E-09	1.00E-02
1.53E+03	5.02E+01	5.00E-01	1	0	2.56E-10	0.00E+00	1.53E+03	5.02E+01	5.00E-01	1	0	6.13E-10	0.00E+00
1.68E+03	5.52E+01	5.00E-01	1	0	4.83E-11	0.00E+00	1.68E+03	5.52E+01	5.00E-01	1	0	1.16E-10	0.00E+00
1.83E+03	6.02E+01	5.00E-01	1	0	9.18E-12	0.00E+00	1.83E+03	6.02E+01	5.00E-01	1	0	2.20E-11	0.00E+00
1.99E+03	6.52E+01	5.00E-01	1	0	1.75E-12	0.00E+00	1.99E+03	6.52E+01	5.00E-01	1	0	4.21E-12	0.00E+00
2.14E+03	7.02E+01	5.00E-01	1	0	3.36E-13	0.00E+00	2.14E+03	7.02E+01	5.00E-01	1	0	8.06E-13	0.00E+00
2.29E+03	7.52E+01	5.00E-01	1	0	6.45E-14	0.00E+00	2.29E+03	7.52E+01	5.00E-01	1	0	1.55E-13	0.00E+00
2.44E+03	8.02E+01	5.00E-01	1	0	1.24E-14	0.00E+00	2.44E+03	8.02E+01	5.00E-01	1	0	2.98E-14	0.00E+00
2.60E+03	8.52E+01	5.00E-01	1	0	2.39E-15	0.00E+00	2.60E+03	8.52E+01	5.00E-01	1	0	5.75E-15	0.00E+00
2.75E+03	9.02E+01	5.00E-01	1	0	4.63E-16	0.00E+00	2.75E+03	9.02E+01	5.00E-01	1	0	1.11E-15	0.00E+00
2.90E+03	9.52E+01	5.00E-01	1	0	8.96E-17	0.00E+00	2.90E+03	9.52E+01	5.00E-01	1	0	2.15E-16	0.00E+00
30 SCFM							70 SCFM						
5.08E+00	1.67E-01	5.00E-01	0.9179	33.4309	1.23E+00	0.00E+00	5.08E+00	1.67E-01	5.00E-01	0.7953	83.3314	3.30E+00	0.00E+00
1.57E+02	5.17E+00	5.00E-01	0.998	0.8118	5.56E-03	3.76E+06	1.57E+02	5.17E+00	5.00E-01	0.9953	1.8967	1.30E-02	1.01E+07
3.10E+02	1.02E+01	5.00E-01	0.9998	0.0814	4.88E-04	9.38E+03	3.10E+02	1.02E+01	5.00E-01	0.9995	0.1899	1.14E-03	2.19E+04
4.62E+02	1.52E+01	5.00E-01	1	0.0113	6.23E-05	5.72E+02	4.62E+02	1.52E+01	5.00E-01	0.9999	0.0264	1.45E-04	1.34E+03
6.15E+02	2.02E+01	5.00E-01	1	0.0018	9.35E-06	5.60E+01	6.15E+02	2.02E+01	5.00E-01	1	0.0042	2.18E-05	1.31E+02
7.67E+02	2.52E+01	5.00E-01	1	0.0003	1.54E-06	6.82E+00	7.67E+02	2.52E+01	5.00E-01	1	0.0007	3.59E-06	1.59E+01
9.19E+02	3.02E+01	5.00E-01	1	0	2.67E-07	9.40E-01	9.19E+02	3.02E+01	5.00E-01	1	0.0001	6.22E-07	2.20E+00
1.07E+03	3.52E+01	5.00E-01	1	0	4.79E-08	1.40E-01	1.07E+03	3.52E+01	5.00E-01	1	0	1.12E-07	3.30E-01
1.22E+03	4.02E+01	5.00E-01	1	0	8.78E-09	2.00E-02	1.22E+03	4.02E+01	5.00E-01	1	0	2.05E-08	5.00E-02
1.38E+03	4.52E+01	5.00E-01	1	0	1.63E-09	0.00E+00	1.38E+03	4.52E+01	5.00E-01	1	0	3.81E-09	1.00E-02
1.53E+03	5.02E+01	5.00E-01	1	0	3.07E-10	0.00E+00	1.53E+03	5.02E+01	5.00E-01	1	0	7.16E-10	0.00E+00
1.68E+03	5.52E+01	5.00E-01	1	0	5.80E-11	0.00E+00	1.68E+03	5.52E+01	5.00E-01	1	0	1.35E-10	0.00E+00
1.83E+03	6.02E+01	5.00E-01	1	0	1.10E-11	0.00E+00	1.83E+03	6.02E+01	5.00E-01	1	0	2.57E-11	0.00E+00
1.99E+03	6.52E+01	5.00E-01	1	0	2.10E-12	0.00E+00	1.99E+03	6.52E+01	5.00E-01	1	0	4.91E-12	0.00E+00
2.14E+03	7.02E+01	5.00E-01	1	0	4.03E-13	0.00E+00	2.14E+03	7.02E+01	5.00E-01	1	0	9.40E-13	0.00E+00
2.29E+03	7.52E+01	5.00E-01	1	0	7.74E-14	0.00E+00	2.29E+03	7.52E+01	5.00E-01	1	0	1.81E-13	0.00E+00
2.44E+03	8.02E+01	5.00E-01	1	0	1.49E-14	0.00E+00	2.44E+03	8.02E+01	5.00E-01	1	0	3.48E-14	0.00E+00
2.60E+03	8.52E+01	5.00E-01	1	0	2.87E-15	0.00E+00	2.60E+03	8.52E+01	5.00E-01	1	0	6.70E-15	0.00E+00
2.75E+03	9.02E+01	5.00E-01	1	0	5.55E-16	0.00E+00	2.75E+03	9.02E+01	5.00E-01	1	0	1.30E-15	0.00E+00
2.90E+03	9.52E+01	5.00E-01	1	0	1.08E-16	0.00E+00	2.90E+03	9.52E+01	5.00E-01	1	0	2.51E-16	0.00E+00

Design

----- Simulated Scenario ----- 1

Simulating information:

Depth to the top of screen (ft)	=	.5000E+00
Depth to the bottom of screen (ft)	=	.1500E+01
Depth to the groundwater table (ft)	=	.1000E+02
Depth to the simulated elevation(ft)	=	.5000E+00
Radius of the simulating well (in.)	=	.2000E+01
Temperature of the soil (C)	=	.2000E+02
Flow rate of pumping/injection well(cfm)	=	.5000E+01
Soil porosity(Dimensionless)	=	.2500E+00
Peameability for R direction (cm**2)	=	.2381E-06
Peameability for Z direction (cm**2)	=	.2381E-06
Peameability Kc/Bc	=	.8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************ OUTPUT ********************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.9868	5.3786	.1902E+00
.157E+03	.517E+01	.500E+00	.9997	.1352	.9255E-03
.310E+03	.102E+02	.500E+00	1.0000	.0136	.8134E-04
.462E+03	.152E+02	.500E+00	1.0000	.0019	.1038E-04
.615E+03	.202E+02	.500E+00	1.0000	.0003	.1558E-05
.767E+03	.252E+02	.500E+00	1.0000	.0000	.2561E-06
.919E+03	.302E+02	.500E+00	1.0000	.0000	.4446E-07
.107E+04	.352E+02	.500E+00	1.0000	.0000	.7982E-08
.122E+04	.402E+02	.500E+00	1.0000	.0000	.1464E-08
.138E+04	.452E+02	.500E+00	1.0000	.0000	.2722E-09
.153E+04	.502E+02	.500E+00	1.0000	.0000	.5111E-10
.168E+04	.552E+02	.500E+00	1.0000	.0000	.9664E-11
.183E+04	.602E+02	.500E+00	1.0000	.0000	.1837E-11
.199E+04	.652E+02	.500E+00	1.0000	.0000	.3506E-12
.214E+04	.702E+02	.500E+00	1.0000	.0000	.6713E-13
.229E+04	.752E+02	.500E+00	1.0000	.0000	.1289E-13
.244E+04	.802E+02	.500E+00	1.0000	.0000	.2482E-14
.260E+04	.852E+02	.500E+00	1.0000	.0000	.4788E-15
.275E+04	.902E+02	.500E+00	1.0000	.0000	.9254E-16
.290E+04	.952E+02	.500E+00	1.0000	.0000	.1791E-16

----- Simulated Scenario ----- 2

Simulating information:

Depth to the top of screen (ft) = .5000E+00

Depth to the bottom of screen (ft) = .1500E+01

Depth to the groundwater table (ft) = .1000E+02

Depth to the simulated elevation(ft) = .5000E+00

Radius of the simulating well (in.) = .2000E+01

Temperature of the soil (C) = .2000E+02

Flow rate of pumping/injection well(cfm)= .1000E+02

Soil porosity(Dimensionless) = .2500E+00

Peameability for R direction (cm**2) = .2381E-06

Peameability for Z direction (cm**2) = .2381E-06

Peameability Kc/Bc = .8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************ OUTPUT ********************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.9734	10.8301	.3856E+00
.157E+03	.517E+01	.500E+00	.9993	.2704	.1852E-02
.310E+03	.102E+02	.500E+00	.9999	.0271	.1627E-03
.462E+03	.152E+02	.500E+00	1.0000	.0038	.2076E-04
.615E+03	.202E+02	.500E+00	1.0000	.0006	.3116E-05
.767E+03	.252E+02	.500E+00	1.0000	.0001	.5122E-06
.919E+03	.302E+02	.500E+00	1.0000	.0000	.8892E-07
.107E+04	.352E+02	.500E+00	1.0000	.0000	.1596E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.2928E-08
.138E+04	.452E+02	.500E+00	1.0000	.0000	.5444E-09
.153E+04	.502E+02	.500E+00	1.0000	.0000	.1022E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.1933E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.3674E-11
.199E+04	.652E+02	.500E+00	1.0000	.0000	.7011E-12
.214E+04	.702E+02	.500E+00	1.0000	.0000	.1343E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.2579E-13
.244E+04	.802E+02	.500E+00	1.0000	.0000	.4964E-14
.260E+04	.852E+02	.500E+00	1.0000	.0000	.9576E-15
.275E+04	.902E+02	.500E+00	1.0000	.0000	.1851E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.3583E-16

----- Simulated Scenario ----- 3

Simulating information:

Depth to the top of screen (ft)	=	.5000E+00
Depth to the bottom of screen (ft)	=	.1500E+01
Depth to the groundwater table (ft)	=	.1000E+02
Depth to the simulated elevation(ft)	=	.5000E+00
Radius of the simulating well (in.)	=	.2000E+01
Temperature of the soil (C)	=	.2000E+02
Flow rate of pumping/injection well(cfm)	=	.1500E+02
Soil porosity(Dimensionless)	=	.2500E+00
Peameability for R direction (cm**2)	=	.2381E-06
Peameability for Z direction (cm**2)	=	.2381E-06
Peameability Kc/Bc	=	.8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************ OUTPUT ********************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.9598	16.3578	.5866E+00
.157E+03	.517E+01	.500E+00	.9990	.4057	.2778E-02
.310E+03	.102E+02	.500E+00	.9999	.0407	.2440E-03
.462E+03	.152E+02	.500E+00	1.0000	.0057	.3114E-04
.615E+03	.202E+02	.500E+00	1.0000	.0009	.4674E-05
.767E+03	.252E+02	.500E+00	1.0000	.0001	.7683E-06
.919E+03	.302E+02	.500E+00	1.0000	.0000	.1334E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.2395E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.4391E-08
.138E+04	.452E+02	.500E+00	1.0000	.0000	.8167E-09
.153E+04	.502E+02	.500E+00	1.0000	.0000	.1533E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.2899E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.5510E-11
.199E+04	.652E+02	.500E+00	1.0000	.0000	.1052E-11
.214E+04	.702E+02	.500E+00	1.0000	.0000	.2014E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.3868E-13
.244E+04	.802E+02	.500E+00	1.0000	.0000	.7446E-14
.260E+04	.852E+02	.500E+00	1.0000	.0000	.1436E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.2776E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.5374E-16

----- Simulated Scenario ----- 4

Simulating information:

Depth to the top of screen (ft)	=	.5000E+00
Depth to the bottom of screen (ft)	=	.1500E+01
Depth to the groundwater table (ft)	=	.1000E+02
Depth to the simulated elevation(ft)	=	.5000E+00
Radius of the simulating well (in.)	=	.2000E+01
Temperature of the soil (C)	=	.2000E+02
Flow rate of pumping/injection well(cfm)	=	.2000E+02
Soil porosity(Dimensionless)	=	.2500E+00
Peameability for R direction (cm**2)	=	.2381E-06

Peameability for Z direction (cm**2) = .2381E-06

Peameability Kc/Bc = .8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************ OUTPUT ********************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.9460	21.9647	.7936E+00
.157E+03	.517E+01	.500E+00	.9987	.5410	.3706E-02
.310E+03	.102E+02	.500E+00	.9999	.0543	.3254E-03
.462E+03	.152E+02	.500E+00	1.0000	.0075	.4151E-04
.615E+03	.202E+02	.500E+00	1.0000	.0012	.6232E-05
.767E+03	.252E+02	.500E+00	1.0000	.0002	.1024E-05
.919E+03	.302E+02	.500E+00	1.0000	.0000	.1778E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.3193E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.5855E-08
.138E+04	.452E+02	.500E+00	1.0000	.0000	.1089E-08
.153E+04	.502E+02	.500E+00	1.0000	.0000	.2045E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.3866E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.7347E-11
.199E+04	.652E+02	.500E+00	1.0000	.0000	.1402E-11
.214E+04	.702E+02	.500E+00	1.0000	.0000	.2685E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.5157E-13
.244E+04	.802E+02	.500E+00	1.0000	.0000	.9928E-14
.260E+04	.852E+02	.500E+00	1.0000	.0000	.1915E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.3701E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.7165E-16

----- Simulated Scenario ----- 5

Simulating information:

Depth to the top of screen (ft)	=	.5000E+00
Depth to the bottom of screen (ft)	=	.1500E+01
Depth to the groundwater table (ft)	=	.1000E+02
Depth to the simulated elevation(ft)	=	.5000E+00
Radius of the simulating well (in.)	=	.2000E+01
Temperature of the soil (C)	=	.2000E+02
Flow rate of pumping/injection well(cfm)	=	.2500E+02
Soil porosity(Dimensionless)	=	.2500E+00
Peameability for R direction (cm**2)	=	.2381E-06
Peameability for Z direction (cm**2)	=	.2381E-06
Peameability Kc/Bc	=	.8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************ OUTPUT ********************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)

.508E+01	.167E+00	.500E+00	.9321	27.6545	.1007E+01
.157E+03	.517E+01	.500E+00	.9983	.6764	.4634E-02
.310E+03	.102E+02	.500E+00	.9998	.0678	.4067E-03
.462E+03	.152E+02	.500E+00	1.0000	.0094	.5189E-04
.615E+03	.202E+02	.500E+00	1.0000	.0015	.7789E-05
.767E+03	.252E+02	.500E+00	1.0000	.0003	.1280E-05
.919E+03	.302E+02	.500E+00	1.0000	.0000	.2223E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.3991E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.7319E-08
.138E+04	.452E+02	.500E+00	1.0000	.0000	.1361E-08
.153E+04	.502E+02	.500E+00	1.0000	.0000	.2556E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.4832E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.9184E-11
.199E+04	.652E+02	.500E+00	1.0000	.0000	.1753E-11
.214E+04	.702E+02	.500E+00	1.0000	.0000	.3357E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.6446E-13
.244E+04	.802E+02	.500E+00	1.0000	.0000	.1241E-13
.260E+04	.852E+02	.500E+00	1.0000	.0000	.2394E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.4627E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.8956E-16

----- Simulated Scenario ----- 6

Simulating information:

Depth to the top of screen (ft) = .5000E+00

Depth to the bottom of screen (ft) = .1500E+01

Depth to the groundwater table (ft) = .1000E+02

Depth to the simulated elevation(ft) = .5000E+00

Radius of the simulating well (in.) = .2000E+01

Temperature of the soil (C) = .2000E+02

Flow rate of pumping/injection well(cfm)= .3000E+02

Soil porosity(Dimensionless) = .2500E+00

Peameability for R direction (cm**2) = .2381E-06

Peameability for Z direction (cm**2) = .2381E-06

Peameability Kc/Bc = .8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************* OUTPUT *********************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.9179	33.4309	.1227E+01
.157E+03	.517E+01	.500E+00	.9980	.8118	.5562E-02
.310E+03	.102E+02	.500E+00	.9998	.0814	.4881E-03
.462E+03	.152E+02	.500E+00	1.0000	.0113	.6227E-04
.615E+03	.202E+02	.500E+00	1.0000	.0018	.9347E-05
.767E+03	.252E+02	.500E+00	1.0000	.0003	.1537E-05
.919E+03	.302E+02	.500E+00	1.0000	.0000	.2667E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.4789E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.8783E-08
.138E+04	.452E+02	.500E+00	1.0000	.0000	.1633E-08
.153E+04	.502E+02	.500E+00	1.0000	.0000	.3067E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.5798E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.1102E-10
.199E+04	.652E+02	.500E+00	1.0000	.0000	.2103E-11
.214E+04	.702E+02	.500E+00	1.0000	.0000	.4028E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.7736E-13
.244E+04	.802E+02	.500E+00	1.0000	.0000	.1489E-13
.260E+04	.852E+02	.500E+00	1.0000	.0000	.2873E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.5552E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.1075E-15

----- Simulated Scenario ----- 7

Simulating information:

Depth to the top of screen (ft)	=	.5000E+00
Depth to the bottom of screen (ft)	=	.1500E+01
Depth to the groundwater table (ft)	=	.1000E+02
Depth to the simulated elevation(ft)	=	.5000E+00
Radius of the simulating well (in.)	=	.2000E+01
Temperature of the soil (C)	=	.2000E+02
Flow rate of pumping/injection well(cfm)	=	.3500E+02
Soil porosity(Dimensionless)	=	.2500E+00
Peameability for R direction (cm**2)	=	.2381E-06
Peameability for Z direction (cm**2)	=	.2381E-06
Peameability Kc/Bc	=	.8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************ OUTPUT ********************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.9035	39.2980	.1454E+01
.157E+03	.517E+01	.500E+00	.9977	.9473	.6491E-02
.310E+03	.102E+02	.500E+00	.9998	.0949	.5695E-03

.462E+03	.152E+02	.500E+00	1.0000	.0132	.7265E-04
.615E+03	.202E+02	.500E+00	1.0000	.0021	.1091E-04
.767E+03	.252E+02	.500E+00	1.0000	.0004	.1793E-05
.919E+03	.302E+02	.500E+00	1.0000	.0001	.3112E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.5587E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.1025E-07
.138E+04	.452E+02	.500E+00	1.0000	.0000	.1906E-08
.153E+04	.502E+02	.500E+00	1.0000	.0000	.3578E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.6765E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.1286E-10
.199E+04	.652E+02	.500E+00	1.0000	.0000	.2454E-11
.214E+04	.702E+02	.500E+00	1.0000	.0000	.4699E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.9025E-13
.244E+04	.802E+02	.500E+00	1.0000	.0000	.1737E-13
.260E+04	.852E+02	.500E+00	1.0000	.0000	.3352E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.6477E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.1254E-15

----- Simulated Scenario ----- 8

Simulating information:

Depth to the top of screen (ft) = .5000E+00

Depth to the bottom of screen (ft) = .1500E+01

Depth to the groundwater table (ft) = .1000E+02

Depth to the simulated elevation(ft) = .5000E+00

Radius of the simulating well (in.) = .2000E+01

Temperature of the soil (C) = .2000E+02

Flow rate of pumping/injection well(cfm)= .4000E+02

Soil porosity(Dimensionless) = .2500E+00

Peameability for R direction (cm**2) = .2381E-06

Peameability for Z direction (cm**2) = .2381E-06

Peameability Kc/Bc = .8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************ OUTPUT ********************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.8888	45.2603	.1689E+01
.157E+03	.517E+01	.500E+00	.9973	1.0828	.7421E-02
.310E+03	.102E+02	.500E+00	.9997	.1085	.6508E-03
.462E+03	.152E+02	.500E+00	1.0000	.0151	.8303E-04
.615E+03	.202E+02	.500E+00	1.0000	.0024	.1246E-04
.767E+03	.252E+02	.500E+00	1.0000	.0004	.2049E-05
.919E+03	.302E+02	.500E+00	1.0000	.0001	.3557E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.6385E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.1171E-07
.138E+04	.452E+02	.500E+00	1.0000	.0000	.2178E-08
.153E+04	.502E+02	.500E+00	1.0000	.0000	.4089E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.7731E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.1469E-10
.199E+04	.652E+02	.500E+00	1.0000	.0000	.2805E-11
.214E+04	.702E+02	.500E+00	1.0000	.0000	.5371E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.1031E-12
.244E+04	.802E+02	.500E+00	1.0000	.0000	.1986E-13
.260E+04	.852E+02	.500E+00	1.0000	.0000	.3830E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.7403E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.1433E-15

----- Simulated Scenario ----- 9

Simulating information:

Depth to the top of screen (ft) = .5000E+00

```
Depth to the bottom of screen (ft)          =          .1500E+01

Depth to the groundwater table (ft)         =          .1000E+02

Depth to the simulated elevation(ft)        =          .5000E+00

Radius of the simulating well (in. )        =          .2000E+01

Temperature of the soil ( C )               =          .2000E+02

Flow rate of pumping/injection well( cfm )=            .4500E+02

Soil porosity( Dimensionless )              =          .2500E+00

Peameability for R direction ( cm**2 )      =          .2381E-06

Peameability for Z direction ( cm**2 )      =          .2381E-06

Peameability  Kc/Bc                         =          .8144E-08


 Aquifer geological structure properties


 1:  Aquifer is isotropic.
 2:  There is a upper confining unit.


************************* OUTPUT *********************************
```

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.8739	51.3225	.1933E+01
.157E+03	.517E+01	.500E+00	.9970	1.2183	.8351E-02
.310E+03	.102E+02	.500E+00	.9997	.1221	.7322E-03
.462E+03	.152E+02	.500E+00	1.0000	.0170	.9341E-04
.615E+03	.202E+02	.500E+00	1.0000	.0027	.1402E-04
.767E+03	.252E+02	.500E+00	1.0000	.0005	.2305E-05
.919E+03	.302E+02	.500E+00	1.0000	.0001	.4001E-06

.107E+04	.352E+02	.500E+00	1.0000	.0000	.7184E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.1317E-07
.138E+04	.452E+02	.500E+00	1.0000	.0000	.2450E-08
.153E+04	.502E+02	.500E+00	1.0000	.0000	.4600E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.8698E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.1653E-10
.199E+04	.652E+02	.500E+00	1.0000	.0000	.3155E-11
.214E+04	.702E+02	.500E+00	1.0000	.0000	.6042E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.1160E-12
.244E+04	.802E+02	.500E+00	1.0000	.0000	.2234E-13
.260E+04	.852E+02	.500E+00	1.0000	.0000	.4309E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.8328E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.1612E-15

----- Simulated Scenario ----- 10

Simulating information:

Depth to the top of screen (ft) = .5000E+00

Depth to the bottom of screen (ft) = .1500E+01

Depth to the groundwater table (ft) = .1000E+02

Depth to the simulated elevation(ft) = .5000E+00

Radius of the simulating well (in.) = .2000E+01

Temperature of the soil (C) = .2000E+02

Flow rate of pumping/injection well(cfm)= .5000E+02

Soil porosity(Dimensionless) = .2500E+00

Peameability for R direction (cm**2) = .2381E-06

Peameability for Z direction (cm**2) = .2381E-06

Peameability Kc/Bc = .8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

*********************** OUTPUT ******************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.8588	57.4897	.2186E+01
.157E+03	.517E+01	.500E+00	.9967	1.3539	.9283E-02
.310E+03	.102E+02	.500E+00	.9997	.1357	.8136E-03
.462E+03	.152E+02	.500E+00	1.0000	.0189	.1038E-03
.615E+03	.202E+02	.500E+00	1.0000	.0030	.1558E-04
.767E+03	.252E+02	.500E+00	1.0000	.0005	.2561E-05
.919E+03	.302E+02	.500E+00	1.0000	.0001	.4446E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.7982E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.1464E-07
.138E+04	.452E+02	.500E+00	1.0000	.0000	.2722E-08
.153E+04	.502E+02	.500E+00	1.0000	.0000	.5111E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.9664E-10
.183E+04	.602E+02	.500E+00	1.0000	.0000	.1837E-10
.199E+04	.652E+02	.500E+00	1.0000	.0000	.3506E-11
.214E+04	.702E+02	.500E+00	1.0000	.0000	.6713E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.1289E-12
.244E+04	.802E+02	.500E+00	1.0000	.0000	.2482E-13
.260E+04	.852E+02	.500E+00	1.0000	.0000	.4788E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.9254E-15
.290E+04	.952E+02	.500E+00	1.0000	.0000	.1791E-15

----- Simulated Scenario ----- 11

Simulating information:

Depth to the top of screen (ft) = .5000E+00

Depth to the bottom of screen (ft) = .1500E+01

Depth to the groundwater table (ft) = .1000E+02

```
Depth to the simulated elevation(ft)       =          .5000E+00

Radius of the simulating well (in. )       =          .2000E+01

Temperature of the soil ( C )              =          .2000E+02

Flow rate of pumping/injection well( cfm )=           .6000E+02

Soil porosity( Dimensionless )             =          .2500E+00

Peameability for R direction ( cm**2 )     =          .2381E-06

Peameability for Z direction ( cm**2 )     =          .2381E-06

Peameability  Kc/Bc                        =          .8144E-08
```

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************* OUTPUT *********************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.8277	70.1627	.2721E+01
.157E+03	.517E+01	.500E+00	.9960	1.6252	.1115E-01
.310E+03	.102E+02	.500E+00	.9996	.1628	.9764E-03
.462E+03	.152E+02	.500E+00	.9999	.0226	.1245E-03
.615E+03	.202E+02	.500E+00	1.0000	.0036	.1869E-04
.767E+03	.252E+02	.500E+00	1.0000	.0006	.3073E-05
.919E+03	.302E+02	.500E+00	1.0000	.0001	.5335E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.9578E-07
.122E+04	.402E+02	.500E+00	1.0000	.0000	.1757E-07
.138E+04	.452E+02	.500E+00	1.0000	.0000	.3267E-08
.153E+04	.502E+02	.500E+00	1.0000	.0000	.6134E-09

.168E+04	.552E+02	.500E+00	1.0000	.0000	.1160E-09
.183E+04	.602E+02	.500E+00	1.0000	.0000	.2204E-10
.199E+04	.652E+02	.500E+00	1.0000	.0000	.4207E-11
.214E+04	.702E+02	.500E+00	1.0000	.0000	.8056E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.1547E-12
.244E+04	.802E+02	.500E+00	1.0000	.0000	.2978E-13
.260E+04	.852E+02	.500E+00	1.0000	.0000	.5746E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.1110E-14
.290E+04	.952E+02	.500E+00	1.0000	.0000	.2150E-15

----- Simulated Scenario ----- 12

Simulating information:

Depth to the top of screen (ft) = .5000E+00

Depth to the bottom of screen (ft) = .1500E+01

Depth to the groundwater table (ft) = .1000E+02

Depth to the simulated elevation(ft) = .5000E+00

Radius of the simulating well (in.) = .2000E+01

Temperature of the soil (C) = .2000E+02

Flow rate of pumping/injection well(cfm)= .7000E+02

Soil porosity(Dimensionless) = .2500E+00

Peameability for R direction (cm**2) = .2381E-06

Peameability for Z direction (cm**2) = .2381E-06

Peameability Kc/Bc = .8144E-08

Aquifer geological structure properties

1: Aquifer is isotropic.
2: There is a upper confining unit.

************************ OUTPUT ********************************

RADIUS (cm)	RADIUS (ft)	ELEVATION (ft)	PRESS (atm.)	PRESS (in H20)	VELOCITY (ft/s)
.508E+01	.167E+00	.500E+00	.7953	83.3314	.3304E+01
.157E+03	.517E+01	.500E+00	.9953	1.8967	.1301E-01
.310E+03	.102E+02	.500E+00	.9995	.1899	.1139E-02
.462E+03	.152E+02	.500E+00	.9999	.0264	.1453E-03
.615E+03	.202E+02	.500E+00	1.0000	.0042	.2181E-04
.767E+03	.252E+02	.500E+00	1.0000	.0007	.3585E-05
.919E+03	.302E+02	.500E+00	1.0000	.0001	.6224E-06
.107E+04	.352E+02	.500E+00	1.0000	.0000	.1117E-06
.122E+04	.402E+02	.500E+00	1.0000	.0000	.2049E-07
.138E+04	.452E+02	.500E+00	1.0000	.0000	.3811E-08
.153E+04	.502E+02	.500E+00	1.0000	.0000	.7156E-09
.168E+04	.552E+02	.500E+00	1.0000	.0000	.1353E-09
.183E+04	.602E+02	.500E+00	1.0000	.0000	.2572E-10
.199E+04	.652E+02	.500E+00	1.0000	.0000	.4908E-11
.214E+04	.702E+02	.500E+00	1.0000	.0000	.9399E-12
.229E+04	.752E+02	.500E+00	1.0000	.0000	.1805E-12
.244E+04	.802E+02	.500E+00	1.0000	.0000	.3475E-13
.260E+04	.852E+02	.500E+00	1.0000	.0000	.6703E-14
.275E+04	.902E+02	.500E+00	1.0000	.0000	.1295E-14
.290E+04	.952E+02	.500E+00	1.0000	.0000	.2508E-15

---------- Simulation finished ----------

EN 454M & CP 454M
Sealed Regenerative Blower w/Explosion-Proof Motor

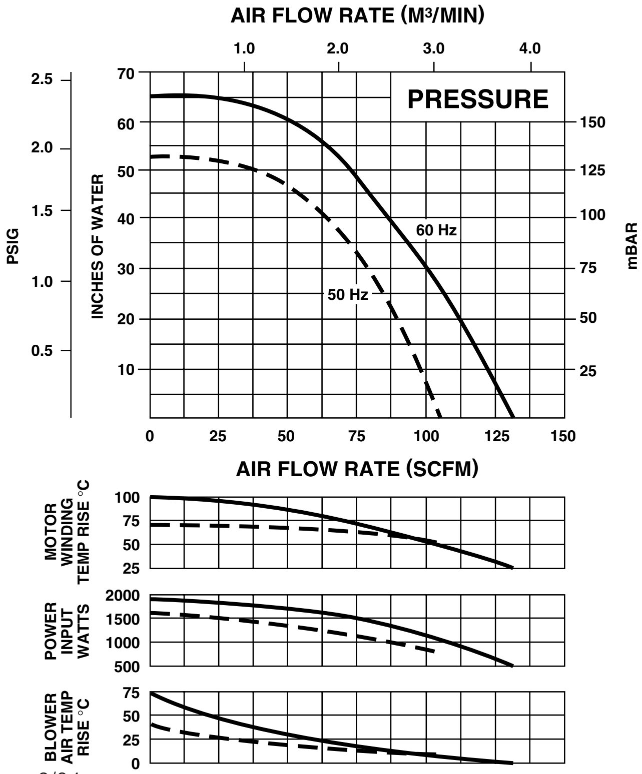
FEATURES
- Manufactured in the USA – ISO 9001 compliant
- Maximum flow: 127 SCFM
- Maximum pressure: 65 IWG
- Maximum vacuum: 59 IWG
- Standard motor: 1.5 HP, explosion-proof
- Cast aluminum blower housing, cover, impeller & manifold; cast iron flanges (threaded); teflon lip seal
- UL & CSA approved motor with permanently sealed ball bearings for explosive gas atmospheres Class I Group D minimum
- Sealed blower assembly
- Quiet operation within OSHA standards

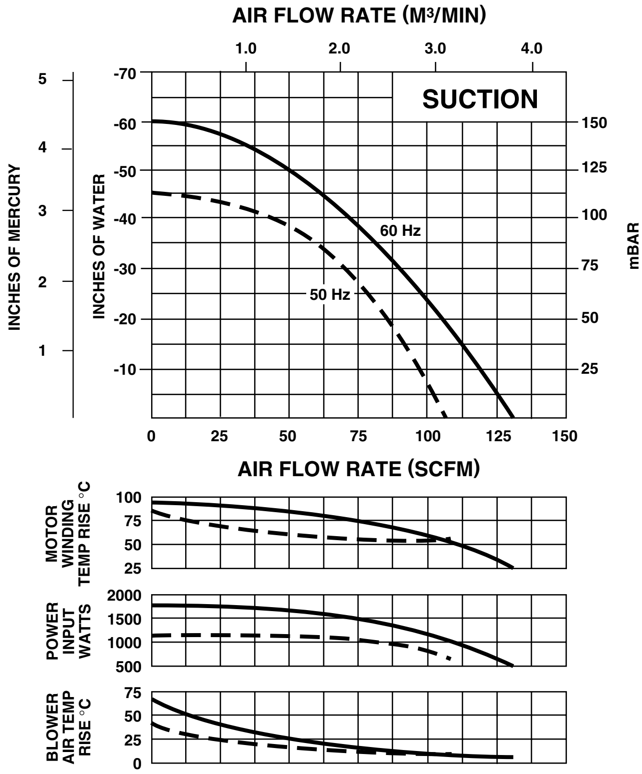
MOTOR OPTIONS
- International voltage & frequency (Hz)
- Chemical duty, high efficiency, inverter duty or industry-specific designs
- Various horsepowers for application-specific needs

BLOWER OPTIONS
- Corrosion resistant surface treatments & sealing options
- Remote drive (motorless) models
- Slip-on or face flanges for application-specific needs

ACCESSORIES (See Catalog Accessory Section)
- Flowmeters reading in SCFM
- Filters & moisture separators
- Pressure gauges, vacuum gauges & relief valves
- Switches – air flow, pressure, vacuum or temperature
- External mufflers for additional silencing
- Air knives (used on blow-off applications)
- Variable frequency drive package

BLOWER PERFORMANCE AT STANDARD CONDITIONS

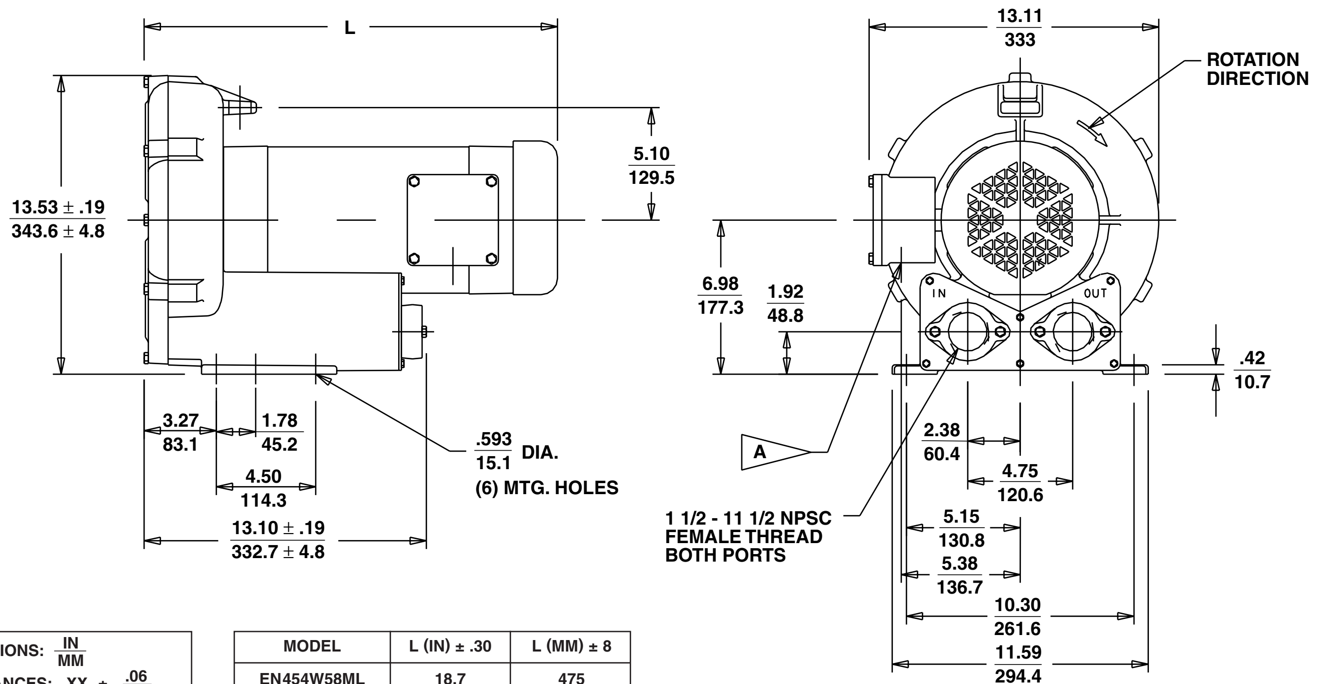




Rev. 2/04

EN 454M & CP 454M
Sealed Regenerative Blower w/Explosion-Proof Motor

Scale CAD drawing available upon request.



DIMENSIONS: $\frac{IN}{MM}$
TOLERANCES: .XX ± $\frac{.06}{1.5}$
(UNLESS OTHERWISE NOTED)

MODEL	L (IN) ± .30	L (MM) ± 8
EN454W58ML	18.7	475
EN454W72ML	15.53	394

A TERMINAL BOX CONNECTOR HOLE 3/4" NPT FEMALE THREAD

SPECIFICATIONS

MODEL	EN454W58ML		EN454W72ML		CP454W72MLR	CP454FR72MLR
Part No.	080487		080488		080490	080494
Motor Enclosure – Shaft Material	Explosion-proof – **CS**		Explosion-proof – **CS**		Chem XP – **CS**	Chem XP – **SS**
Horsepower	1.5		1.5		Same as EN454W72ML – 080488 except add Chemical Processing (CP) features from catalog inside front cover	Same as EN454W72ML – 080488 except add Chemical Processing (CP) features from catalog inside front cover
Phase – Frequency [1]	Single - 60 Hz		Three - 60 Hz			
Voltage [1]	115	208-230	230	460		
Motor Nameplate Amps	15	7.9-7.5	4.6	2.3		
Max. Blower Amps [3]	20	10.9-10	5.6	2.8		
Inrush Amps	96	48	32	16		
Starter Size	1	0	00	00		
Service Factor	1.0		1.0			
Thermal Protection [2]	Class B - Pilot Duty		Class B - Pilot Duty			
XP Motor Class – Group	I-D, II-F&G		I-D, II-F&G			
Shipping Weight	86 lb (39 kg)		80 lb (36.2 kg)			

1 Rotron motors are designed to handle a broad range of world voltages and power supply variations. Our dual voltage 3 phase motors are factory tested and certified to operate on both: **208-230/415-460 VAC-3 ph-60 Hz** and **190-208/380-415 VAC-3 ph-50 Hz**. Our dual voltage 1 phase motors are factory tested and certified to operate on both: **104-115/208-230 VAC-1 ph-60 Hz** and **100-110/200-220 VAC-1 ph-50 Hz**. All voltages above can handle a ±10% voltage fluctuation. Special wound motors can be ordered for voltages outside our certified range.

2 Maximum operating temperature: Motor winding temperature (winding rise plus ambient) should not exceed 140°C for Class F rated motors or 120°C for Class B rated motors. Blower outlet air temperature should not exceed 140°C (air temperature rise plus inlet temperature). Performance curve maximum pressure and suction points are based on a 40°C inlet and ambient temperature. Consult factory for inlet or ambient temperatures above 40°C.

3 Maximum blower amps corresponds to the performance point at which the motor or blower temperature rise with a 40°C inlet and/or ambient temperature reaches the maximum operating temperature.

Specifications subject to change without notice. Please consult your Local Field Sales Engineer for specification updates.

Rev. 2/04

Table 1
SSDS Pilot Testing Data Summary
Rossville Shopping Center
Staten Island, New York
Langan Project No.: 100843501

Time	VEP [At Wellhead]			VEP [At Process Equipment]		Monitoring Points Vacuum (IWC)							Notes
	Vacuum (IWC)	Temp (°F)	Flow (SCFM)	Vacuum (IWC)	Flow (SCFM)	VMP- 1 Distance - 5 ft	VMP- 2 Distance - 10 ft	VMP- 3 Distance - 20 ft	VMP- 4 Distance - 15 ft	VMP- 5 Distance - 50 ft	VMP-6 (Liquor Store) Distance - 20 ft	VMP-7 (Grocery Store) Distance - 15 ft	
Background	--	--	--	--	--	0.004	0.002	0.002	0.005	0.002	0.000	0.000	
10:40	-1.7	43.4	8.95	-2.5	148.82	-0.073	-0.003	0.000	0.015	0.000	-	-	Dilution 100% Open
11:00	-4.8	43.2	13.41	-5.1	153.21	-0.195	-0.024	0.000	0.006	0.001	-	-	Dilution 75% Open
11:30	-4.8	45.5	14.15	-5.1	157.56	-0.175	-0.024	-0.002	0.001	0.001	0.000	0.000	Dilution 75% Open
11:55	-10.3	52	20.25	-11.1	125.85	-0.39	-0.047	0.000	0.001	-0.001	0.000	0.000	Dilution 50% Open
12:30	-20.7	51.2	29.09	-21.3	109.38	-0.74	-0.086	-0.001	-0.018	0.000	-0.001	0.000	Dilution 25% Open
13:00	-56.1	48.9	51.65	-58.1	62.78	-1.662	-0.178	-0.012	-0.062	0.000	-0.008	0.000	Dilution 0% Open
13:30	-33	-	41.08	-33.8	88.63	-1.063	-0.124	-0.001	-0.035	0.000	-0.003	-	Dilution 10% Open
14:00	-15.5	-	26.06	-	-	-0.499	-0.065	0.000	-0.009	0.000	-0.001	-	Dilution 35% Open

Notes:
SSDS - sub slab depressurization system
VEP - vapor extraction point
VMP - vacuum monitoring point
IWC - inches of water column vacuum
°F - degrees Fahrenheit
SCFM - standard cubic feet per minute

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN

for

990-1026 Rossville Avenue
Block 7054, Lot 518
Staten Island, New York

Prepared For:

Allied Rossville LLC
118-25 Queens Boulevard
16th Floor
Forest Hills, New York 11375

Prepared By:

Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C.
300 Kimball Drive
Parsippany, New Jersey 07054

6 March 2020
100849501

LANGAN

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1.0 PROJECT DESCRIPTION

1.1 Introduction

Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C. (Langan) has prepared this Quality Assurance Project Plan (QAPP) on behalf of Allied Rossville LLC (the Participant) for the property at 990-1026 Rossville Avenue (Tax Block 7054, Lot 518) in the Rossville neighborhood of Staten Island, New York (the Site). A Site Location Map is included as Figure 1.

This QAPP specifies analytical methods to be used to ensure that data collected during implementation of the Interim Remedial Measures Work Plan (IRMWP) are precise, accurate, representative, comparable, complete, and meet the sensitivity requirements of the project.

1.2 Project Objectives

The objective of the IRMWP is to mitigate soil vapor intrusion (SVI) conditions within the western portion of the building located on Lot 518. As described in Section 1.6 of the IRMWP, exterior soil vapor samples and collocated indoor air/sub-slab soil vapor samples were collected across the site, and their analytical results revealed elevated concentrations of chlorinated volatile organic compounds (CVOCs), primarily in the vicinity and downgradient of the on-site dry cleaners. CVOCs including tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride were detected at concentrations requiring monitoring and/or mitigation according to the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion Matrices within the western portion of the Lot 518 building. Based on the soil vapor/indoor air results and extent of the groundwater impacts documented in the Subsurface Investigation Report (SIR), SVI mitigation is required for the tenant spaces located in the western portion of the building (i.e., the dry cleaners, liquor store, hair salon, karate studio, and ice cream parlor) and is not required for the tenant spaces in the northern portion of the building (i.e., the pizzeria, laundromat, bagel shop, restaurant, vacant former restaurant, and the grocery store). Although elevated concentrations of CVOCs in sub-slab soil vapor/indoor air samples collected within the grocery store in the northwestern corner of the building were not identified, elevated concentrations of CVOCs were detected in exterior soil vapor sample locations to the north and west of the tenant space. As such, an active sub-slab depressurization system (SSDS) will be installed to prevent intrusion of contaminated vapors into the western portion of the Lot 518 building, including the grocery store, dry cleaners, liquor store, hair salon, karate studio, and ice cream parlor.

1.3 Scope of Work

The specific scope of work covered in this QAPP includes any documentation sampling that will occur during implementation of the IRM Work Plan.

The following sampling activities will be performed as part of the interim remedial action:

- Indoor Air Sampling – Indoor air samples will be collected from each tenant space, excluding the on-site dry cleaners as PCE is actively used within the tenant space. Samples will be analyzed for VOCs via United States Environmental Protection Agency (USEPA) method TO-15.
- Sub-Slab Soil Vapor Sampling – Soil vapor samples will be collected from vacuum monitoring points, SSDS sampling ports, and/or temporary sub-slab sampling points within each tenant space. Samples will be analyzed for VOCs via USEPA method TO-15.
- Waste Classification Soil Sampling – Soil as part of SSDS construction activities will be sampled for laboratory analysis per disposal facility requirements, and visually examined, screened, and characterized to determine whether it is suitable for potential re-use onsite (pending waste classification analytical sampling results) or will be transported to an approved off-site disposal facility. Laboratory tests for classification of a waste stream typically include all or a subset of the following list and will be determined by the facility's permit requirements: Extractable Petroleum Hydrocarbons (EPH); Target Compound List (TCL) volatile organic compounds (VOC) and semi-volatile organic compounds (SVOC); polychlorinated biphenyls (PCB); Target Analyte List (TAL) metals including hexavalent chromium; pesticides and herbicides; total cyanide; the Resource Conservation and Recovery Act (RCRA) hazardous characteristics of ignitability, corrosivity, and reactivity; RCRA toxicity characteristic using the Toxic Characteristics Leaching Procedure (TCLP) for VOCs, SVOCs, metals, pesticides, and herbicides.

2.0 DATA QUALITY OBJECTIVES AND PROCESS

Data Quality Objectives (DQOs) are qualitative and quantitative statements to help ensure that data of known and appropriate quality are obtained during the project. The overall objectives are:

- To evaluate the quality of indoor air through the collection of indoor air samples approximately one month after system start-up;
- To evaluate the quality of soil vapor through the collection of soil vapor samples approximately one month after system start-up; and,
- To adequately characterize excavated soil based on the sampling requirements of proposed soil disposal facilities.

DQOs for sampling activities are determined by evaluating five factors:

- Data needs and uses: The types of data required and how the data will be used after it is obtained.
- Parameters of Interest: The types of chemical or physical parameters required for the intended use.
- Level of Concern: Levels of constituents, which may require remedial actions or further investigations.
- Required Analytical Level: The level of data quality, data precision, and quality assurance/quality control (QA/QC) documentation required for chemical analysis.
- Required Detection Limits: The detection limits necessary based on the above information.

The quality assurance and quality control objectives for all measurement data include:

- Precision – an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Field sampling precision will be determined by analyzing coded duplicate samples and analytical precision will be determined by analyzing internal QC duplicates and/or matrix spike duplicates.
- Accuracy – a measure of the degree of agreement of a measured value with the true or expected value of the quantity of concern. For soil samples,

accuracy will be determined through the assessment of the analytical results of field blanks and trip blanks for each sample set. Analytical accuracy will be assessed by examining the percent recoveries of surrogate compounds that are added to each sample (organic analyses only), internal standards, laboratory method blanks, instrument calibration, and the percent recoveries of matrix spike compounds added to selected samples and laboratory blanks.

- Representativeness – expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is dependent upon the adequate design of the sampling program and will be satisfied by ensuring that the scope of work is followed and that specified sampling and analysis techniques are used. Representativeness in the laboratory is ensured by compliance to nationally-recognized analytical methods, meeting sample holding times, and maintaining sample integrity while the samples are in the laboratory's possession. This is accomplished by following all applicable methods, laboratory-issued standard operating procedures (SOPs), the laboratory's Quality Assurance Manual, and this QAPP. The laboratory is required to be properly certified and accredited.
- Completeness – the percentage of measurements made which are judged to be valid. Completeness will be assessed through data validation. The QC objective for completeness is generation of valid data for at least 90 percent of the analyses requested.
- Comparability – expresses the degree of confidence with which one data set can be compared to another. The comparability of all data collected for this project will be ensured using several procedures, including standard methods for sampling and analysis as documented in the QAPP, using standard reporting units and reporting formats, and data validation.
- Sensitivity – the ability of the instrument or method to detect target analytes at the levels of interest. The project manager will select, with input from the laboratory and QA personnel, sampling and analytical procedures that achieve the required levels of detection.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Implementation of the IRMWP will be overseen by Langan for Allied Rossville LLC. The environmental consultant will also arrange data analysis and reporting tasks. The analytical services will be performed by an Environmental Laboratory Approval Program (ELAP)-certified laboratory. Data validation services will be performed by approved data validation contractor(s).

For the required sampling as stated in the IRMWP, sampling will be conducted by Langan, the analytical services will be performed by Alpha Analytical, Inc. of Mansfield, MA. (New York State Department of Health [NYSDOH] ELAP certification number 11148 [Westboro Laboratory] and 11627 [Mansfield Laboratory]). Data validation services will be performed by Emily Strake; résumé attached (Attachment A).

Key contacts for this project are as follows:

Allied Rossville LLC c/o Muss Development	Joshua Muss Telephone: (718) 263-3800
Langan Project Manager:	Christopher McMahon Telephone: (973) 560-4900
Langan Quality Assurance Officer (QAO):	Jessica Friscia Telephone: (973) 560-4900
Langan Remedial Engineer:	Stewart Abrams Telephone: (973) 560-4900
Program Quality Assurance Monitor:	Brandon Reiner Telephone: (973) 560-4900
Data Validator:	Emily Strake Telephone: (215) 491-6526
Laboratory Representative:	Alpha Analytical, Inc. Ben Rao Telephone: (201) 847-9100

4.0 QUALITY ASSURANCE OBJECTIVES FOR COLLECTION OF DATA

The overall quality assurance objective is to develop and implement procedures for sampling, laboratory analysis, field measurements, and reporting that will provide data of sufficient quality to evaluate soil impacts at the site. The sample set, chemical analysis results, and interpretations must be based on data that meet or exceed quality assurance objectives established for the site. Quality assurance objectives are usually expressed in terms of accuracy or bias, sensitivity, completeness, representativeness, comparability, and sensitivity of analysis. Variances from the quality assurance objectives at any stage of the investigation will result in the implementation of appropriate corrective measures and an assessment of the impact of corrective measures on the usability of the data.

Precision

Precision is a measure of the degree to which two or more measurements are in agreement. Field precision is assessed through the collection and measurement of field duplicates. Laboratory precision and sample heterogeneity also contribute to the uncertainty of field duplicate measurements. This uncertainty is taken into account during the data assessment process. For field duplicates, results less than 2x the reporting limit (RL) meet the precision criteria if the absolute difference is less than ±2X the RL. For results greater than 2X the RL, the acceptance criteria is a relative percent difference (RPD) of ≤50% (soil), and <30% (groundwater). RLs and method detection limits (MDL) are provided in Attachment B.

Accuracy

Accuracy is the measurement of the reproducibility of the sampling and analytical methodology. It should be noted that precise data may not be accurate data. For the purpose of this QAPP, bias is defined as the constant or systematic distortion of a measurement process, which manifests itself as a persistent positive or negative deviation from the known or true value. This may be due to (but not limited to) improper sample collection, sample matrix interferences, poorly calibrated analytical or sampling equipment, or limitations or errors in analytical methods and techniques.

Accuracy in the field is assessed through the use of field blanks and through compliance to all sample handling, preservation, and holding time requirements. All field blanks should be non-detect when analyzed by the laboratory. Any contaminant detected in an associated field blank was evaluated against laboratory blanks (preparation or method) and evaluated against field samples collected on the same day to determine potential for bias.

Laboratory accuracy is assessed by evaluating the percent recoveries of MS/MSD samples, LCS/LCSDs, surrogate compound recoveries, internal standard responses and the results of method preparation blanks. MS/MSD, LCS/LCSD, internal standard responses and surrogate percent recoveries were compared to either method-specific control limits or laboratory-derived control limits. Sample volume permitting, samples displaying outliers should be reanalyzed. All associated method blanks should be non-detect when analyzed by the laboratory.

Completeness

Laboratory completeness is the ratio of total number of samples analyzed and verified as acceptable compared to the number of samples submitted to the fixed-base laboratory for analysis, expressed as a percent. Three measures of completeness are defined:

- Sampling completeness, defined as the number of valid samples collected relative to the number of samples planned for collection;
- Analytical completeness, defined as the number of valid sample measurements relative to the number of valid samples collected; and
- Overall completeness, defined as the number of valid sample measurements relative to the number of samples planned for collection.

Soil and groundwater data will meet a 90% completeness criterion. If the criterion is not met, sample results will be evaluated for trends in rejected and unusable data. The effect of unusable data required for a determination of compliance will also be evaluated.

Representativeness

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary. Representativeness is dependent upon the adequate design of the sampling program and was satisfied by ensuring that the scope of work is followed and that specified sampling and analysis techniques are used. This is performed by following applicable standard operating procedures (SOPs) and this QAPP. All field technicians will be given copies of appropriate documents prior to sampling events and will be required to read, understand, and follow each document as it pertains to the tasks at hand.

Representativeness in the laboratory is ensured by compliance to nationally-recognized analytical methods, meeting sample holding times, and maintaining sample integrity while the samples are in the laboratory's possession. This is performed by following all applicable EPA and standard methods, laboratory-issued SOPs, the laboratory's Quality Assurance Manual, and this QAPP. The laboratory is required to be properly certified and accredited.

Comparability

Comparability is an expression of the confidence with which one data set can be compared to another. Comparability is dependent upon the proper design of the sampling program and was satisfied by ensuring that the sampling plan is followed and that sampling is performed according to the SOPs or other project-specific procedures. Analytical data were comparable when similar sampling and analytical methods are used as documented in the QAPP. Comparability was controlled by requiring the use of specific nationally-recognized analytical methods and requiring consistent method performance criteria. Comparability is also dependent on similar quality assurance objectives. Previously collected data were evaluated to determine whether they may be combined with contemporary data sets.

Sensitivity

Sensitivity is the ability of the instrument or method to detect target analytes at the levels of interest (e.g., at the NJDEP SRS). The Project Manager will select, with input from the laboratory and QA personnel, sampling and analytical procedures that achieve the required levels of detection and QC acceptance limits that meet established performance criteria. Concurrently, the Project Manager will select the level of data assessment to ensure that only data meeting the project DQOs are used in decision-making.

Field equipment will be used that can achieve the required levels of detection for analytical measurements in the field. In addition, the field sampling staff will collect and submit full volumes of samples as required by the laboratory for analysis, whenever possible. Full volume aliquots will help ensure achievement of the required limits of detection and allow for reanalysis if necessary. The concentration of the lowest level check standard in a multi-point calibration curve will represent the reporting limit.

Analytical methods and quality assurance parameters associated with the sampling program are presented in Attachment C. The frequency of associated field blanks and duplicate samples will be based on the recommendations listed in DER-10 and as described in Section 5.3.2.

5.0 SAMPLE COLLECTION AND FIELD DATA ACQUISITION PROCEDURES

Soil sampling will be conducted in accordance with the established NYSDEC protocols contained in DER-10/Technical Guidance for Site Investigation and Remediation (May 2010). The following sections describe procedures to be followed for specific tasks.

5.1 Field Documentation Procedures

Field documentation procedures will include summarizing field data in field books and proper sample labeling. These procedures are described in the following sections.

5.1.1 Field Data and Notes

Field notebooks contain the documentary evidence regarding procedures conducted by field personnel. Hard cover, bound field notebooks will be used because of their compact size, durability and secure page binding. The pages of the notebook will not be removed.

Entries were made in waterproof, permanent blue or black ink. No erasures will be allowed. Incorrect entries will be crossed out with a single strike mark and the change initialed and dated by the team member making the change.

Each entry will be dated. Entries will be legible and contain accurate and complete documentation of the individual or sampling team's activities or observations made. The level of detail will be sufficient to explain and reconstruct the activity conducted. Each entry will be signed by the person(s) making the entry.

The following types of information will be provided for each sampling task, as appropriate:

- Project name and number;
- Reasons for being on-site or taking the sample;
- Date and time of activity;
- Sample identification numbers;
- Geographical location of sampling points with references to the site, other facilities or a map coordinate system. Sketches were made in the field logbook when appropriate;

- Physical location of sampling locations such as depth below ground surface;
- Description of the method of sampling including procedures followed, equipment used and any departure from the specified procedures;
- Description of the sample including physical characteristics, odor, etc.;
- Readings obtained from health and safety equipment;
- Weather conditions at the time of sampling and previous meteorological events that may affect the representative nature of a sample;
- Photographic information including a brief description of what was photographed, the date and time, the compass direction of the picture and the number of the picture on the camera;
- Other pertinent observations such as the presence of other persons on the site, actions by others that may affect performance of site tasks, etc.; and,
- Names of sampling personnel and signature of persons making entries.

Field records will also be collected on field data sheets including boring logs, which will be used for geologic and drilling data during soil boring activities. Field data sheets will include the project-specific number and stored in the field project files when not in use. At the completion of the field activities, the field data sheets will be maintained in the central project file.

5.1.2 Sample Labeling

Each sample collected will be assigned a unique identification number and placed in an appropriate sample container. Each sample container will have a sample label affixed to the outside with the date and time of sample collection and project name. In addition, the label will contain the sample identification number, analysis required and chemical preservatives added, if any. All documentation will be completed in waterproof ink. Sample nomenclature procedures are included in Attachment D.

5.2 Equipment Calibration and Preventative Maintenance

A photoionization detector (PID) will be used during the sampling activities to evaluate work zone action levels and screen soil samples. Field calibration and/or field checking of the PID will be the responsibility of the field team leader and the site HSO, and will be accomplished by following the procedures outlined in the operating manual for the instrument. At a minimum, field calibration and/or field equipment checking will be performed once daily, prior to use. Field calibration will be documented in the field notebook. Entries made into the logbook regarding the status of field equipment will include the following information:

- Date and time of calibration
- Type of equipment serviced and identification number (such as serial number)
- Reference standard used for calibration
- Calibration and/or maintenance procedure used
- Other pertinent information

Equipment that fails calibration or becomes inoperable during use will be removed from service and segregated to prevent inadvertent utilization. The equipment will be properly tagged to indicate that it is out of calibration. Such equipment will be repaired and recalibrated to the manufacturer's specifications by qualified personnel. Equipment that cannot be repaired will be replaced.

Off-site calibration and maintenance of field instruments will be conducted as appropriate throughout the duration of project activities. All field instrumentation, sampling equipment and accessories will be maintained in accordance with the manufacturer's recommendations and specifications and established field equipment practice. Off-site calibration and maintenance will be performed by qualified personnel. A logbook will be kept to document that established calibration and maintenance procedures have been followed. Documentation will include both scheduled and unscheduled maintenance.

5.3 Sample Collection

5.3.1 Indoor Air Samples

Indoor air sampling is anticipated approximately one month after SSDS start-up. Samples will be collected in accordance with the Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH October 2006). Indoor air samples will be collected by installing six-liter stainless steel summa canisters within each tenant space, excluding the on-site dry cleaning facility. Four indoor air samples will be collected in the grocery store; two in the basement and two on the first floor. Two indoor air samples will be collected in the remaining tenant spaces. 24 total indoor air samples will be collected over an eight-hour sample acquisition period during business hours. Indoor air sample locations will be based on field conditions at the time of sample collection.

Samples will be collected in appropriate sized Summa canisters that have been certified clean with regulators supplied by Alpha and analyzed by using USEPA Method TO-15. Flow rate for sampling will not exceed 0.0125 L/min. A sample log sheet will be maintained summarizing sample identification, date and time of sample collection, identity of samplers, sampling methods and devices volume of the indoor air extracted, vacuum of canisters before and after the samples are collected, and chain of custody protocols.

5.3.1.1 Indoor Air Sample Duplicates

Duplicate indoor air samples will be collected and analyzed for quality assurance purposes. Duplicate samples will be collected at a frequency of 1 per 20 investigative soil samples and will be submitted to the laboratory as "blind" samples. If less than 20 samples are collected during a particular sampling event, one duplicate sample will be collected.

5.3.2 Sub-Slab Soil Vapor Samples

Sub-slab soil vapor sampling is anticipated approximately one month after SSDS start-up. Samples will be collected in accordance with the Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH October 2006). The soil vapor samples will be collected by installing one six-liter stainless steel summa canister at either a vacuum monitoring point (VMP) and/or SSDS sampling port within each mitigated tenant space, or at sub-slab vapor points installed by Langan within the unmitigated tenant spaces along the northern portion of the site, for a total of eleven soil vapor samples. The soil vapor samples will be collected over a two-hour sample acquisition period during business hours. One ambient air sample will be collected per day of soil vapor sampling over an eight-hour sample acquisition period. Sample locations within the mitigated area will be based on VMP/SSDS sample port locations as identified in the full-scale SSDS Manifold Layout as-built drawing. A proposed full-scale SSDS Manifold Layout drawing is provided as Figure 2. Sample locations within the unmitigated tenant spaces will be based on field conditions at the time of sample collection.

Samples will be collected in appropriate sized Summa canisters that have been certified clean with regulators supplied by Alpha and analyzed by using USEPA Method TO-15. Flow rate for purging of soil vapor samples will not exceed 0.2 L/min. Flow rate for sampling will not exceed 0.2 L/min for the soil vapor samples and 0.05 L/min for the ambient air sample(s). A sample log sheet will be maintained summarizing sample identification, date and time of sample collection, identity of samplers, sampling methods and devices, soil vapor purge volumes, volume of the soil vapor and ambient air extracted, vacuum of canisters before and after the samples are collected, and chain of custody protocols.

5.3.2.1 Soil Vapor Sample Duplicates

Duplicate soil vapor samples will be collected and analyzed for quality assurance purposes. Duplicate samples will be collected at a frequency of 1 per 20 investigative soil samples and will be submitted to the laboratory as "blind" samples. If less than 20 samples are collected during a particular sampling event, one duplicate sample will be collected.

5.3.3 Waste Classification Soil Samples

Soil generated from SSDS installation will be staged in 55-gallon stainless steel drums prior to soil disposal and will field screened using a PID to assess potential impacts from VOCs and for health and safety monitoring. Soil samples collected for analysis of VOCs will be collected using Terra Core® sampling equipment. For analysis of non-volatile parameters, samples will be homogenized and placed into glass jars. Laboratory tests for classification of a waste stream typically include all or a subset of the following list and will be determined by the facility's permit requirements: EPH; TCL VOC and SVOC; PCB; TAL metals including hexavalent chromium; pesticides and herbicides; total cyanide; the RCRA hazardous characteristics of ignitability, corrosivity, and reactivity; RCRA toxicity characteristic using the TCLP for VOCs, SVOCs, metals, pesticides, and herbicides. Composite waste classification soil samples will be collected from the 55-gallon drum(s) after excavation for SSDS installation is complete.

After collection, all sample jars will be capped and securely tightened, and placed in iced coolers and maintained at 4°C ±2°C until they are transferred to the laboratory for analysis, in accordance with the procedures outlined in Section 5.4. Analysis and/or extraction and digestion of collected soil samples will meet the holding times required for each analyte as specified in Attachment C. In addition, soil waste classification samples will not receive NYSDEC Category-B data packages or data validation/data usability reports.

5.3.3.1 Sample Field Blanks, Trip Blanks, and Duplicates

Field blanks will be collected for quality assurance purposes at a rate of one per 20 waste classification soil samples. Field blanks will be obtained by pouring laboratory-demonstrated analyte-free water on or through a sampling device prior to use. The water will be collected off of the sampling device into a laboratory-provided sample container for analysis. Field blanks will be analyzed for the complete list of analytes specified above for soil waste classifications samples. If less than 20 samples are collected during a particular sampling event, one field blank sample will be collected. Trip blanks for VOC analysis will be collected at a rate of one per day.

Duplicate soil samples will be collected and analyzed for quality assurance purposes. Duplicate samples will be collected at a frequency of 1 per 20 waste classification soil samples and will be submitted to the laboratory as "blind" samples. If less than 20 samples are collected during a particular sampling event, one duplicate sample will be collected.

5.4 Sample Containers and Handling

Certified, commercially clean sample containers will be obtained from the analytical laboratory. The laboratory will also prepare and supply the required field blank sample containers and reagent preservatives. Sample containers, including the field blank containers, will be placed in plastic coolers by the laboratory. These coolers will be received by the field sampling team within 24 hours of their preparation in the laboratory. Prior to the commencement of field work, Langan field personnel will fill the plastic coolers with ice in Ziploc® bags (or equivalent) to maintain a temperature of 4°C±2° C.

Samples collected in the field for laboratory analysis will be placed directly into the laboratory-supplied sample containers. Samples, except indoor air and soil vapor samples, will then be placed and stored on-ice in laboratory provided coolers until shipment to the laboratory. The temperature in the coolers containing samples and associated field blanks will be maintained at a temperature of 4°C±2°C while on-site and during sample shipment to the analytical laboratory.

Possession of samples collected in the field will be traceable from the time of collection until they are analyzed by the analytical laboratory or are properly disposed. Chain-of-custody procedures, described in Section 5.9, will be followed to maintain and document sample possession. Samples will be packaged and shipped as described in Section 5.6.

5.5 Sample Preservation

Sample preservation measures will be used in an attempt to prevent sample decomposition by contamination, degradation, biological transformation, chemical interactions and other factors during the time between sample collection and analysis. Preservation will commence at the time of sample collection and will continue until analyses are performed. Should chemical preservation be required, the analytical laboratory will add the preservatives to the appropriate sample containers before shipment to the office or field. Samples will be preserved according to the requirements of the specific analytical method selected, as shown in Attachment C.

5.6 Sample Shipment

5.6.1 Packaging

Sample containers, except indoor air and soil vapor samples, will be placed in plastic coolers. Ice in Ziploc® bags (or equivalent) will be placed around sample containers. Cushioning material will be added around the sample containers if necessary. Chains-of-custody and other paperwork will be placed in a Ziploc® bag (or equivalent) and placed inside the cooler and custody seals will be affixed to one side of the cooler at a minimum. If the samples are being shipped by an express delivery company (third-party courier, e.g., FedEx) then laboratory address labels will be placed on top of the cooler.

5.6.2 Shipping

Standard procedures to be followed for shipping environmental samples to the analytical laboratory are outlined below.

- All environmental samples will be transported to the laboratory from the site or Langan office by a laboratory provided courier under the chain-of-custody protocols described in Section 5.9. A third-party courier may be used if necessary.
- Prior notice will be provided to the laboratory regarding when to expect shipped samples. If the number, type or date of shipment changes due to site constraints or program changes, the laboratory will be informed.

5.7 Decontamination Procedures

Though not anticipated, decontamination procedures will be used if non-dedicated sampling equipment is utilized during the IRM. Decontamination of field personnel is discussed in the site-specific Construction Health and Safety Plan (CHASP) included in Appendix D of the IRMWP. Field sampling equipment that is to be reused will be decontaminated in the field in accordance with the following procedures:

1. Laboratory-grade glassware detergent and tap water scrub to remove visual contamination
2. Generous tap water rinse
3. Distilled/de-ionized water rinse

5.8 Residuals Management

Debris (e.g., paper, plastic and disposable PPE) will be collected in plastic garbage bags and disposed of as non-hazardous industrial waste. Debris is expected to be transported to a local municipal landfill for disposal. If applicable, residual solids (e.g., leftover soil cuttings) will be placed back in the borehole from which it was sampled. If gross contamination is observed, soil will be collected and stored in Department of Transportation (DOT)-approved 55-gallon drums in a designated storage area at the site. The residual materials stored in a designated storage area at the site for further characterization, treatment or disposal.

5.9 Chain of Custody Procedures

A chain-of-custody protocol has been established for collected samples was and will be followed during sample handling activities in both field and laboratory operations. The primary purpose of the chain-of-custody procedures is to document the possession of the samples from collection through shipping, storage and analysis to data reporting and disposal. Chain-of-custody refers to actual possession of the samples. Samples are considered to be in custody if they are within sight of the individual responsible for their security or locked in a secure location. Each person who takes possession of the samples, except for third-party shipping couriers, is responsible for sample integrity and safe keeping. Chain-of-custody procedures are provided below:

- Chain-of-custody will be initiated by the laboratory supplying the pre-cleaned and prepared sample containers. Chain-of-custody forms will accompany the sample containers.
- Following sample collection, the chain-of-custody form will be completed for the samples collected. The sample identification number, date and time of sample collection, analysis requested and other pertinent information (e.g., preservatives) will be recorded on the form. Entries will be made in waterproof, permanent blue or black ink.
- Langan field personnel will be responsible for the care and custody of the samples collected until the samples are transferred to another party, dispatched to the laboratory, or disposed. The sampling/Field Team Leader will be responsible for enforcing chain-of-custody procedures during field work.
- When the form is full or when all samples have been collected that will fit in a single cooler, the sampling/Field Team Leader will check the form for

possible errors and sign the chain-of-custody form. Any necessary corrections will be made to the record with a single strike mark, dated, and initialed.

Samples will be packaged for shipment or pickup via courier to the laboratory with the appropriate chain-of-custody form. If applicable, a shipping bill will be completed for each cooler and the shipping bill number recorded on the chain-of-custody form. A copy of the form will be retained by the Langan sampling team for the project file, and the original will be sent to the laboratory with the samples. Bills of lading will also be retained as part of the documentation for the chain-of-custody records, if applicable. When transferring custody of the samples, the individuals relinquishing and receiving custody of the samples will verify sample numbers and condition and will document the sample acquisition and transfer by signing and dating the chain-of-custody form. This process documents sample custody transfer from the sampler to the analytical laboratory.

Laboratory chain-of-custody will be maintained throughout the analytical processes as described in the laboratory's Quality Assurance Manual. The analytical laboratory will provide a copy of the chain-of-custody in the analytical data deliverable package. The chain-of-custody becomes the permanent record of sample handling and shipment.

5.10 Laboratory Sample Storage Procedures

The subcontracted laboratory will use a laboratory information management system (LIMS) to track and schedule samples upon receipt by the analytical laboratories. Any sample anomalies identified during sample log-in must be evaluated on individual merit for the impact upon the results and the data quality objectives of the project. When irregularities do exist, Langan must be notified to discuss recommended courses of action and documentation of the issue must be included in the project file.

For samples requiring thermal preservation, the temperature of each cooler will be immediately recorded. Each sample and container will be assigned a unique laboratory identification number and secured within the custody room walk-in coolers designated for new samples. Samples will be, as soon as practical, disbursed in a manner that is functional for the operational team. The temperature of all coolers and freezers will be monitored and recorded using a certified temperature sensor. Any temperature excursions outside of acceptance criteria (i.e., below 2°C or above 6°C) will initiate an investigation to determine whether any samples may have been affected. Following analysis, the laboratory's specific procedures for retention and disposal will be followed as specified in the laboratory's SOPs and/or QA manual.

6.0 DATA REDUCTION, VALIDATION, AND REPORTING

6.1 Introduction

Data collected during the field investigation will be reduced and reviewed by the laboratory QA personnel, and a report on the findings will be tabulated in a standard format. The criteria used to identify and quantify the analytes will be those specified for the applicable methods in the USEPA SW-846 and subsequent updates. The data package provided by the laboratory will contain all items specified in the USEPA SW-846 appropriate for the analyses to be performed, and be reported in standard format.

The completed copies of the chain-of-custody records (both external and internal) accompanying each sample from time of initial bottle preparation to completion of analysis shall be attached to the analytical reports.

6.2 Data Reduction

The Analytical Services Protocol (ASP) Category B data packages and an electronic data deliverable (EDD) will be provided by the laboratory after receipt of a complete sample delivery group, not including the soil waste characterization samples. The Project Manager will immediately arrange for archiving the results and preparation of result tables. These tables will form the database for assessment of the site contamination condition.

Each EDD deliverable must be formatted using a Microsoft Windows operating system and the NYSDEC data deliverable format for EQuIS. To avoid transcription errors, data will be loaded directly into the American Standard Code for Information Interchange (ASCII) format from the LIMS. If this cannot be accomplished, the consultant should be notified via letter of transmittal indicating that manual entry of data is required for a particular method of analysis. All EDDs must also undergo a QC check by the laboratory before delivery. The original data, tabulations, and electronic media are stored in a secure and retrievable fashion.

The Project Manager or Task Manager will maintain close contact with the QA reviewer to ensure all non-conformance issues are acted upon prior to data manipulation and assessment routines. Once the QA review has been completed, the Project Manager may direct the Team Leaders or others to initiate and finalize the analytical data assessment.

6.3 Data Validation

Data validation will be performed in accordance with the USEPA validation guidelines for organic and inorganic data review. Validation will include the following:

- Verification of the QC sample results,
- Verification of the identification of sample results (both positive hits and non-detects),
- Recalculation of 10 percent of all investigative sample results, and
- Preparation of Data Usability Summary Reports (DUSR).

A DUSR will be prepared and reviewed by the QAO before issuance. The DUSR will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation and COC procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method. A detailed assessment of each SDG will follow. For each of the organic analytical methods, the following will be assessed:

- Holding times;
- Instrument tuning;
- Instrument calibrations;
- Blank results;
- System monitoring compounds or surrogate recovery compounds (as applicable);
- Internal standard recovery results;
- MS and MSD results;
- Target compound identification;
- Chromatogram quality;

- Pesticide cleanup (if applicable);
- Compound quantitation and reported detection limits;
- System performance; and
- Results verification.

For each of the inorganic compounds, the following will be assessed:

- Holding times;
- Calibrations;
- Blank results;
- Interference check sample;
- Laboratory check samples;
- Duplicates;
- Matrix Spike;
- Furnace atomic absorption analysis QC;
- Inductively couple plasma (ICP) serial dilutions; and
- Results verification and reported detection limits.

Based on the results of data validation, the validated analytical results reported by the laboratory will be assigned one of the following usability flags:

- "U" - Not detected. The associated number indicates the approximate sample concentration necessary to be detected significantly greater than the level of the highest associated blank;
- "UJ" - Not detected. Quantitation limit may be inaccurate or imprecise;
- "J" - Analyte is present. Reported value may be associated with a higher level of uncertainty than is normally expected with the analytical method;
- "N" – Tentative identification. Analyte is considered present in the sample;
- "R" – Unreliable result; data is rejected or unusable. Analyte may or may not be present in the sample; and,
- No Flag - Result accepted without qualification.

7.0 QUALITY ASSURANCE PERFORMANCE AUDITS AND SYSTEM AUDITS

7.1 Introduction

Quality assurance audits may be performed by the project quality assurance group under the direction and approval of the QAO. These audits will be implemented to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement system(s). Functioning as an independent body and reporting directly to corporate quality assurance management, the QAO may plan, schedule, and approve system and performance audits based upon procedures customized to the project requirements. At times, the QAO may request additional personnel with specific expertise from company and/or project groups to assist in conducting performance audits. However, these personnel will not have responsibility for the project work associated with the performance audit.

7.2 System Audits

System audits may be performed by the QAO or designated auditors, and encompass a qualitative evaluation of measurement system components to ascertain their appropriate selection and application. In addition, field and laboratory quality control procedures and associated documentation may be system audited. These audits may be performed once during the performance of the project. However, if conditions adverse to quality are detected or if the Project Manager requests, additional audits may occur.

7.3 Performance Audits

The laboratory may be required to conduct an analysis of Performance Evaluation samples or provide proof that Performance Evaluation samples submitted by USEPA or a state agency have been analyzed within the past twelve months.

7.4 Formal Audits

Formal audits refer to any system or performance audit that is documented and implemented by the QA group. These audits encompass documented activities performed by qualified lead auditors to a written procedure or checklists to objectively verify that quality assurance requirements have been developed, documented, and instituted in accordance with contractual and project criteria. Formal audits may be performed on project and subcontractor work at various locations.

Audit reports will be written by auditors who have performed the site audit after gathering and evaluating all data. Items, activities, and documents determined by lead auditors to be in noncompliance shall be identified at exit interviews conducted with the involved management. Non-compliances will be logged, and documented through audit findings, which are attached to and are a part of the integral audit report. These audit-finding forms are directed to management to satisfactorily resolve the noncompliance in a specified and timely manner.

The Project Manager has overall responsibility to ensure that all corrective actions necessary to resolve audit findings are acted upon promptly and satisfactorily. Audit reports must be submitted to the Project Manager within fifteen days of completion of the audit. Serious deficiencies will be reported to the Project Manager within 24 hours. All audit checklists, audit reports, audit findings, and acceptable resolutions are approved by the QAO prior to issue. Verification of acceptable resolutions may be determined by re-audit or documented surveillance of the item or activity. Upon verification acceptance, the QAO will close out the audit report and findings.

8.0 CORRECTIVE ACTION

8.1 Introduction

The following procedures have been established to ensure that conditions adverse to quality, such as malfunctions, deficiencies, deviations, and errors, are promptly investigated, documented, evaluated, and corrected.

8.2 Procedure Description

When a significant condition adverse to quality is noted at site, laboratory, or subcontractor location, the cause of the condition will be determined and corrective action will be taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the QAO, Project Manager, Field Team Leader and involved contractor management, at a minimum. Implementation of corrective action is verified by documented follow-up action.

All project personnel have the responsibility, as part of the normal work duties, to promptly identify, solicit approved correction, and report conditions adverse to quality. Corrective actions will be initiated as follows:

- When predetermined acceptance standards are not attained;
- When procedure or data compiled are determined to be deficient;
- When equipment or instrumentation is found to be faulty;
- When samples and analytical test results are not clearly traceable;
- When quality assurance requirements have been violated;
- When designated approvals have been circumvented;
- As a result of system and performance audits;
- As a result of a management assessment;
- As a result of laboratory/field comparison studies; and,
- As required by USEPA SW-846, and subsequent updates, or by the NYSDEC ASP.

Project management and staff, such as field investigation teams, remedial response planning personnel, and laboratory groups, monitor on-going work performance in the normal course of daily responsibilities. Work may be audited at the sites, laboratories, or contractor locations. Activities, or documents ascertained to be noncompliant with quality assurance requirements will be documented. Corrective actions will be mandated through audit finding sheets attached to the audit report. Audit findings are logged, maintained, and controlled by the Task Manager.

Personnel assigned to quality assurance functions will have the responsibility to issue and control Corrective Action Request (CAR) Forms (Figure 8.1 or similar). The CAR identifies the out-of-compliance condition, reference document(s), and recommended corrective action(s) to be administered. The CAR is issued to the personnel responsible for the affected item or activity. A copy is also submitted to the Project Manager. The individual to whom the CAR is addressed returns the requested response promptly to the QA personnel, affixing his/her signature and date to the corrective action block, after stating the cause of the conditions and corrective action to be taken. The QA personnel maintain the log for status of CARs, confirms the adequacy of the intended corrective action, and verifies its implementation. CARs will be retained in the project file for the records.

Any project personnel may identify noncompliance issues; however, the designated QA personnel are responsible for documenting, numbering, logging, and verifying the close out action. The Project Manager will be responsible for ensuring that all recommended corrective actions are implemented, documented, and approved.

FIGURE 8.1

CORRECTIVE ACTION REQUEST

Number: ____________________________ Date: _____________

TO: ____

You are hereby requested to take corrective actions indicated below and as otherwise determined by you to (a) resolve the noted condition and (b) to prevent it from recurring. Your written response is to be returned to the project quality assurance manager by _______________

CONDITION:

REFERENCE DOCUMENTS:

RECOMMENDED CORRECTIVE ACTIONS:

__________	______	__________	________	___________	________
Originator	Date	Approval	Date	Approval	Date

RESPONSE

CAUSE OF CONDITION

CORRECTIVE ACTION

(A) RESOLUTION

(B) PREVENTION

(C) AFFECTED DOCUMENTS

C.A. FOLLOWUP:

CORRECTIVE ACTION VERIFIED BY: ____________________________ DATE:_____________

9.0 REFERENCES

NYSDEC. Division of Environmental Remediation. DER-10/Technical Guidance for Site Investigation and Remediation, dated May 3, 2010.

NYSDOH. Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, dated October 2006.

Taylor, J. K., 1987. Quality Assurance of Chemical Measurements. Lewis Publishers, Inc., Chelsea, Michigan

USEPA, 1986. SW-846 "Test Method for Evaluating Solid Waste," dated November 1986. U.S. Environmental Protection Agency, Washington, D.C.

USEPA, 1987. Data Quality Objectives for Remedial Response Actions Activities: Development Process, EPA/540/G-87/003, OSWER Directive 9355.0-7 - U.S. Environmental Protection Agency, Washington, D.C.

USEPA, 1992a. CLP Organics Data Review and Preliminary Review. SOP No. HW-6, Revision #8, dated January 1992. USEPA Region II.

USEPA, 1992b. Evaluation of Metals Data for the Contract Laboratory Program (CLP) based on SOW 3/90. SOP No. HW-2, Revision XI, dated January 1992. USEPA Region II.

USEPA. Hazardous Waste Support Section. Analysis of Volatile Organic Compounds in Air Contained in Canisters by Method TO-15. SOP No. HW-31, Revision #6, dated June 2014.

FIGURES

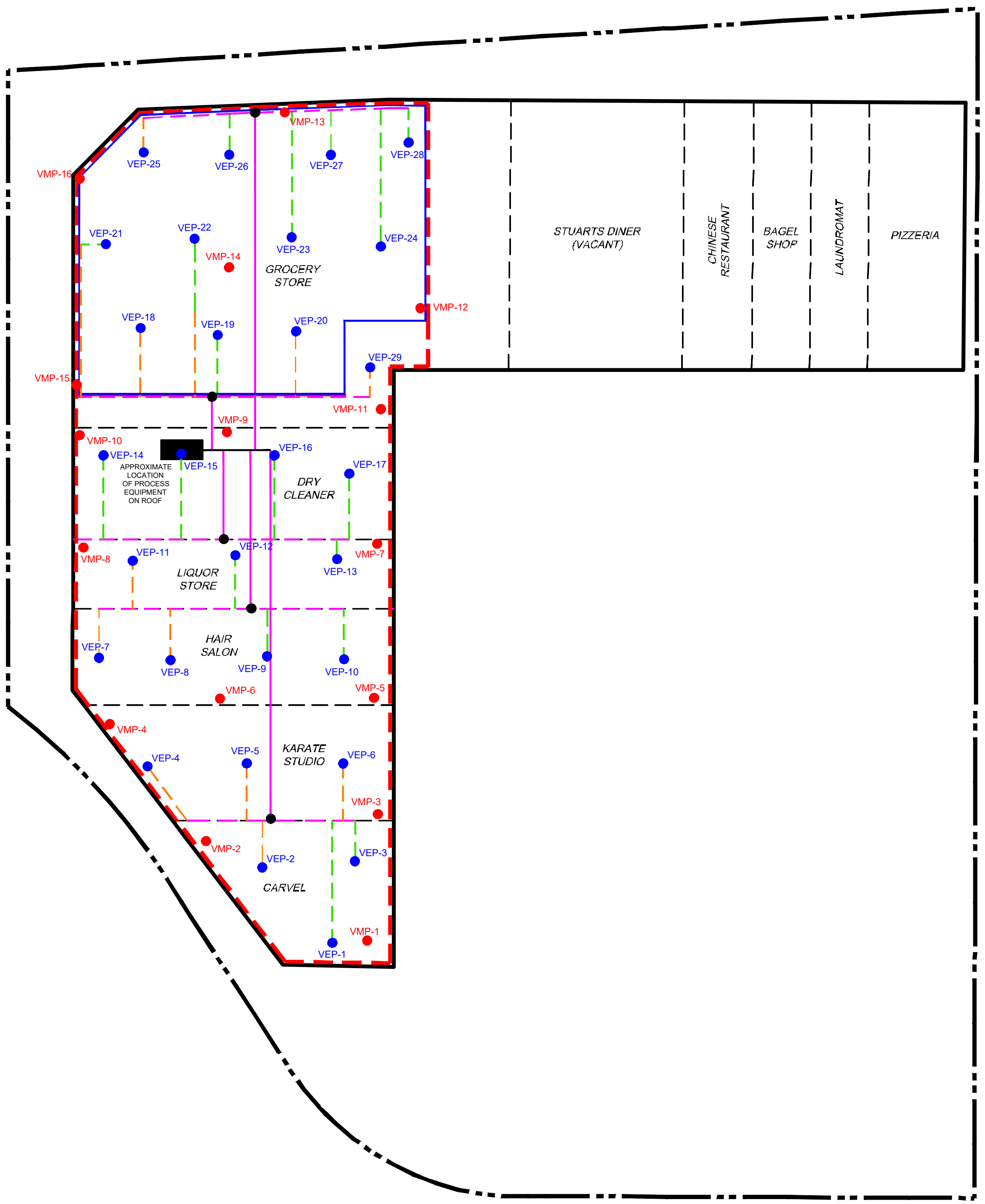
2,000 0 2,000

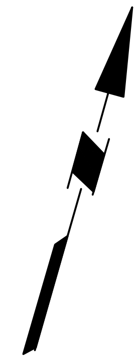
SCALE IN FEET

Notes:
1. USGS Topographic basemap is provided through Langan's Esri ArcGIS software licensing and ArcGIS Online.
2. Parcel information from MapPLUTO 18v2 copyrighted by the New York City Department of Planning, last updated 2018.

LANGAN 300 Kimball Drive Parsippany, NJ 07054 T: 973.560.4900 F: 973.560.4901 www.langan.com Langan Engineering & Environmental Services, Inc. Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C. Langan International LLC Collectively known as Langan NJ CERTIFICATE OF AUTHORIZATION No. 24GA27996400	Project **990-1026 ROSSVILLE AVENUE** BLOCK No. 7054, LOT No. 518 CITY OF STATEN ISLAND RICHMOND COUNTY NEW YORK	Drawing Title **USGS SITE LOCATION MAP**	Project No. 100849501 Date 2/28/2020 Scale 1 " = 2,000 ' Drawn By KMB	Figure 1

Path: \\langan.com\data\PAR\data5\100849501\Project Data\ArcGIS\Export\PDF\Env_Figures\2020-02 QAPP\Figure 1 - Site Location Map.mxd Date: 2/28/2020 User: ibaker Time: 12:01:22 PM



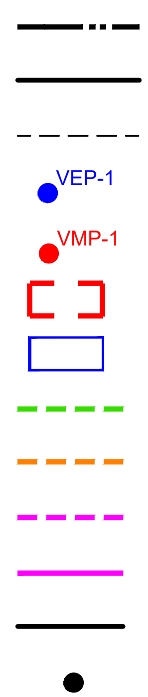


NOTES:

PVC - POLYVINYL CHLORIDE
SCH - SCHEDULE
SSDS - SUB-SLAB DEPRESSURIZATION SYSTEM
VEP - VAPOR EXTRACTION POINT
VMP - VACUUM MONITORING POINT

1. THE PROPOSED MITIGATION AREA IS BASED ON THE RESULTS OF THE INDOOR AIR SAMPLING COMPLETED BY LANGAN ON 21 AND 22 JANUARY 2020. THE INDOOR AIR ANALYTICAL RESULTS IDENTIFIED CONCENTRATIONS OF TETRACHLOROETHENE (PCE), TRICHLOROETHENE (TCE), CIS-1,2-DICHLOROETHENE (DCE), AND VINYL CHLORIDE IN EXCESS OF THE USEPA VAPOR INTRUSION SCREENING LEVEL FOR COMMERCIAL/INDUSTRIAL INDOOR AIR WITHIN THE PROPOSED MITIGATION AREA.
2. THE PROPOSED FULL-SCALE VEP, VMP, AND SYSTEM MANIFOLD PIPING LOCATIONS ARE SUBJECT TO CHANGE BASED ON THE OBSERVED FIELD CONDITIONS (I.E., ABOVE GROUND AND/OR BELOW GRADE BUILDING ELEMENTS).
3. THE PROPOSED VEP LOCATIONS AND ASSOCIATED MANIFOLD PIPING HAVE BEEN CO-LOCATED WITH BUILDING WALLS, TO THE EXTENT POSSIBLE, TO MINIMIZE TRENCHING AND DISTURBANCE TO NORMAL BUSINESS OPERATIONS FOLLOWING SYSTEM INSTALLATION.
4. THE PROPOSED VEP LOCATIONS ARE TO BE PIPED VERTICALLY VIA 2-INCH INDIVIDUAL LINES. IN SOME CASES, THE 2-INCH INDIVIDUAL VEP LINE MAY NEED TO FIRST BE TRENCHED BENEATH THE EXISTING BUILDING SLAB TO THE NEAREST BUILDING WALL AND THEN TRANSITION TO VERTICAL. EACH 2-INCH INDIVIDUAL VEP LINE, ONCE RUN TO THE CEILING OF THE BUILDING, WILL MANIFOLD INTO A 4-INCH SUBHEADER LINE WHICH WILL RUN ALONG THE INTERIOR OF THE BUILDING AT CEILING LEVEL. EACH 4-INCH SUBHEADER LINE WILL MANIFOLD FIVE OR SIX VEP LOCATIONS (THIS MAY CHANGE BASED ON FINAL WELL LAYOUT). THE 4-INCH SUBHEADER LINE WILL EXIT THE BUILDING ROOF AND WILL BE PIPED TO ROOF-MOUNTED PROCESS EQUIPMENT. PRIOR TO THE PROCESS EQUIPMENT, THE SUBHEADER LINES WILL MANIFOLD INTO A 6-INCH MAIN HEADER LINE ON THE ROOF. ANY BELOW GRADE OR ABOVE GROUND EXTERIOR PIPING WILL BE CONSTRUCTED OF SCH40 PVC. EXTERIOR PIPING WILL ALSO BE EQUIPPED WITH INSULATION. ANY ABOVE GROUND INTERIOR PIPING WILL BE CONSTRUCTED OF METAL.
5. THE MANIFOLD PIPING HAS BEEN DESIGNED SUCH THAT IF IN THE FUTURE IT IS DETERMINED THAT ACTIVE OPERATION OF THE FULL-SCALE SSDS IS NO LONGER NECESSARY, THE SYSTEM CAN BE CONVERTED TO PASSIVE OPERATION (EACH 4-INCH SUBHEADER LINE CAN BE EQUIPPED WITH A DISCHARGE STACK AND TURBINE.
6. ALL SSDS MANIFOLD PIPING MUST BE CLEARLY LABELED.
7. SSDS EXHAUST TO MAINTAIN MINIMUM 10-FOOT CLEARANCE OF ANY WINDOW, DOOR OR INTAKE.
8. EACH INDIVIDUAL VEP LINE WILL BE EQUIPPED WITH A VACUUM GAUGE GATE VALE, AND SAMPLE PORT FOR MONITORING AND PERFORMANCE ADJUSTMENTS. THE WELL-SPECIFIC INSTRUMENTATION WILL BE LOCATED ABOVE-GROUND AND WILL BE ACCESSIBLE FOR FUTURE ACCESS.
9. THE SSDS PROCESS EQUIPMENT WILL BE INSTALLED ON THE ROOF OF THE EXISTING BUILDING IN A NOISE AND WEATHER-PROOF ENCLOSURE.
10. VISUAL DAMAGE AND/OR DEFECTS TO THE EXISTING NORTH BUILDING SLAB [I.E., CRACKS] WHICH MAY COMPROMISE THE INTEGRITY AND CONFINING NATURE OF THE SLAB MUST BE REPAIRED, AS REQUIRED.

LEGEND:



— · · —	PROPERTY LINE
———	EXISTING BUILDING OUTLINE
— — —	INTERIOR WALL
VEP-1	SSDS FULL-SCALE VEP
VMP-1	SSDS FULL-SCALE VMP
	PROPOSED SSDS MITIGATION AREA
	APPROXIMATE BASEMENT EXTENTS
	INDIVIDUAL BELOW GRADE WELL LINE (SCH40 PVC)
	INDIVIDUAL ABOVE GROUND WELL LINE (2-INCH METAL)
	INTERIOR SUBHEADER LINE (4-INCH METAL)
	EXTERIOR SUBHEADER LINE (4-INCH SCH40 PVC)
	EXTERIOR MAIN HEADER LINE (6-INCH SCH40 PVC)
●	ROOF PENETRATION LOCATION

40 0 10 25 40
SCALE: 1 INCH = 40 FEET

SIGNATURE / DATE SIGNED	LANGAN	Project	Drawing Title	Project No. / Date / Drawn By / Checked By	Drawing No.
STEWART ABRAMS PROFESSIONAL ENGINEER NY LIC. No. 078833-1	Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C. 300 Kimball Drive Parsippany, NJ 07054 T: 973.560.4900 F: 973.560.4901 www.langan.com NJ Certificate of Authorization No.24GA27996400	990-1026 ROSSVILLE AVENUE BLOCK No. 7054, LOT No. 518 STATEN ISLAND NEW YORK	FULL-SCALE SSDS MANIFOLD LAYOUT	Project No. 100849501; Date 02/28/2020; Drawn By AC; Checked By BR	2

ATTACHMENT A

Resumes

EMILY G. STRAKE

PROJECT CHEMIST / RISK ASSESSOR

ENVIRONMENTAL ENGINEERING

Ms. Strake has 17 years of environmental chemistry, risk assessment, auditing, and quality assurance experience. Most recently, she has focused her efforts on human health risk assessment, and has been the primary author or key contributor of risk assessment reports and screening evaluations for projects governed under RCRA, CERCLA, NJDEP, DNREC, SWRCB, DTSC, PADEP, CTDEEP, ODEQ, NYSDEC and MDE. She has experience in site-specific strategy development, which has enabled her to perform assessments to focus areas of investigation and identify risk-based alternatives for reducing remediation costs. Ms. Strake is a member of the Interstate Technology and Regulatory Council Risk Assessment Team responsible for the development and review of organizational risk assessment guidance documents and serves as a National Trainer in risk assessment for the organization.

Ms. Strake has extensive experience in environmental data validation, focused on ensuring laboratory deliverables follow specific guidelines as described by regulatory agencies and the analytical methods employed. In addition, she has experience in EQuIS chemical database management. She also has a broad range of environmental field experience and maintains current OSHA HAZWOPER certification. Ms. Strake is experienced in auditing laboratory and field-sampling activities for compliance with Quality Assurance Project Plans (QAPPs), the National Environmental Laboratory Accreditation Conference Standards Quality Systems manual, and applicable USEPA Guidance. Ms. Strake has also audited on-site laboratories in support of groundwater treatment operations and implemented corrective actions. Her responsibilities include writing reports on the value of laboratory work, writing/editing QAPPs for clients and project-specific sites, peer reviewing colleague's work, and mentoring staff within the office. She has also served as the Quality Assurance officer for several long-term projects, responsible for the achievement of all forms of Quality Control/Quality Assurance by onsite personnel relating to sampling, analysis, and data evaluation.

SELECTED PROJECTS

- Sunoco Refineries, Various Locations
- PECO/Exelon, Various Locations
- Avon, Rye, NY
- Honeywell, Highland Park, NJ
- Delaware City Refinery, DE
- Major League Soccer's San Jose Earthquakes Stadium, Santa Clara, CA
- DuPont, Waynesboro, VA
- Texas Instruments, San Francisco, CA
- Regency, Philadelphia, PA
- Veteran's Affairs, Palo Alto, CA
- DOW Chemical, Various Locations
- Golden Gate National Parks Conservancy, San Francisco, CA
- Occidental Chemical, Bakersfield, CA

EDUCATION

MBA
The University of Scranton

B.S., Chemistry
Cedar Crest College

PROFESSIONAL REGISTRATION

Board Certified Environmental Professional (CEP)

TRAINING

40 HR OSHA HAZWOPER Training/Nov 2002

8 HR HAZWOPER Supervisor/June 2004

8 HR OSHA HAZWOPER Refresher/2013

AFFILIATIONS

The Society for Risk Analysis

Interstate Technology and Regulatory Council

- Floreffe Terminal, Pittsburgh, PA
- Ryder, Hartford, CT
- Rohm and Haas, Philadelphia, PA

BRANDON REINER, EIT

SENIOR STAFF ENGINEER

ENVIRONMENTAL ENGINEERING

Mr. Reiner has 4 years of experience in environmental engineering. His responsibilities include conducting field investigations as well as providing oversight on environmental construction and remediation projects throughout the New York & New Jersey area.

SELECTED PROJECTS

- 100 Middlesex Avenue, Carteret, NJ
- 101 Murray Street, New York, NY
- 110 University Place, New York, NY
- 111 Washington Street Development, New York, NY
- 1525 Bedford Avenue, Brooklyn, NY
- 158 Bergen Turnpike, Ridgefield Park, NJ
- 1681-1693 Third Avenue Development, New York, NY
- 1766-1768 Second Avenue, New York, NY
- 17th Street Development, New York, NY
- 228 Cherry Street, New York, NY
- 365 Bond Street Residential Development, Brooklyn, NY
- 432 Rodney Street, Brooklyn, NY
- 50 Norfolk Street, New York, NY
- 530-548 West 53rd/543 West 52nd Street, New York, NY
- 536-544 W. 26th St. Development, New York, NY
- 545 Sackett Street, Brooklyn, NY
- Brodson, Montville, NJ
- City Point Tower 3 / 138 Willoughby St, Brooklyn, NY
- Collegiate School New Building Project, New York, NY
- Con Edison 11th Ave & 50th St. Spill, New York, NY
- Dwight-Englewood School Village Project, Englewood, NJ
- Fresh Direct Warehouse, Bronx, NY
- Hess Terminal, Edgewater, NJ
- Horace Mann School, New Buildings
- Lowe’s Home Improvement Store, Eatontown, NJ
- Marble Collegiate Church Office Building, New York, NY
- 700 Jackson Redevelopment and Resiliency Park, Hoboken, NJ
- NPL Environmental Due Diligence, Old Bridge, NJ
- NYU Langone Medical Center, Tisch Hospital Courtyard, New York, NY
- Pan Graphics, Lodi, NJ
- Project P Development, New York, NY
- Stop & Shop, Emerson, NJ
- Village Green Marketplace, Chestnut Ridge, NY

EDUCATION

B.S., Civil/Environmental Engineering
Pennsylvania State University

PROFESSIONAL REGISTRATION

Engineer in Training (EIT)

AFFILIATIONS

American Society of Civil Engineers

Jessica Friscia

Senior Staff Engineer
Environmental Engineering

4 years in the industry ~ 4 years with Langan

Ms. Friscia's experience includes field work and office work on environmental investigation and remediation projects across New Jersey and New York. Her field work experience includes soil, soil vapor, and groundwater sampling; drilling oversight; air monitoring; soil management; and remediation oversight, including excavation, zero-valent iron injections, air sparge/SVE system installation, MPE system installation, and SSDS installation. Her office work experience includes EQuIS database management, data evaluation, remedial design, and report work, including, but not limited to, Phase I ESAs, Preliminary Assessment/Site Investigations, Remedial Investigation Reports, Remedial Action Work Plans, and Remedial Action Reports.

Selected Projects

Former Penick Corporation Facility RCRA Site, Montville, NJ – Remedial Investigation, Remedial Design, Remedial Pilot Testing, Remedial Action

Bond Street Brownfields Redevelopment Site, Brooklyn, NY – Remedial Investigation, Remedial Action, EPA-approved Bulkhead Installation along Gowanus Canal Superfund Site

Former Pan Graphics Facility, Garfield, NJ – Remedial Monitoring

Former Flintkote Company Facility Site, East Rutherford, NJ – Remedial Action
Former Agricultural Research Facility, West Windsor, NJ – Due Diligence File Review

Liberty Plaza VCP Site, Randallstown, MD – Remedial Investigation, Remedial Action

Consolidated Edison Site, New York, NY – Remedial Alternative Evaluation
Kent Avenue Site, Brooklyn, NY – Due Diligence, Remedial Alternative Cost Estimation

505 West 19th Street NYCOER E-Designated Site, New York, NY – Remedial Investigation

401 Washington Street NYCOER E-Designated Site, New York, NY – Remedial Investigation

400 Park Avenue South Site NYCOER E-Designated Site, New York, NY – Remedial Investigation, Remedial Action

Education

M.E., Environmental and Water Quality Engineering
Massachusetts Institute of Technology

B.E., Civil Engineering
The Cooper Union for the Advancement of Science and Art

Professional Registration

Engineer in Training: NY

OSHA 40-Hour HAZWOPER 29 CFR 1910.120(e)(4) Certification

LANGAN

Christopher McMahon, CHMM

Associate

Brownfield Redevelopment, Environmental Site Assessments, Site Investigation/Remedial Actions, Vapor Intrusion Investigations

15 years in the industry ~ 9 years with Langan

Mr. McMahon is a consulting geologist whose primary focus within his tenure at Langan has been in providing environmental support to redevelopment sites within the metropolitan New York area. He has experience with projects in the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup, Voluntary Cleanup and Spill Programs, and New York City Office of Environmental Remediation E-Designated and New York City Voluntary Cleanup Program sites. These projects have included the completion of Phase I environmental site assessments, Phase II and remedial investigations, UST closures, NYSDEC closures and remedial excavation oversight for off-site disposal and/or treatment. Mr. McMahon also has significant field experience including implementation and management of all phases of environmental projects involving soil, sediment, groundwater, surface water, and soil vapor contamination including Phase I inspections, Phase II site investigations, Remedial Investigations, and Remedial Actions.

Many of these projects have included his oversight of remedial actions to clean up or mitigate hazardous waste sites in rural, urban, and industrial settings. These remedial action designs have included in-situ soil remedial injections, contaminated soil removal/disposal management plans, and soil vapor intrusion mitigation systems including advanced vapor barriers and sub-slab depressurization systems.

Selected Projects

NYSDEC Brownfield Redevelopment 363 and 365 Bond Street, Brooklyn, NY
NYSDEC Brownfield Redevelopment, Fashion Outlets of Niagara Falls, NY
NYSDEC Spills Redevelopment, 540 West 26th Street, New York, NY
NYSDEC Spills Redevelopment, 101 Murray Street, New York, NY
NYSDEC Spills Redevelopment, 110 University Place, New York, NY
NYSDEC Spills Redevelopment, Grant Park, Yonkers, NY
NYSDEC Spills Redevelopment, The Shops At Nanuet, Nanuet, NY
NYCOER E-Designation Remediation, 505 W 19th Street, New York, NY
NYCOER E-Designation Remediation, 53 West 53rd Street, New York, NY
NYCOER E-Designation Remediation, 525 West 52nd Street, New York, NY
NYCOER E-Designation Remediation, 412 Greenwich Street, New York, NY
NYCOER E-Designation Remediation, 508 West 24th Street, New York, NY
NYSDEC (Region 7) Site Remedial Investigation, Hillcrest, NY
Former Manufactured Gas Plant Site Remedial Investigation, Geneva, NY
NYSDEC (Region 2) Superfund Site Remedial Investigation, Jamaica, NY
NYSDEC (Region 5) Superfund Site Remedial Investigation, Whitehall, NY
Former Manufactured Gas Plant Site Investigation/Confidential Client, Mechanicville, NY
Remedial Investigation of Industrial Facility/Confidential Client, Batavia, NY
OGS Geotechnical Survey for Construction, Rome, NY

Education

B. A., Geology, State University of New York College at Potsdam
With Honors in Geology and Environmental Science

Professional Registration

Certified Hazardous Materials Manager (CHMM)

OSHA 29 CFR 1910.120 Certification for Hazardous Waste Operations and Emergency Response

OSHA Certification for Hazardous Waste Site Supervisor

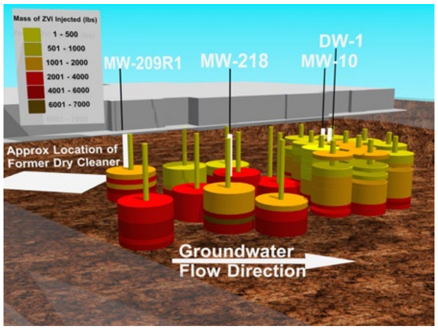
Red Cross CPR & First Aid Training

LANGAN

STEWART H. ABRAMS, PE

PRINCIPAL/VICE PRESIDENT

CORPORATE DIRECTOR OF REMEDIATION TECHNOLOGY



Brixmor – Randallstown, MD


New Jersey Turnpike, Cranbury, NJ

Mr. Abrams has close to 40 years of experience in site remediation, groundwater remediation, Brownfields redevelopment, water treatment and engineering design. He is an expert in remedial technology, with particular emphasis on bioremediation, chemical oxidation/reduction technologies, soil vapor extraction and air sparging. He also has extensive experience in water process engineering, notably water and wastewater treatment and industrial waste treatment for both organics and metals. He has recently become involved in the emerging field of Sustainable Remediation. Previous to joining Langan, Mr. Abrams held positions of National Practice Leader for Remediation at a major national consulting and engineering company and as Vice President of Operations at an environmental R&D firm.

SELECTED PROJECTS

Brixmor – Randallstown, MD – Directed the use of injected zero valent iron at a Brownfields site for the remediation of chlorinated solvents. Pneumatic fracturing used to inject 500,000 pounds of micro-scale iron into the shallow bedrock source zone. This resulted in remediation of the 20,000 square foot source zone and conditions favorable to the long term natural attenuation of the plume.

New Jersey – Directed the in situ remediation of hexavalent chromium through the use of calcium polysulfide (CaSx) addition injection. Injections performed both inside the building as well as outside. Pneumatic fracturing used to remediation in shallow bedrock. Monitoring showed that concentrations in the source area groundwater declined to non-detect from 15,000 ug/l in less than 1 week time.

New Jersey Turnpike, Cranbury, NJ – Managed design (pilot testing, conceptual, and plans and specifications) of remediation system consisting of 77 air sparging wells and 37 SVE wells for New Jersey Turnpike at the Molly Pitcher Service Area. Oversaw installation and system start-up. Innovative one-day duration AS/SVE pilot test. Volatilization and destruction of 10,000 gallons of subsurface free product. First use of catalytic oxidation at a Turnpike facility for air pollution control. Performed under subcontract to WBE contractor, PARS Environmental, Inc.

EDUCATION

M.Sc., Environmental Sciences Rutgers University, 1991

Graduate Studies in Public Administration
New York University

B.Sc., Civil Engineering
Rutgers University, 1981

B.A., Political Science
Rutgers University, 1981

PROFESSIONAL REGISTRATION

Professional Engineer (PE) in NJ, NY, PA, NC

New Jersey Subsurface Evaluator and UST Certification

Underground Storage Tank in NJ

AFFILIATIONS

Sustainable Remediation Forum (SURF) (2009 – present)

ITRC Integrated Chlorinated Site Remedy Committee (2007 – 2009)

NJDEP Advisory Council on Environmental Justice (2002 - 2004, 2006 - 2013)

LANGAN

GE – Schenectady, NY – Served as Technical Director of the design of a comprehensive remediation program for a New York State site involving the bioremediation of three separate VOC plumes, as well as the collection and treatment of leachate seeps. Supported GE Researchers in the design and execution of a laboratory flow through column test utilizing innovative sulfate reduction techniques to remediate a BTEX plume. In turn, lead the scale up of this column study into a design.

United Technologies Corporation, Lodi, NJ – Oversaw the design and implementation of a dual-phase soil vapor extraction system of 60 wells. Led the design and operation of in-situ bioremediation for the cleanup of toluene-contaminated groundwater. Hydrogen peroxide was used as the oxygen source in fractured bedrock in this early bioremediation project (1992). Recirculation of bedrock water with minimal treatment. Negotiated NJPDES DGW permit. Designed iron removal system.

BROS Superfund Site, Bridgeport, NJ – Directed extensive laboratory treatability studies and design scale-up of aerobic and anaerobic bioremediation, in situ Fenton's reagent for chlorinated solvents and BTEX and cometabolic testing of BCEE degradation. Bench testing was correlated to site conceptual model, with particular tests tailored to conditions in specific segments and zones of the aquifer. This included detailed work plans for submission to USEPA Laboratories in Cincinnati and Oklahoma.

Sunoco, Blackwood, NJ – First use of propane injection at a gasoline station site for the purpose of bioremediating MTBE. Combined use of low-level propane with air biosparging has been shown to promote the direct remediation of ethers, notably MTBE. MTBE concentrations driven to non-detect in less than 4 months.

First Morris Bank, Former Morris Graphics Facility, Morristown, NJ – Performed pilot testing, design, construction and O&M of 20-well dual-phase extraction soil vapor extraction system in an urban neighborhood. Included installation within the building footprint.

Woodlands Superfund Site, Woodland Twp, NJ – As a subcontractor to de maximis, inc., directed the subsurface design, installation and testing of a major air sparging/SVE system (+200 vertical wells) for a Superfund site in southern New Jersey. Work involved air sparging pilot testing, SVE pneumatic modeling, early use of CPT/MIPS, and an extensive well installation utilizing sonic drilling.

Massachusetts – Site with both Cr+6 and TCE contamination being contained by a pump & treat system. Pursued pump & treat shutdown strategy through a wide range of both chemical and biological reducing agents that were laboratory tested and reviewed as part of a comprehensive feasibility study. Zero-valent iron, bioremediation, calcium polysulfide, and ferrous sulfate were all lab-tested. Directed the field pilot testing of bioaugmentation and nano-scale zero valent iron at the sites. Bioaugmentation selected for full scale, since it was highly effective for both Cr+6 and TCE.

New Jersey – Innovative first use of aerobic bioaugmentation for the shutdown of a 20-year pump & treat system in 1995. TCE and daughter products were the contaminants of concern. Shut-down occured over a six-

Governor-elect Corzine Environmental Policy Transition Committee (2005 – 2006)

NJDEP Remediation Stakeholders Committee (2007 - 2009)

Sustainable Cherry Hill – Board of Trustees (2008 – 2011) month period through the repeated injection of bioaugmentation culture.

New Jersey – Directed the use of injected zero valent iron at a northern New Jersey site for the remediation of chlorinated solvents. Pneumatic fracturing used to inject micro-scale iron into recovery zone. Temporary shutdown permission obtained from NJDEP. Injection a significant success, resulting in permanent cessation of pump and treat activities at the site, resulting in considerable cost savings to the client.

New Jersey – Directing the injection of emulsified vegetable oil, followed by bioaugmentation culture, in an aquifer contaminated with PCE. Aquifer preconditioned with baker's yeast and sugar, prior to injection of EVO. Bioaugmentation activities completed in April 2012. Second source area to be remediated via in situ thermal remediation in 2014.

Greenberg Gibbons Commercial, Annapolis, MD – Directed the injection of over 400,000 pounds of potassium permanganate for chlorinated solvent destruction at a large Brownfields site in Maryland. Extensive use of horizontal wells. Work performed under a fixed price contract with blended finite insurance. This project was awarded the prestigious Phoenix Award for EPA Region 3 by the National Brownfields Association.

SELECTED PUBLICATIONS, REPORTS, AND PRESENTATIONS

Evaluation of Remedial Alternatives via Three Bench-Scale Treatability Studies for a Mixed Dense Non-Aqueous Phase Plume. Battelle International Symposium on Bioremediation and Sustainable Environmental Technologies. Jacksonville, FL (June 2013).

Sustainable Remediation and SURF. RE3 Conference. Atlantic City, NJ (November 2012).

Application of Pneumatic Fracturing and Zero-Valent Iron for a Maryland Brownfield Site. Battelle International Symposium on In-Situ and Sustainable Technologies. Monterey, CA (May 2012).

Integrating Remediation and Redevelopment. Honeywell "All-Hands" RES Meeting. Morristown, NJ (December 2011).

Assessing Innovative Remedial Technologies. Presented to Environmental Bankers Association, Charlotte, NC (January 2009).

Time, Cost & Effectiveness: Assessing Innovative Remedial Technologies. Presented at ITRC/Langan Conference, East Brunswick, NJ (June 2008).

Remediation Technology Pitfalls. Prudential Realty Investors Conference, New Orleans, LA (December 2008).

Selecting Innovative Remedial Technologies. Presented at NJ Innovative Environmental Technology Conference, Newark, NJ (October 2007).

Bioaugmentation for Site Remediation. Presented at AWMA Central New York Conference, Syracuse, NY (March 2007).

Selecting Innovative Remedial Technologies. NJ Innovative Environmental Technology Conference, Newark, NJ (October 2007).

Use of Persulfate for MTBE Remediation. By Abrams, S.H. & E. Mott-Smith, et al., AEHS West Conference, San Diego, CA (March 2006).

Innovative Approaches to Chlorinated Solvent Remediation. Presentation to conference of Envirogen clients. Oak Brook, IL (May 2002).

Bioremediation. Guest Lecturer, Rutgers Graduate School, New Brunswick, NJ (October 2001).

Biosparging and Bioventing for In Situ Cleanup. Guest Lecturer, Rutgers Graduate School, New Brunswick, NJ (April 1995).

NPDES Permitting in the Pulp & Paper Industry. Presented at TAPPI Delaware Valley Section Meeting, Yardley, PA (November 1991).

Strategies to Minimize Liabilities Under the New Jersey Clean Water Enforcement Act. Presented to New Jersey Business & Industry Association, West Windsor, NJ (October 1990).

Meeting EPA's Organic Chemicals Plastics and Synthetic Fibers Pretreatment Regulations. Presented at the Mid-Atlantic Industrial Waste Conference, Harrisburg, PA (June 1989).

Design of Packed Columns for Water Treatment. Guest Lecturer – Rutgers Graduate School, New Brunswick, NJ (March 1987).

Columns for Water Treatment. Guest Lecturer - Rutgers Graduate School, New Brunswick, NJ.

Workshop on Response to Volatile Organics in Public Water Supplies. Technology transfer session presented to water suppliers, Edison, NJ (March 1987).

ATTACHMENT B

Laboratory Reporting Limits and Method Detection Limits

Langan Engineering & Environmental

Volatile Organics in Air: TO-15 (SOIL_VAPOR)

Holding Time: 30 days
Container/Sample Preservation: 1 - Canister - 2.7 Liter

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
1,1,1-Trichloroethane	71-55-6	0.2	0.0501	ppbV	70-130			25	25			
1,1,2,2-Tetrachloroethane	79-34-5	0.2	0.0614	ppbV	70-130			25	25			
1,1,2-Trichloroethane	79-00-5	0.2	0.067	ppbV	70-130			25	25			
1,1-Dichloroethane	75-34-3	0.2	0.0628	ppbV	70-130			25	25			
1,1-Dichloroethene	75-35-4	0.2	0.0643	ppbV	70-130			25	25			
1,2,3-Trimethylbenzene	526-73-8	0.2	0.0576	ppbV	70-130			25	25			
1,2,4-Trichlorobenzene	120-82-1	0.2	0.0674	ppbV	70-130			25	25			
1,2,4-Trimethylbenzene	95-63-6	0.2	0.0368	ppbV	70-130			25	25			
1,2,4,5-Tetramethylbenzene	95-93-2	0.2	0.0604	ppbV	70-130			25	25			
1,2-Dibromoethane	106-93-4	0.2	0.0561	ppbV	70-130			25	25			
1,2-Dichlorobenzene	95-50-1	0.2	0.0628	ppbV	70-130			25	25			
1,2-Dichloroethane	107-06-2	0.2	0.0602	ppbV	70-130			25	25			
1,2-Dichloropropane	78-87-5	0.2	0.061	ppbV	70-130			25	25			
1,3,5-Trimethylbenzene	108-67-8	0.2	0.0675	ppbV	70-130			25	25			
1,3-Butadiene	106-99-0	0.2	0.067	ppbV	70-130			25	25			
1,3-Dichlorobenzene	541-73-1	0.2	0.0627	ppbV	70-130			25	25			
1,4-Dichlorobenzene	106-46-7	0.2	0.0636	ppbV	70-130			25	25			
1,4-Dioxane	123-91-1	0.2	0.0805	ppbV	70-130			25	25			
2,2,4-Trimethylpentane	540-84-1	0.2	0.0361	ppbV	70-130			25	25			
2-Butanone	78-93-3	0.5	0.0482	ppbV	70-130			25	25			
2-Hexanone	591-78-6	0.2	0.0648	ppbV	70-130			25	25			
2-Methylthiophene	554-14-3	0.2	0.0524	ppbV	70-130			25	25			
3-Methylthiophene	616-44-4	0.2	0.0393	ppbV	70-130			25	25			
3-Chloropropene	107-05-1	0.2	0.0585	ppbV	70-130			25	25			
2-Ethylthiophene	872-55-9	0.2	0.0407	ppbV	70-130			25	25			
4-Ethyltoluene	622-96-8	0.2	0.037	ppbV	70-130			25	25			
Acetone	67-64-1	1	0.689	ppbV	40-160			25	25			
Benzene	71-43-2	0.2	0.0487	ppbV	70-130			25	25			
Benzyl chloride	100-44-7	0.2	0.0482	ppbV	70-130			25	25			
Benzothiophene	95-15-8	0.5	0.077	ppbV	70-130			25	25			
Bromodichloromethane	75-27-4	0.2	0.0504	ppbV	70-130			25	25			
Bromoform	75-25-2	0.2	0.0641	ppbV	70-130			25	25			
Bromomethane	74-83-9	0.2	0.0773	ppbV	70-130			25	25			
Carbon disulfide	75-15-0	0.2	0.0559	ppbV	70-130			25	25			
Carbon tetrachloride	56-23-5	0.2	0.0499	ppbV	70-130			25	25			
Chlorobenzene	108-90-7	0.2	0.0624	ppbV	70-130			25	25			
Chloroethane	75-00-3	0.2	0.0805	ppbV	70-130			25	25			
Chloroform	67-66-3	0.2	0.0633	ppbV	70-130			25	25			
Chloromethane	74-87-3	0.2	0.0689	ppbV	70-130			25	25			
cis-1,2-Dichloroethene	156-59-2	0.2	0.117	ppbV	70-130			25	25			
cis-1,3-Dichloropropene	10061-01-5	0.2	0.0409	ppbV	70-130			25	25			
Cyclohexane	110-82-7	0.2	0.0368	ppbV	70-130			25	25			

Please Note that the RL information provided in this table is calculated using a 100% Solids factor. (Soil/Solids only)
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Langan Engineering & Environmental

Volatile Organics in Air: TO-15 (SOIL_VAPOR)

Holding Time: 30 days
Container/Sample Preservation: 1 - Canister - 2.7 Liter

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Dibromochloromethane	124-48-1	0.2	0.0614	ppbV	70-130			25	25			
Dichlorodifluoromethane	75-71-8	0.2	0.0583	ppbV	70-130			25	25			
Ethyl Alcohol	64-17-5	5	0.733	ppbV	40-160			25	25			
Ethyl Acetate	141-78-6	0.5	0.122	ppbV	70-130			25	25			
Ethylbenzene	100-41-4	0.2	0.0432	ppbV	70-130			25	25			
1,1,2-Trichloro-1,2,2-Trifluoroethane	76-13-1	0.2	0.0656	ppbV	70-130			25	25			
1,2-Dichloro-1,1,2,2-tetrafluoroethane	76-14-2	0.2	0.0591	ppbV	70-130			25	25			
Hexachlorobutadiene	87-68-3	0.2	0.0529	ppbV	70-130			25	25			
iso-Propyl Alcohol	67-63-0	0.5	0.478	ppbV	40-160			25	25			
Methylene chloride	75-09-2	0.5	0.134	ppbV	70-130			25	25			
4-Methyl-2-pentanone	108-10-1	0.5	0.0421	ppbV	70-130			25	25			
Methyl tert butyl ether	1634-04-4	0.2	0.0525	ppbV	70-130			25	25			
Methyl Methacrylate	80-62-6	0.5	0.0697	ppbV	40-160			25	25			
p/m-Xylene	179601-23-1	0.4	0.091	ppbV	70-130			25	25			
o-Xylene	95-47-6	0.2	0.0453	ppbV	70-130			25	25			
Xylene (Total)	1330-20-7	0.2	0.0453	ppbV				25	25			
Heptane	142-82-5	0.2	0.047	ppbV	70-130			25	25			
n-Heptane	142-82-5	0.2	0.047	ppbV	70-130			25	25			
n-Hexane	110-54-3	0.2	0.0364	ppbV	70-130			25	25			
Propylene	115-07-1	0.5	0.0599	ppbV	70-130			25	25			
Styrene	100-42-5	0.2	0.0434	ppbV	70-130			25	25			
Tetrachloroethene	127-18-4	0.2	0.0655	ppbV	70-130			25	25			
Thiophene	110-02-1	0.2	0.0389	ppbV	70-130			25	25			
Tetrahydrofuran	109-99-9	0.5	0.0568	ppbV	70-130			25	25			
Toluene	108-88-3	0.2	0.052	ppbV	70-130			25	25			
trans-1,2-Dichloroethene	156-60-5	0.2	0.0643	ppbV	70-130			25	25			
1,2-Dichloroethene (total)	540-59-0	0.2	0.0643	ppbV				25	25			
trans-1,3-Dichloropropene	10061-02-6	0.2	0.0436	ppbV	70-130			25	25			
1,3-Dichloropropene, Total	542-75-6	0.2	0.0409	ppbV				25	25			
Trichloroethene	79-01-6	0.2	0.0505	ppbV	70-130			25	25			
Trichlorofluoromethane	75-69-4	0.2	0.0686	ppbV	70-130			25	25			
Vinyl acetate	108-05-4	1	0.0479	ppbV	70-130			25	25			
Vinyl bromide	593-60-2	0.2	0.0717	ppbV	70-130			25	25			
Vinyl chloride	75-01-4	0.2	0.0627	ppbV	70-130			25	25			
Naphthalene	91-20-3	0.2	0.0885	ppbV	70-130			25	25			
Total HC As Hexane	NONE	10	0.0364	ppbV	70-130			25	25			
Total VOCs As Toluene	NONE	10	0.052	ppbV	70-130			25	25			
Propane	74-98-6	0.5	0.132	ppbV	70-130			25	25			
Acrylonitrile	107-13-1	0.5	0.0555	ppbV	70-130			25	25			
Acrolein	107-02-8	0.5	0.0596	ppbV	70-130			25	25			
1,1,1,2-Tetrachloroethane	630-20-6	0.2	0.0561	ppbV	70-130			25	25			
Isopropylbenzene	98-82-8	0.2	0.0491	ppbV	70-130			25	25			

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Volatile Organics in Air: TO-15 (SOIL_VAPOR)

Holding Time: 30 days
Container/Sample Preservation: 1 - Canister - 2.7 Liter

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
1,2,3-Trichloropropane	96-18-4	0.2	0.061	ppbV	70-130			25	25			
Acetonitrile	75-05-8	0.2	0.082	ppbV	70-130			25	25			
Bromobenzene	108-86-1	0.2	0.0613	ppbV	70-130			25	25			
Chlorodifluoromethane	75-45-6	0.2	0.0584	ppbV	70-130			25	25			
Dichlorofluoromethane	75-43-4	0.2	0.0807	ppbV	70-130			25	25			
Dibromomethane	74-95-3	0.2	0.0563	ppbV	70-130			25	25			
Pentane	109-66-0	0.2	0.0659	ppbV	70-130			25	25			
Octane	111-65-9	0.2	0.0445	ppbV	70-130			25	25			
Tertiary-Amyl Methyl Ether	994-05-8	0.2	0.0476	ppbV	70-130			25	25			
o-Chlorotoluene	95-49-8	0.2	0.0486	ppbV	70-130			25	25			
p-Chlorotoluene	106-43-4	0.2	0.056	ppbV	70-130			25	25			
2,2-Dichloropropane	594-20-7	0.2	0.0458	ppbV	70-130			25	25			
1,1-Dichloropropene	563-58-6	0.2	0.0457	ppbV	70-130			25	25			
Isopropyl Ether	108-20-3	0.2	0.0621	ppbV	70-130			25	25			
Ethyl-Tert-Butyl-Ether	637-92-3	0.2	0.0422	ppbV	70-130			25	25			
1,2,3-Trichlorobenzene	87-61-6	0.2	0.0715	ppbV	70-130			25	25			
Ethyl ether	60-29-7	0.2	0.0737	ppbV	70-130			25	25			
n-Butylbenzene	104-51-8	0.2	0.044	ppbV	70-130			25	25			
sec-Butylbenzene	135-98-8	0.2	0.0429	ppbV	70-130			25	25			
tert-Butylbenzene	98-06-6	0.2	0.042	ppbV	70-130			25	25			
1,2-Dibromo-3-chloropropane	96-12-8	0.2	0.0495	ppbV	70-130			25	25			
p-Isopropyltoluene	99-87-6	0.2	0.052	ppbV	70-130			25	25			
n-Propylbenzene	103-65-1	0.2	0.0419	ppbV	70-130			25	25			
1,3-Dichloropropane	142-28-9	0.2	0.106	ppbV	70-130			25	25			
Methanol	67-56-1	5	1.84	ppbV	70-130			25	25			
Acetaldehyde	75-07-0	2.5	0.444	ppbV	70-130			25	25			
Butane	106-97-8	0.2	0.0646	ppbV	70-130			25	25			
Nonane (C9)	111-84-2	0.2	0.0463	ppbV	70-130			25	25			
Decane (C10)	124-18-5	0.2	0.0404	ppbV	70-130			25	25			
Undecane	1120-21-4	0.2	0.0427	ppbV	70-130			25	25			
Indane	496-11-7	0.2	0.0507	ppbV	70-130			25	25			
Indene	95-13-6	0.2	0.0433	ppbV	70-130			25	25			
1-Methylnaphthalene	90-12-0	1	0.466	ppbV	70-130			25	25			
Dodecane (C12)	112-40-3	0.2	0.0658	ppbV	70-130			25	25			
Butyl Acetate	123-86-4	0.5	0.126	ppbV	70-130			25	25			
tert-Butyl Alcohol	75-65-0	0.5	0.0466	ppbV	70-130			25	25			
2-Methylnaphthalene	91-57-6	1	0.393	ppbV	70-130			25	25			
1,2-Dichloroethane-d4	*17060-07-0*									*70-130*		
Toluene-d8	*2037-26-5*									*70-130*		
Bromofluorobenzene	*460-00-4*									*70-130*		

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Langan Engineering & Environmental

NJ EPH Method (10/08, Rev3) -Category 1 (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - Glass 250ml/8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Total EPH	NONE	24.012	24.012	mg/kg	40-140	25	40-140	50	50			
Chloro-Octadecane	*3386-33-2*									*40-140*		
o-Terphenyl	*84-15-1*									*40-140*		

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New Jersey - EPA 8260C/5035 High & Low (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - 1 Vial MeOH/2 Vial Water

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
1,2-Dibromo-3-chloropropane	96-12-8	0.003	0.000396	mg/kg	40-160	30	40-160	30	30			
1,4-Dioxane	123-91-1	0.1	0.01442	mg/kg	40-160	30	40-160	30	30			
1,2-Dibromoethane	106-93-4	0.003	0.0001744	mg/kg	70-130	30	70-130	30	30			
Methylene chloride	75-09-2	0.005	0.001104	mg/kg	70-130	30	70-130	30	30			
1,1-Dichloroethane	75-34-3	0.0015	0.0000856	mg/kg	70-130	30	70-130	30	30			
Chloroform	67-66-3	0.0015	0.00037	mg/kg	70-130	30	70-130	30	30			
Carbon tetrachloride	56-23-5	0.001	0.00021	mg/kg	70-130	30	70-130	30	30			
1,2-Dichloropropane	78-87-5	0.0035	0.000228	mg/kg	70-130	30	70-130	30	30			
Dibromochloromethane	124-48-1	0.001	0.0001536	mg/kg	70-130	30	70-130	30	30			
1,1,2-Trichloroethane	79-00-5	0.0015	0.000304	mg/kg	70-130	30	70-130	30	30			
Tetrachloroethene	127-18-4	0.001	0.0001402	mg/kg	70-130	30	70-130	30	30			
Chlorobenzene	108-90-7	0.001	0.000348	mg/kg	70-130	30	70-130	30	30			
Trichlorofluoromethane	75-69-4	0.005	0.000388	mg/kg	40-160	30	40-160	30	30			
1,2-Dichloroethane	107-06-2	0.001	0.0001134	mg/kg	70-130	30	70-130	30	30			
1,1,1-Trichloroethane	71-55-6	0.001	0.0001108	mg/kg	70-130	30	70-130	30	30			
Bromodichloromethane	75-27-4	0.001	0.0001732	mg/kg	70-130	30	70-130	30	30			
trans-1,3-Dichloropropene	10061-02-6	0.001	0.0001208	mg/kg	70-130	30	70-130	30	30			
cis-1,3-Dichloropropene	10061-01-5	0.001	0.0001176	mg/kg	40-160	30	40-160	30	30			
1,3-Dichloropropene, Total	542-75-6	0.001	0.0001176	mg/kg				30	30			
Bromoform	75-25-2	0.004	0.000236	mg/kg	40-160	30	40-160	30	30			
1,1,2,2-Tetrachloroethane	79-34-5	0.001	0.0001008	mg/kg	40-160	30	40-160	30	30			
Benzene	71-43-2	0.001	0.000118	mg/kg	70-130	30	70-130	30	30			
Toluene	108-88-3	0.0015	0.0001948	mg/kg	70-130	30	70-130	30	30			
Ethylbenzene	100-41-4	0.001	0.0001274	mg/kg	70-130	30	70-130	30	30			
Chloromethane	74-87-3	0.005	0.000294	mg/kg	40-160	30	40-160	30	30			
Bromomethane	74-83-9	0.002	0.000338	mg/kg	40-160	30	40-160	30	30			
Vinyl chloride	75-01-4	0.002	0.0001174	mg/kg	70-130	30	70-130	30	30			
Chloroethane	75-00-3	0.002	0.000316	mg/kg	40-160	30	40-160	30	30			
1,1-Dichloroethene	75-35-4	0.001	0.000262	mg/kg	70-130	30	70-130	30	30			
trans-1,2-Dichloroethene	156-60-5	0.0015	0.000212	mg/kg	70-130	30	70-130	30	30			
Trichloroethene	79-01-6	0.001	0.000125	mg/kg	70-130	30	70-130	30	30			
1,2-Dichlorobenzene	95-50-1	0.005	0.0001532	mg/kg	70-130	30	70-130	30	30			
1,3-Dichlorobenzene	541-73-1	0.005	0.000135	mg/kg	70-130	30	70-130	30	30			
1,4-Dichlorobenzene	106-46-7	0.005	0.0001384	mg/kg	70-130	30	70-130	30	30			
Methyl tert butyl ether	1634-04-4	0.002	0.0000844	mg/kg	70-130	30	70-130	30	30			
p/m-Xylene	179601-23-1	0.002	0.0001978	mg/kg	70-130	30	70-130	30	30			
o-Xylene	95-47-6	0.002	0.0001718	mg/kg	70-130	30	70-130	30	30			
Xylene (Total)	1330-20-7	0.002	0.0001718	mg/kg				30	30			
cis-1,2-Dichloroethene	156-59-2	0.001	0.0001428	mg/kg	70-130	30	70-130	30	30			
1,2-Dichloroethene (total)	540-59-0	0.001	0.0001428	mg/kg				30	30			
Styrene	100-42-5	0.002	0.000402	mg/kg	40-160	30	40-160	30	30			
Dichlorodifluoromethane	75-71-8	0.01	0.0001908	mg/kg	40-160	30	40-160	30	30			

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New Jersey - EPA 8260C/5035 High & Low (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - 1 Vial MeOH/2 Vial Water

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Acetone	67-64-1	0.036	0.001036	mg/kg	40-160	30	40-160	30	30			
Carbon disulfide	75-15-0	0.01	0.001102	mg/kg	40-160	30	40-160	30	30			
2-Butanone	78-93-3	0.01	0.000272	mg/kg	40-160	30	40-160	30	30			
4-Methyl-2-pentanone	108-10-1	0.01	0.000244	mg/kg	40-160	30	40-160	30	30			
2-Hexanone	591-78-6	0.01	0.000666	mg/kg	40-160	30	40-160	30	30			
Bromochloromethane	74-97-5	0.005	0.000276	mg/kg	70-130	30	70-130	30	30			
Isopropylbenzene	98-82-8	0.001	0.0001038	mg/kg	70-130	30	70-130	30	30			
1,2,3-Trichlorobenzene	87-61-6	0.005	0.0001476	mg/kg	70-130	30	70-130	30	30			
1,2,4-Trichlorobenzene	120-82-1	0.005	0.0001818	mg/kg	70-130	30	70-130	30	30			
Methyl Acetate	79-20-9	0.004	0.00027	mg/kg	70-130	30	70-130	30	30			
Cyclohexane	110-82-7	0.02	0.000146	mg/kg	70-130	30	70-130	30	30			
Methyl cyclohexane	108-87-2	0.004	0.0001546	mg/kg	70-130	30	70-130	30	30			
1,1,2-Trichloro-1,2,2-Trifluoroethane	76-13-1	0.02	0.000274	mg/kg	70-130	30	70-130	30	30			
1,2-Dichloroethane-d4	*17060-07-0*									*70-130*		
Toluene-d8	*2037-26-5*									*70-130*		
4-Bromofluorobenzene	*460-00-4*									*70-130*		
Dibromofluoromethane	*1868-53-7*									*70-130*		

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New Jersey ABN Extractables - EPA 8270D (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - Glass 250ml/8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Acenaphthene	83-32-9	0.1332	0.0139194	mg/kg	70-130	30	70-130	30	30			
2-Chloronaphthalene	91-58-7	0.1665	0.0158508	mg/kg	70-130	30	70-130	30	30			
Hexachlorobenzene	118-74-1	0.047952	0.0158841	mg/kg	70-130	30	70-130	30	30			
Bis(2-chloroethyl)ether	111-44-4	0.05994	0.0200133	mg/kg	70-130	30	70-130	30	30			
3,3'-Dichlorobenzidine	91-94-1	0.127872	0.042624	mg/kg	70-130	30	70-130	30	30			
2,4-Dinitrotoluene	121-14-2	0.082917	0.027639	mg/kg	70-130	30	70-130	30	30			
2,6-Dinitrotoluene	606-20-2	0.065934	0.021978	mg/kg	70-130	30	70-130	30	30			
Fluoranthene	206-44-0	0.0999	0.0191142	mg/kg	70-130	30	70-130	30	30			
4-Chlorophenyl phenyl ether	7005-72-3	0.1665	0.013986	mg/kg	70-130	30	70-130	30	30			
Bis(2-chloroisopropyl)ether	108-60-1	0.1998	0.0191475	mg/kg	70-130	30	70-130	30	30			
Bis(2-chloroethoxy)methane	111-91-1	0.17982	0.0158175	mg/kg	70-130	30	70-130	30	30			
Hexachlorobutadiene	87-68-3	0.061938	0.0206793	mg/kg	70-130	30	70-130	30	30			
Hexachlorocyclopentadiene	77-47-4	0.47619	0.105228	mg/kg	20-160	30	20-160	30	30			
Hexachloroethane	67-72-1	0.080919	0.0269397	mg/kg	20-160	30	20-160	30	30			
Isophorone	78-59-1	0.055944	0.0186147	mg/kg	70-130	30	70-130	30	30			
Naphthalene	91-20-3	0.1665	0.0202797	mg/kg	70-130	30	70-130	30	30			
Nitrobenzene	98-95-3	0.073926	0.024642	mg/kg	70-130	30	70-130	30	30			
NitrosoDiPhenylAmine(NDPA)/DPA	86-30-6	0.040959	0.0135531	mg/kg	70-130	30	70-130	30	30			
n-Nitrosodi-n-propylamine	621-64-7	0.041958	0.0139194	mg/kg	70-130	30	70-130	30	30			
Bis(2-Ethylhexyl)phthalate	117-81-7	0.1665	0.0172827	mg/kg	70-130	30	70-130	30	30			
Butyl benzyl phthalate	85-68-7	0.1665	0.0221778	mg/kg	70-130	30	70-130	30	30			
Di-n-butylphthalate	84-74-2	0.1665	0.0147186	mg/kg	70-130	30	70-130	30	30			
Di-n-octylphthalate	117-84-0	0.1665	0.051948	mg/kg	70-130	30	70-130	30	30			
Diethyl phthalate	84-66-2	0.1665	0.0150849	mg/kg	70-130	30	70-130	30	30			
Dimethyl phthalate	131-11-3	0.1665	0.0159507	mg/kg	70-130	30	70-130	30	30			
Benzo(a)anthracene	56-55-3	0.055944	0.0187479	mg/kg	70-130	30	70-130	30	30			
Benzo(a)pyrene	50-32-8	0.121878	0.040626	mg/kg	70-130	30	70-130	30	30			
Benzo(b)fluoranthene	205-99-2	0.041958	0.0138861	mg/kg	70-130	30	70-130	30	30			
Benzo(k)fluoranthene	207-08-9	0.034965	0.011655	mg/kg	70-130	30	70-130	30	30			
Chrysene	218-01-9	0.0999	0.0171162	mg/kg	70-130	30	70-130	30	30			
Acenaphthylene	208-96-8	0.1332	0.018648	mg/kg	70-130	30	70-130	30	30			
Anthracene	120-12-7	0.0999	0.0148185	mg/kg	70-130	30	70-130	30	30			
Benzo(ghi)perylene	191-24-2	0.1332	0.0195804	mg/kg	70-130	30	70-130	30	30			
Fluorene	86-73-7	0.1665	0.0160173	mg/kg	70-130	30	70-130	30	30			
Phenanthrene	85-01-8	0.0999	0.0119547	mg/kg	70-130	30	70-130	30	30			
Dibenzo(a,h)anthracene	53-70-3	0.057942	0.0192474	mg/kg	70-130	30	70-130	30	30			
Indeno(1,2,3-cd)Pyrene	193-39-5	0.06993	0.0232101	mg/kg	70-130	30	70-130	30	30			
Pyrene	129-00-0	0.0999	0.0144522	mg/kg	70-130	30	70-130	30	30			
4-Chloroaniline	106-47-8	0.1665	0.0191808	mg/kg	20-160	30	20-160	30	30			
2-Nitroaniline	88-74-4	0.1665	0.0305694	mg/kg	70-130	30	70-130	30	30			
3-Nitroaniline	99-09-2	0.1665	0.0314019	mg/kg	70-130	30	70-130	30	30			
4-Nitroaniline	100-01-6	0.1665	0.068931	mg/kg	70-130	30	70-130	30	30			

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New Jersey ABN Extractables - EPA 8270D (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - Glass 250ml/8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Dibenzofuran	132-64-9	0.1665	0.0146853	mg/kg	70-130	30	70-130	30	30			
2-Methylnaphthalene	91-57-6	0.1998	0.0176157	mg/kg	70-130	30	70-130	30	30			
2,4,6-Trichlorophenol	88-06-2	0.094905	0.0315684	mg/kg	70-130	30	70-130	30	30			
P-Chloro-M-Cresol	59-50-7	0.1665	0.0248085	mg/kg	70-130	30	70-130	30	30			
2-Chlorophenol	95-57-8	0.054945	0.018315	mg/kg	70-130	30	70-130	30	30			
2,4-Dichlorophenol	120-83-2	0.07992	0.0267732	mg/kg	70-130	30	70-130	30	30			
2,4-Dimethylphenol	105-67-9	0.158841	0.052947	mg/kg	70-130	30	70-130	30	30			
2-Nitrophenol	88-75-5	0.35964	0.027306	mg/kg	70-130	30	70-130	30	30			
2,4-Dinitrophenol	51-28-5	0.23976	0.077589	mg/kg	20-160	30	20-160	30	30			
4,6-Dinitro-o-cresol	534-52-1	0.23976	0.07992	mg/kg	70-130	30	70-130	30	30			
Pentachlorophenol	87-86-5	0.10989	0.03663	mg/kg	20-160	30	20-160	30	30			
Phenol	108-95-2	0.1665	0.0197469	mg/kg	20-160	30	20-160	30	30			
2-Methylphenol	95-48-7	0.1665	0.0258075	mg/kg	70-130	30	70-130	30	30			
3-Methylphenol/4-Methylphenol	108-39-4/106-44-5	0.23976	0.0240426	mg/kg	20-160	30	20-160	30	30			
2,4,5-Trichlorophenol	95-95-4	0.1665	0.0319014	mg/kg	70-130	30	70-130	30	30			
Carbazole	86-74-8	0.1665	0.0106227	mg/kg	70-130	30	70-130	30	30			
4-Nitrophenol	100-02-7	0.2331	0.046287	mg/kg	20-160	30	20-160	30	30			
4-Bromophenyl phenyl ether	101-55-3	0.1665	0.0185148	mg/kg	70-130	30	70-130	30	30			
Acetophenone	98-86-2	0.1665	0.0174159	mg/kg	70-130	30	70-130	30	30			
Biphenyl	92-52-4	0.37962	0.038628	mg/kg	70-130	30	70-130	30	30			
Atrazine	1912-24-9	0.1332	0.058275	mg/kg	70-130	30	70-130	30	30			
2-Fluorophenol	*367-12-4*									*30-130*		
Phenol-d6	*13127-88-3*									*30-130*		
Nitrobenzene-d5	*4165-60-0*									*30-130*		
2-Fluorobiphenyl	*321-60-8*									*30-130*		
2,4,6-Tribromophenol	*118-79-6*									*30-130*		
4-Terphenyl-d14	*1718-51-0*									*30-130*		

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NJ PCB - EPA 8082A (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - Glass 250ml/8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Aroclor 1016	12674-11-2	0.0335	0.0029748	mg/kg	40-140	30	40-140	30	30			
Aroclor 1221	11104-28-2	0.0335	0.0033567	mg/kg	40-140	30	40-140	30	30			
Aroclor 1232	11141-16-5	0.0335	0.007102	mg/kg	40-140	30	40-140	30	30			
Aroclor 1242	53469-21-9	0.0335	0.0045158	mg/kg	40-140	30	40-140	30	30			
Aroclor 1248	12672-29-6	0.0335	0.005025	mg/kg	40-140	30	40-140	30	30			
Aroclor 1254	11097-69-1	0.0335	0.0036649	mg/kg	40-140	30	40-140	30	30			
Aroclor 1260	11096-82-5	0.0335	0.0061908	mg/kg	40-140	30	40-140	30	30			
Aroclor 1262	37324-23-5	0.0335	0.0042545	mg/kg	40-140	30	40-140	30	30			
Aroclor 1268	11100-14-4	0.0335	0.0034706	mg/kg	40-140	30	40-140	30	30			
PCBs, Total	1336-36-3	0.0335	0.0029748	mg/kg				30	30			
2,4,5,6-Tetrachloro-m-xylene	*877-09-8*									*30-150*		
Decachlorobiphenyl	*2051-24-3*									*30-150*		

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Langan Engineering & Environmental

METALS by 6010D (SOIL)

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria	Holding Time	Container/Sample Preservation
Aluminum, Total	7429-90-5	4	1.08	mg/kg	48-151		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Antimony, Total	7440-36-0	2	0.152	mg/kg	1-208		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Arsenic, Total	7440-38-2	0.4	0.0832	mg/kg	79-121		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Arsenic, TCLP	7440-38-2	1	0.019	mg/l	75-125	20	75-125	20	20		180 days	1 - Glass 250ml/8oz unpreserved
Barium, TCLP	7440-39-3	0.5	0.021	mg/l	75-125	20	75-125	20	20		180 days	1 - Glass 250ml/8oz unpreserved
Barium, Total	7440-39-3	0.4	0.0696	mg/kg	83-117		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Beryllium, Total	7440-41-7	0.2	0.0132	mg/kg	83-117		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Cadmium, TCLP	7440-43-9	0.1	0.01	mg/l	75-125	20	75-125	20	20		180 days	1 - Glass 250ml/8oz unpreserved
Cadmium, Total	7440-43-9	0.4	0.0392	mg/kg	83-117		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Calcium, Total	7440-70-2	4	1.4	mg/kg	81-119		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Chromium, Total	7440-47-3	0.4	0.0384	mg/kg	80-120		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Chromium, TCLP	7440-47-3	0.2	0.021	mg/l	75-125	20	75-125	20	20		180 days	1 - Glass 250ml/8oz unpreserved
Cobalt, Total	7440-48-4	0.8	0.0664	mg/kg	84-115		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Copper, Total	7440-50-8	0.4	0.1032	mg/kg	81-118		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Iron, Total	7439-89-6	2	0.3612	mg/kg	45-155		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Lead, Total	7439-92-1	2	0.1072	mg/kg	81-117		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Lead, TCLP	7439-92-1	0.5	0.027	mg/l	75-125	20	75-125	20	20		180 days	1 - Glass 250ml/8oz unpreserved
Magnesium, Total	7439-95-4	4	0.616	mg/kg	76-124		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Manganese, Total	7439-96-5	0.4	0.0636	mg/kg	81-117		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Nickel, Total	7440-02-0	1	0.0968	mg/kg	83-117		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Potassium, Total	7440-09-7	100	5.76	mg/kg	71-129		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Selenium, TCLP	7782-49-2	0.5	0.035	mg/l	75-125	20	75-125	20	20		180 days	1 - Glass 250ml/8oz unpreserved
Selenium, Total	7782-49-2	0.8	0.1032	mg/kg	78-122		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Silver, TCLP	7440-22-4	0.1	0.028	mg/l	75-125	20	75-125	20	20		180 days	1 - Glass 250ml/8oz unpreserved
Silver, Total	7440-22-4	0.4	0.1132	mg/kg	75-124		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Sodium, Total	7440-23-5	80	1.26	mg/kg	72-127		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Thallium, Total	7440-28-0	0.8	0.126	mg/kg	80-120		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Vanadium, Total	7440-62-2	0.4	0.0812	mg/kg	78-122		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Zinc, Total	7440-66-6	2	0.1172	mg/kg	82-118		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv

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METALS by 7471B (SOIL)

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria	Holding Time	Container/Sample Preservation
Mercury, Total	7439-97-6	0.08	0.05216	mg/kg	72-128		80-120	20	20		28 days	Metals Only-Glass 60mL/2oz unpreserv

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METALS by 7470A (SOIL)

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria	Holding Time	Container/Sample Preservation
Mercury, TCLP	7439-97-6	0.000001	4.575E-07	mg/l	85-115		80-120	20	20		28 days	1 - Glass 250ml/8oz unpreserved

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NJ Pesticides - EPA 8081B (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - Glass 250ml/8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Delta-BHC	319-86-8	0.0016008	0.00031349	mg/kg	40-140	30	30-150	30	30			
Lindane	58-89-9	0.000667	0.000298149	mg/kg	40-140	30	30-150	30	30			
Alpha-BHC	319-84-6	0.000667	0.000189428	mg/kg	40-140	30	30-150	30	30			
Beta-BHC	319-85-7	0.0016008	0.00060697	mg/kg	40-140	30	30-150	30	30			
Heptachlor	76-44-8	0.0008004	0.000358846	mg/kg	40-140	30	30-150	30	30			
Aldrin	309-00-2	0.0016008	0.000563615	mg/kg	40-140	30	30-150	30	30			
Heptachlor epoxide	1024-57-3	0.0030015	0.00090045	mg/kg	40-140	30	30-150	30	30			
Endrin	72-20-8	0.000667	0.00027347	mg/kg	40-140	30	30-150	30	30			
Endrin aldehyde	7421-93-4	0.002001	0.00070035	mg/kg	40-140	30	30-150	30	30			
Endrin ketone	53494-70-5	0.0016008	0.000412206	mg/kg	40-140	30	30-150	30	30			
Dieldrin	60-57-1	0.0010005	0.00050025	mg/kg	40-140	30	30-150	30	30			
4,4'-DDE	72-55-9	0.0016008	0.000370185	mg/kg	40-140	30	30-150	30	30			
4,4'-DDD	72-54-8	0.0016008	0.000570952	mg/kg	40-140	30	30-150	30	30			
4,4'-DDT	50-29-3	0.0030015	0.00128731	mg/kg	40-140	30	30-150	30	30			
Endosulfan I	959-98-8	0.0016008	0.000378189	mg/kg	40-140	30	30-150	30	30			
Endosulfan II	33213-65-9	0.0016008	0.000534934	mg/kg	40-140	30	30-150	30	30			
Endosulfan sulfate	1031-07-8	0.000667	0.000317492	mg/kg	40-140	30	30-150	30	30			
Methoxychlor	72-43-5	0.0030015	0.0009338	mg/kg	40-140	30	30-150	30	30			
Toxaphene	8001-35-2	0.030015	0.0084042	mg/kg	40-140	30	30-150	30	30			
Chlordane	57-74-9	0.01334	0.00530265	mg/kg	40-140	30	30-150	30	30			
cis-Chlordane	5103-71-9	0.002001	0.000557612	mg/kg	40-140	30	30-150	30	30			
trans-Chlordane	5103-74-2	0.002001	0.000528264	mg/kg	40-140	30	30-150	30	30			
2,4,5,6-Tetrachloro-m-xylene	*877-09-8*									*30-150*		
Decachlorobiphenyl	*2051-24-3*									*30-150*		

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NJ Herbicides -EPA 8151A (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - Glass 250ml/8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
2,4-D	94-75-7	0.1665	0.0104895	mg/kg	30-150	30	30-150	30	30			
2,4,5-T	93-76-5	0.1665	0.0051615	mg/kg	30-150	30	30-150	30	30			
2,4,5-TP (Silvex)	93-72-1	0.1665	0.0044289	mg/kg	30-150	30	30-150	30	30			
DCAA	*19719-28-9*									*30-150*		

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WETCHEM (SOIL)

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Method	Holding Time	Container/Sample Preservation
Cyanide, Reactive	57-12-5	10	10	mg/kg	30-125	40		40	40	7.3	14 days	1 - Glass 250ml/8oz unpreserved
Sulfide, Reactive	NONE	10	10	mg/kg	60-125	40		40	40	7.3	14 days	1 - Glass 250ml/8oz unpreserved
pH	12408-02-5	0		SU	99-101			5	5	9045D	24 hours	1 - Glass 250ml/8oz unpreserved
Chromium, Hexavalent	18540-29-9	0.8	0.16	mg/kg	80-120	20	75-125	20	20	7196A	30 days	1 - Glass 120ml/4oz unpreserved
Cyanide, Total	57-12-5	1	0.212	mg/kg	80-120	35	75-125	35	35	9010C/9012B	14 days	1 - Glass 250ml/8oz unpreserved

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TCLP Volatile Organics - EPA 8260C/1311 (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - Vial Large Septa unpreserved (4

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Chloroform	67-66-3	7.5	2.22	ug/l	70-130	20	70-130	20	20			
Carbon tetrachloride	56-23-5	5	1.34	ug/l	63-132	20	63-132	20	20			
Tetrachloroethene	127-18-4	5	1.81	ug/l	70-130	20	70-130	20	20			
Chlorobenzene	108-90-7	5	1.78	ug/l	75-130	25	75-130	25	25			
1,2-Dichloroethane	107-06-2	5	1.32	ug/l	70-130	20	70-130	20	20			
Benzene	71-43-2	5	1.59	ug/l	70-130	25	70-130	25	25			
Vinyl chloride	75-01-4	10	0.714	ug/l	55-140	20	55-140	20	20			
1,1-Dichloroethene	75-35-4	5	1.69	ug/l	61-145	25	61-145	25	25			
Trichloroethene	79-01-6	5	1.75	ug/l	70-130	25	70-130	25	25			
1,4-Dichlorobenzene	106-46-7	25	1.87	ug/l	70-130	20	70-130	20	20			
2-Butanone	78-93-3	50	19.4	ug/l	63-138	20	63-138	20	20			
1,2-Dichloroethane-d4	*17060-07-0*									*70-130*		
Toluene-d8	*2037-26-5*									*70-130*		
4-Bromofluorobenzene	*460-00-4*									*70-130*		
Dibromofluoromethane	[illegible]									[illegible]		

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TCLP ABN Compounds - EPA 8270D/1311 (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - Glass 250ml/8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Hexachlorobenzene	118-74-1	10	2.895	ug/l	40-140	30	40-140	30	30			
2,4-Dinitrotoluene	121-14-2	25	4.225	ug/l	40-132	30	40-132	30	30			
Hexachlorobutadiene	87-68-3	10	3.585	ug/l	28-111	30	28-111	30	30			
Hexachloroethane	67-72-1	10	3.41	ug/l	21-105	30	21-105	30	30			
Nitrobenzene	98-95-3	10	3.765	ug/l	40-140	30	40-140	30	30			
2,4,6-Trichlorophenol	88-06-2	25	3.405	ug/l	30-130	30	30-130	30	30			
Pentachlorophenol	87-86-5	50	17.15	ug/l	9-103	30	9-103	30	30			
2-Methylphenol	95-48-7	25	5.1	ug/l	30-130	30	30-130	30	30			
3-Methylphenol/4-Methylphenol	108-39-4/106-44-5	25	5.55	ug/l	30-130	30	30-130	30	30			
2,4,5-Trichlorophenol	95-95-4	25	3.575	ug/l	30-130	30	30-130	30	30			
Pyridine	110-86-1	17.5	9.35	ug/l	10-66	30	10-66	30	30			
2-Fluorophenol	*367-12-4*									*21-120*		
Phenol-d6	*13127-88-3*									*10-120*		
Nitrobenzene-d5	*4165-60-0*									*23-120*		
2-Fluorobiphenyl	*321-60-8*									*15-120*		
2,4,6-Tribromophenol	*118-79-6*									*10-120*		
4-Terphenyl-d14	*1718-51-0*									*33-120*		

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TCLP Pesticides - EPA 8081B/1311 (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - Glass 250ml/8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Lindane	58-89-9	0.1	0.0217	ug/l	30-150	20	30-150	30	30			
Heptachlor	76-44-8	0.1	0.0155	ug/l	30-150	20	30-150	30	30			
Heptachlor epoxide	1024-57-3	0.1	0.02075	ug/l	30-150	20	30-150	30	30			
Endrin	72-20-8	0.2	0.02145	ug/l	30-150	20	30-150	30	30			
Methoxychlor	72-43-5	1	0.0342	ug/l	30-150	20	30-150	30	30			
Toxaphene	8001-35-2	1	0.3135	ug/l	30-150	20	30-150	30	30			
Chlordane	57-74-9	1	0.2315	ug/l	30-150	20	30-150	30	30			
2,4,5,6-Tetrachloro-m-xylene	*877-09-8*									*30-150*		
Decachlorobiphenyl	*2051-24-3*									*30-150*		

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TCLP Herbicides - EPA 8151A/1311 (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - Glass 250ml/8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
2,4-D	94-75-7	0.025	0.001245	mg/l	30-150	25	30-150	25	25			
2,4,5-TP (Silvex)	93-72-1	0.005	0.0013475	mg/l	30-150	25	30-150	25	25			
DCAA	*19719-28-9*									*30-150*		

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ATTACHMENT C

Analytical Methods / Quality Assurance Summary Table

ATTACHMENT C
ANALYTICAL METHODS/QUALITY ASSURANCE SUMMARY TABLE

Matrix Type	Field Parameters	Laboratory Parameters	Analytical Methods	Sample Preservation	Sample Container Volume and Type	Sample Hold Time	Number of Samples to be Collected	Field Duplicate Samples	Equipment Blank Samples	Trip Blank Samples	Ambient Air Samples	MS/MSD Samples
Indoor Air	Total VOCs via PID	Part 375 + TCL VOCs	EPA TO-15	NA	6 Liter Summa Cannister	30 days	24	1 per 20 samples (minimum 1)	NA	NA	1 per day	NA
Sub-Slab Soil Vapor							11	1 per 20 samples (minimum 1)				
Soil	Total VOCs via PID	NJ EPH*	NJ EPH Method (10/08, Rev. 3) - Category 1	Cool to 4°C	8 oz. jar	14 days	1 per 800 cubic yards	1 per 20 samples (minimum 1)	1 per 20 samples, (minimum 1)	1 per shipment of VOC samples	NA	NA
		TCL VOCs	EPA 8260C/5035	Cool to 4°C	Two 40-ml VOC vials with 5ml H_2O, one with MeOH or 3 Encore Samplers (separate container for % solids)	14 days, freeze at lab within 48 hours						
		TCL SVOCs*	EPA 8270D	Cool to 4°C	8 oz. jar	14 days extract, 40 days after extraction to analysis						
		Total Cyanide*	9010C/9012B	Cool to 4°C	8 oz jar	14 days						
		RCRA (Ignitability, Corrosivity, and Reactivity)*	7.3	Cool to 4°C	8 oz jar	14 days						
		TCLP VOCs*	8260C/1311	Cool to 4°C	4 oz septa jar	14 days						
		TCLP SVOCs*	8270D/1311	Cool to 4°C	8 oz jar	14 days						
		TCLP Metals*	6010D, 7470A	Cool to 4°C	8 oz jar	6 months, except Mercury 28 days						
		TCLP Pesticides*	8081B/1311	Cool to 4°C	8 oz jar	14 days						
		TCLP Herbicides*	8151A/1311	Cool to 4°C	8 oz jar	14 days						
		TAL Metals*	EPA 6010D, 7471B	Cool to 4°C	2 oz. jar / 8 oz jar	6 months, except Mercury 28 days						
		Hexavalent Chromium*	EPA 7196A	Cool to 4°C	4 oz. jar	30 days						
		TCL Herbicides*	EPA 8151A	Cool to 4°C	8 oz. jar	14 days extract, 40 days after extraction to analysis						
		TCL Pesticides*	EPA 8081B	Cool to 4°C	8 oz. jar	14 days extract, 40 days after extraction to analysis						
		TCL PCBs*	EPA 8082A	Cool to 4°C	8 oz. jar	14 days extract, 40 days after extraction to analysis						

Notes:
*can be combined in one or more 8 oz. jars
mL = milliliter
VOC = Volatile organic compound
SVOC = Semi-volatile organic compound
PCB = Polychlorinated biphenyls
TAL = Total Analyte List
TCL = Target Criteria List

PID = Photoionization detector
Part 375 = New York State Department of Environmental Conservation (NYSDEC) Title 6 New York City Rules and Regulation (NYCRR) Part 375 List.
ORP = Oxidation reduction potential
EPA = U.S. Environmental Protection Agency
NA = Not applicable
ºC = degree Celsius

ATTACHMENT D

Sample Nomenclature

SAMPLE NOMENCLATURE

The sample nomenclature outlined below provides consistency between sample events and projects but, most importantly, establish unique sample IDs that will avoid confusion months or years after the sample has been collected. Furthermore, unique sample IDs are required for any data submitted to the NYSDEC in EDD format or being uploaded to an EQuIS database.

1.0 INVESTIGATION LOCATION CODES

SB	Soil Boring	SV	Soil Vapor Point
WC	Waste Characterization Boring	IA	Indoor Air
TP	Test Pit	AA	Ambient Air
EPSW	Endpoint Location (Sidewall)	SVE	Vapor Extraction Well
EPB	Endpoint Location (Bottom)	DS	Drum
MW	Monitoring Well	IDW	Investigation Derived Waste
TMW	Temporary Monitoring Well	SL	Sludge
SW	Surface Water	FP	Free Product

2.0 SAMPLE NOMENCLATURE

Each sample at a site must have a unique value.

- **Soil/Sediment Samples:**

SBxx_y-y

Sample Location Code + Number (two digits minimum)

Sampling Interval (y-y)

Sample Type	Sample Location Code	Sampling Depth or Interval (feet bgs or approx. elevation)	Sample Name
Phase II/Remedial Investigation			
Grab Soil Sample	SB01	2 to 4	SB01_2-4
	SB02	4	SB02_4
Waste Characterization			
Grab Soil Sample	WC01	2 to 4	WC01_2-4
	WC02	4	WC02_4
Composite Soil Sample from one or more locations	COMP01 or COMP02 + COMP03	0 to 10 (Fill)	COMP01_0-10

Sample Type	Sample Location Code	Sampling Depth or Interval (feet bgs or approx. elevation)	Sample Name
Endpoint Sampling			
Grab Soil Sample	EPSW01_N	5	EPSW01_N_5
	EPSW01_S	5	EPSW01_S_5
	EPSW01_E	5	EPSW01_E_5
	EPSW01_W	5	EPSW01_W_5
	EPB01	6	EPB01_6

- **Groundwater/Surface Water Samples:**

MWxx_MMDDYY

Sample Location Code + Number (two digits minimum)

Sampling Date (MMDDYY)

Sample Type	Sample Location Code	Sampling Date	Sample Name
Groundwater Sample	MW01	02/21/2013	MW01_022113

- **Air/Soil Vapor Samples:**

IAxx_MMDDYY

Sample Location Code + Number (two digits minimum)

Sampling Date (MMDDYY)

Sample Type	Sample Location Code	Date	Sample Name
Air Sample	IA01	02/21/2013	IA01_022113
Soil Vapor Sample	SV01	02/21/2013	SV01_022113
Vapor Extraction Well Sample	SVE01 (INLET/MIDPOINT/OUTLET)	02/21/2013	SVE01_IN_022113 SVE01_ MID_022113 SVE01_ OUT_022113

- **QA/QC Samples:**

Sample Matrix Codes

SO	Soil	AS	Air
SE	Sediment	SV	Soil Vapor
GW	Groundwater	SL	Sludge
SW	Surface Water	FP	Free Product

- Duplicates Samples

SODUPxx_MMDDYY

Sample Matrix Code — Sample Type + Number (two digits minimum) — Sampling Date (MMDDYY)

Sample Type	Parent Sample Code	Date	Sample Name
Groundwater Duplicate Sample (DUP)	MW01_022113	02/21/2013	GWDUP01_022113
Soil boring Duplicate Sample (DUP)	SBP01_022113	02/21/2013	SODUP01_022113
Grab Waste Characterization	WC01	02/21/2013	WCDUP01_022113
Composite Waste Characterization	COMP01	02/21/2013	COMPDUP01_022113

- Field Blanks and Trip Blanks

SBFBxx_MMDDYY

Sample Matrix Code — Sample Type + Number (two digits minimum) — Sampling Date (MMDDYY)

Sample Type	Date	Sample Name
Groundwater Field Blank (FB)	02/21/2013	GWFB01_022113
Groundwater Trip Blank (TB)	02/21/2013	GWTB01_022113
Soil Field Blank	02/21/2013	SOFB01_022113
Soil Trip Blank	02/21/2013	SOTB01_022113

- Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Parent Sample Name_MS or MSD

Sample Type	Sample Location	Parent Sample Name	Sample Name
Matrix Spike Soil (MS)	SB01	SB01_2-4	SB01_2-4_MS
Matrix Spike Soil Duplicate (MSD)	SB01	SB01_2-4	SB01_2-4_MSD
Matrix Spike GW (MS)	MW01	MW01	MW01_MS
Matrix Spike GW Duplicate (MSD)	MW01	MW01	MW01_MSD

3.0 NOTES

1. The sample location code should not exceed 20 characters and the sample name should not exceed 40 characters.
2. Sample location code (**SB01, MW01, etc.)** is a sequential number (starting with 01) and should be a minimum of two digits.
3. Sample Interval (SB01_**0-5**) is separated from the sample location code with an underscore, and the top and bottom interval with a dash. Soil and sediment sample intervals should always be in

feet. Soil and sediment sample intervals should contain no "/" or "()" or unit.

4. Sample date (MW01_**022113**) is separated from the sample location code with an underscore and should be provided in MMDDYY format [the date should contain no "/" or "-"].
5. If groundwater samples are collected from multiple intervals within one well, you may assign a letter designation (in lower case) to the well ID to differentiate between intervals (i.e., MW01a_022113, MW01b_022113, and MW01c_022113). The letter "a" would indicate the shallowest interval and "c" the deepest. The actual depth intervals should be documented in the project field book or field sheets and the letter designations should be used consistently between sampling events.
6. According to USEPA's Contract Laboratory Program (CLP) Guidance for Field Samplers (January 2011), field duplicate samples should remain "blind" to the laboratory (i.e., they should have separate CLP Sample numbers). Assign two separate (unique) CLP sample numbers (i.e., one number to the field sample and one to the duplicate). Submit blind to the laboratory. (http://www.epa.gov/superfund/programs/clp/download/sampler/CLPSamp-01-2011.pdf)

APPENDIX C

CONSTRUCTION HEALTH AND SAFETY PLAN

LANGAN

CONSTRUCTION HEALTH AND SAFETY PLAN

for

990-1026 Rossville Avenue
Block 7054, Lot 518
Staten Island, New York

Prepared For:

Allied Rossville LLC
118-25 Queens Boulevard
16th Floor
Forest Hills, New York 11375

Prepared By:

Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C.
300 Kimball Drive
Parsippany, New Jersey 07054

6 March 2020
100849501

LANGAN

ENVIRONMENTAL HEALTH AND SAFETY PLAN

Client:	**Allied Rossville LLC**
Project:	**Soil Vapor Intrusion Interim Remedial Measure Work Plan Implementation**
Location:	**990-1026 Rossville Avenue**
Chemical Hazards:	**Volatile Organic Compounds**
Prepared By:	**Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C.**
Version:	**1**
Date:	**6 March 2020**

Client Contact:	**Jeff Kay**	**(718) 263-3800**
Langan Project Manager (PM):	**Chris McMahon**	**(973) 560-4861**
Langan Health & Safety Manager (HSM):	**Tony Moffa, CHMM**	**(215) 491-6545**
Langan Health and Safety Officer (HSO):	**Field Personnel**	
WorkCare:	**1-888-449-7787**	
Langan Incident/Injury Hotline:	**(973) 560-4699**	

LANGAN ENGINEERING, ENVIRONMENTAL, SURVEYING, LANDSCAPE ARCHITECTURE AND GEOLOGY, D.P.C. (LANGAN), AND LANGAN SUBCONTRACTORS, DO NOT GUARANTEE THE HEALTH OR SAFETY OF ANY PERSON ENTERING THIS SITE. DUE TO THE NATURE OF THIS SITE AND THE ACTIVITY OCCURRING THEREON, IT IS NOT POSSIBLE TO DISCOVER, EVALUATE, AND PROVIDE PROTECTION FOR ALL POSSIBLE HAZARDS WHICH MAY BE ENCOUNTERED. STRICT ADHERENCE TO THE HEALTH AND SAFETY GUIDELINES SET FORTH HEREIN WILL REDUCE, BUT NOT ELIMINATE, THE POTENTIAL FOR INJURY AT THIS SITE. THE HEALTH AND SAFETY GUIDELINES IN THIS PLAN WERE PREPARED SPECIFICALLY FOR THIS SITE AND SHOULD NOT BE USED ON ANY OTHER SITE WITHOUT PRIOR RESEARCH AND EVALUATION BY A TRAINED HEALTH AND SAFETY SPECIALIST.

APPROVALS

By signature, the personnel identified below hereby acknowledge that they have reviewed this Construction Health and Safely Plan (CHASP) and agree to comply with the requirements contained therein as well as the applicable provisions of 29 CFR Parts 1910 and 1926. The undersigned also acknowledge and accept that this CHASP is the project CHASP for the site work described in the Remedial Action Plan (RAP). Furthermore, in reviewing and accepting this CHASP, as currently written, the undersigned agree that to the best of their knowledge, this CHASP adequately identifies the activities and hazards associated with work at this site and describes the appropriate and necessary precautions and protections for site workers required by the applicable OSHA statutes and regulations.

______________________________	3/6/2020
LANGAN Project Manager - PM (Chris McMahon)	Date
______________________________	______________
LANGAN Health and Safety Manager (Tony Moffa, CHMM)	Date
______________________________	______________
LANGAN Health and Safety Officer – HSO	Date

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1.0 INTRODUCTION

1.1 Purpose and Policy

This Construction Health and Safety Plan (CHASP) has been developed to comply with the regulations under Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120(b)(4), Hazardous Waste Operations and Emergency Response. It addresses foreseeable activities associated with the site work activities to be conducted 990-1026 Rossville Avenue in Staten Island, New York (see Figure 1). This CHASP establishes personnel protection standards and mandatory safety practices and procedures. Additionally, it assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may arise while operations are being conducted at known or suspected hazardous waste sites.

Langan personnel involved with inspection of site work activities which involve the displacement of soil and/or material during the installation of the sub-slab depressurization system (SSDS) shall comply with the requirements of this CHASP. All Langan personnel engaged in onsite activities will read this document carefully and complete the Safety Briefing Form (Attachment A), a copy of which will be provided to Langan's Project files. Contractors and subcontractors conducting construction-related activities associated with soil vapor intrusion interim remedial measures work plan (IRMWP) implementation which will disturb or displace soil are required to develop and follow their own HASP which must be equal or more stringent than the Langan CHASP. Contractors and subcontractors are responsible for their own workers Health and Safety and providing a safe working environment in accordance with all applicable federal, state and local requirements. Each Subcontractor will have a designated Site Health and Safety Manager who will be responsible for ensuring that the designated procedures are implemented in the field. Personnel who have any questions or concerns regarding implementation of this plan are encouraged to request clarification from the Langan Project Manager. Field personnel must follow the designated health and safety procedures, be alert to the hazards associated with working close to vehicles and equipment, and use common sense and exercise reasonable caution at all times.

This CHASP covers construction related field activities which have the potential to disturb and/or displace contaminated fill, native soil, and/or groundwater. These activities include, but are not limited to SSDS installation, indoor air sampling, soil vapor sampling, and soil waste classification sampling.

This CHASP was prepared in accordance with the following documents and/or guidelines:

- Occupational Safety and Health Administration (OSHA) regulations for hazardous site workers (29 CFR 1910.120 and 29 CFR 1926); and,
- NIOSH/OSHA/USCG/USEPA *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities.*

Langan's Health and Safety Program and Safe Operating Procedures support this site-specific CHASP.

The level of protection and the procedures specified in this CHASP represent the minimum health and safety requirements to be observed by site personnel engaged in the referenced inspection of construction related activities. Unknown conditions may exist, and known conditions may change. Should an employee find himself or herself in a potentially hazardous situation, the employee will immediately discontinue the hazardous procedures(s) and either personally effect appropriate preventative or corrective measures, or immediately notify the Health and Safety Officer or the Langan Project Manager of the nature of the hazard. In the event of an immediately dangerous or life threatening situation, the employee always has "stop work" authority. Any necessary revision to the Health and Safety procedures will be recorded in the Field Procedure Change Authorization Form (Attachment B), and will require authorization from the Langan Health and Safety Officer and Project Manager.

THE ULTIMATE RESPONSIBILITY FOR THE HEALTH AND SAFETY OF THE INDIVIDUAL EMPLOYEE RESTS WITH THE EMPLOYEE AND HIS OR HER COLLEAGUES. Each employee is responsible for exercising the utmost care and good judgment in protecting his or her own health and safety and that of fellow employees. Should any employee observe a potentially unsafe condition or situation, it is the responsibility of that employee to immediately bring the observed condition to the attention of the appropriate health and safety personnel as designated above and to follow-up the verbal notification by completing the Unsafe Conditions and Practices Form provided in Attachment C, a copy of which will be provided to the Langan Health and Safety Officer.

"Extenuating" circumstances such as budget or time constraints, equipment breakdown, changing or unexpected conditions, never justify unsafe work practices or procedures. In fact, the opposite is true. Under stressful circumstances all project personnel must be mindful of the potential to consciously or unconsciously compromise health and safety standards, and be especially safety conscious. **ALL SITE PERSONNEL ARE EXPECTED TO CONSIDER "SAFETY FIRST" AT ALL TIMES.**

1.2 Site Descriptions

The Site is located in the Rossville section of Staten Island, New York. Lot 518 is located on Block 7054 on the existing New York City Tax Map. A Site Location Plan is provided as Figure 1. The Site is an approximately 66,700-square foot parcel and is bound to the north by three residential buildings, to the east by Rossville Avenue followed by a mixed-use residential and commercial building and a residential building, to the south by Grafe Street followed by a condominium complex, and to the west by asphalt-paved recreational space associated with a condominium complex. The site contains an approximately 25,800-square foot one-story shopping center that is currently occupied by a dry cleaner, liquor store, beauty salon, karate studio, ice cream parlor, grocery store, Chinese restaurant, bagel shop, laundromat, pizzeria, and a vacant former restaurant. A cellar exists beneath the grocery store in the northwestern corner of the shopping center. The remaining portion of the Site consists of an asphalt-paved parking lot in the southeastern portion of the Site and an access road for deliveries along the western and northern perimeters of the Site. Soil disturbance activities will be completed within the building to allow for the construction of the SSDS. Work will be performed in accordance with the rules and regulations of the local governing bodies.

1.3 Scope of Work

The site work activities which will require the oversight by Langan personnel include the following tasks:

- Task 1 – SSDS construction activities including excavation of fill and/or native soil, soil screening, and gravel backfilling for sub-slab pit(s) and/or trenching;
- Task 2 – Vacuum monitoring, indoor air and soil vapor sampling after SSDS start-up; and,
- Task 3 – Waste characterization soil sampling from soil generated during SSDS construction.

Details of the scopes of work to be completed for this project are provided within the March 2020 Interim Remedial Measures Work Plan.

During IRMWP implementation, all soils excavated or disturbed at the site will be transported off site for disposal at an approved facility. Personnel conducting activities that will contact fill/native soil shall abide to the provisions of this CHASP.

2.0 PROJECT TEAM ORGANIZATION AND RESPONSIBILITIES

This section specifies the Langan Engineering, Environmental, Survey, Landscape Architecture and Geology, D.P.C. (Langan) Project Organization.

2.1 Langan Project Manager

The Langan Project Manager (PM) is Chris McMahon. The PM responsibilities include:

Responsibilities:

- Prepares and organizes the background review of site conditions, the site HASP, and the field team.
- Obtains permission for site access and coordinates activities with appropriate officials.
- Briefs the field team on their specific assignments.
- Coordinates with the Health and Safety Officer (HSO) to ensure that health and safety requirements are met.
- Serves as the liaison with public officials.
- Ensuring that this HASP is developed and approved prior to on-site activities.
- Ensuring that all the tasks in the project are performed in a manner consistent with Langan's comprehensive Health and Safety Program for Hazardous Waste Operations and this HASP.

2.2 Health and Safety Manager (HSM)

The Langan Corporate Health and Safety Manager (HSM) is Tony Moffa. His responsibilities include:

- Serving as a resource in the development and implementation of HASPs;
- Assist in reviewing results of Jobsite Safety Inspections;
- Assisting site Health and Safety Officer (HSO) with development of the HASP, updating HASP as dictated by changing conditions, jobsite inspection results, etc.;
- Maintaining all records on personnel (medical evaluation results, training and certifications, accident investigation results, etc.).

2.3 Health and Safety Officer (HSO)

The Langan Health and Safety Officer (HSO) will be identified prior to the start of field work. The HSO responsibilities include:

- Participating in the development and implementation of this HASP;
- Conducting Jobsite Safety Inspections (Attachment H) and correcting any shortcomings in a timely manner;
- Helping to select proper PPE (Personal Protective Equipment) and periodically inspecting it;
- Ensuring that PPE is properly stored and maintained;
- Controlling entry into and exit from the contaminated areas or zones of the site;
- Confirming each team member's suitability for work based on a current physician's recommendation;
- Monitoring the work parties for signs of stress, such as heat stress, fatigue, and cold exposure;
- Monitoring site hazards and conditions;
- Knowing (and ensuring that all site personnel also know) emergency procedures, evacuation routes, and the telephone numbers of the ambulance, local hospital, poison control center, fire department, and police department;
- Resolves conflicting situations which may arise concerning safety requirements and working conditions.
- Conducting daily tailgate meetings to review applicable JSAs as well as check-in with site personnel.

3.0 HAZARDS ANALYSIS

This section presents all assessment of the general, chemical, physical and biological hazards that may be encountered during the tasks specified under this CHASP (Section 1.3). A detail on types of potential contaminants of concerns Langan anticipates to encounter at different locations during the intrusive investigation is listed in Tables 1 and 2 of this CHASP.

3.1 General Hazard Assessment

A general hazard assessment was conducted for the required field work described in Section 1.3 and the following potential hazards have been identified:

- Inhalation of volatile contaminants;
- Skin and eye contact with contaminants;
- Ingestion of contaminants;
- Physical hazards associated with the use of heavy equipment;
- Excavation hazards;
- Tripping hazards;
- Noise exposure;
- Heat stress (depending on weather conditions);
- Cold exposure (depending on weather conditions);
- Flammable hazards;
- Electrical hazards; and,
- Use of personal protective equipment.

These hazards are further described in the task-by-task hazard analysis in Table 3. Specific chemical, physical and biological hazards are discussed below.

Mitigation and controls will include as needed work procedures, work/rest regiment, dust control measures, personal protective equipment, and respiratory protection as appropriate.

3.2 Chemical Exposure Hazards

The following chemical hazard evaluation for the proposed site development activities is based on the previous environmental investigation of the site. The evaluation has been conducted to identify chemicals/materials that potentially may be present at the site, and to ensure that work activities, personnel protection, and emergency response are consistent with the specific contaminants that potentially could be encountered.

3.2.1 Specific Chemical Hazards Previously Detected at the Site

Impacted fill, native soil, groundwater, and soil vapor has been identified on the subject property as reported in the March 2020 Site Investigation Report. Table 1 lists Contaminants of Concern and potentially affected media. The potential contaminants that might be encountered during the field activities and the exposure limits are listed in Table 2.

3.2.2 Chemical Hazard Exposure Routes

Potential hazards and their exposure routes include:

- Inhalation of organic vapors due to the presence of volatile organic compounds from diesel-powered equipment.
- Inadvertent ingestion of potentially toxic substances via hand to mouth contact or deliberate ingestion of materials inadvertently contaminated with potentially toxic materials such as metals.
- Skin and eye contact with contaminants at the site and decontamination activities.

Exposure limits and health effects of selected chemicals are in Table 2. The probability of exposure for each task is outlined in Table 3.

3.2.3 Control of Exposure to Chemical Hazards

To protect potentially exposed personnel the following procedures and protocols will be adopted and used as needed: work procedures will be adhered to, work zones will be established, dust control will be utilized, respirators (if required) and personal protective equipment will be worn, area air monitoring will be conducted during times of disturbance of the fill, native soil, and/or groundwater and strict personnel decontamination procedures will be followed.

3.3 Physical Hazards

3.3.1 Temperature Extremes

Hot Temperatures
Heat stress is a significant potential hazard, which is greatly exacerbated with the use of PPE, in hot environments. The potential hazards of working in hot environments include dehydration, cramps, heat rash, heat exhaustion, and heat stroke. If onsite workers exhibit the signs of heat exhaustion or heat stroke, they should seek immediate medical attention.

Cold Temperatures
Workers may be exposed to the hazard of working in a cold environment. Potential hazards in cold environments include frostbite, trench foot or immersion foot, hypothermia, as well as slippery surfaces, brittle equipment, poor judgment, and unauthorized procedural changes. In order to prevent frostbite, hypothermia, trench foot and immersion foot, the workers are responsible for dressing warmly in layers with thick socks, gloves, and appropriate head and face gear. Upon the onset of discomfort due to the cold, onsite workers should take regular five to ten minute breaks to warm up inside nearby buildings and to drink warm fluids. Please note that the NYCDEP statute prohibits idling an engine for more than three minutes (one-minute if adjacent to a school). This statue includes the use of a vehicle for the purpose of warming up employees. As such, all contractors and employees shall identify a place to warm up in advance. If discomfort continues and the onsite workers start to exhibit the signs of frostbite, hypothermia, trench foot or immersion foot, they should seek immediate medical attention.

3.3.2 Noise and Air Resources

Noise is a potential hazard associated with the operation of heavy equipment, power tools, pumps and generators. Hearing protection is required and shall be used in designated areas of the site as indicated by the posted signs.

3.3.3 Hand and Power Tools

In order to complete the various tasks for the project, personnel will utilize hand and power tools. The use of hand and power tools can present a variety of hazards, including physical harm from being struck by flying objects, being cut or struck by the tool, fire, and electrocution. Hand and power tools will be inspected prior to use. Proper personal protective equipment shall be worn while utilizing hand and power tools. Ground Fault Circuit Interrupters (GFCIs) are required for all portable electric tools.

3.3.4 Slips, Trips, and Falls

Working in and around the site will pose slip, trip and fall hazards due to equipment, piping, slippery surfaces that may be oil covered, or from surfaces that are wet from rain or ice. Potential adverse health effects include falling to the ground and becoming injured or twisting an ankle. Good housekeeping at the site must be maintained at all times.

3.3.5 Fire and Explosion

Prior to starting all excavation work, a review of appropriate New York City maps will be conducted to identify potential hazards. The possibility of encountering fire and explosion hazards exists from under- ground utilities and gases. Therefore, all excavation equipment must be grounded.

3.3.6 Material Handling

Manual lifting of heavy objects may be required. Failure to follow proper lifting techniques can result in back injuries and strains. Back injuries are a serious concern as they are the most common workplace injury, often resulting in lost or restricted work time, and long treatment and recovery periods.

Whenever possible, heavy objects must be lifted and moved by mechanical devices rather than by manual effort. The mechanical devices will be appropriate for the lifting or moving task and will be operated only by trained and authorized personnel. Objects that require special handling or rigging will only be moved under the guidance of a person who has been specifically trained to move such objects, such as a Master Rigger or equivalent. Lifting devices, including equipment, slings, ropes, chains, and straps, will be inspected, certified, and labeled to confirm their weight capacities. Defective equipment will be taken out of service immediately and repaired or destroyed.

The wheels of any trucks being loaded or unloaded, and/or parked on an incline, will be chocked to prevent movement. If applicable, outriggers will be extended on a flat, firm surface during operation. The lift and swing path of a crane/equipment will be watched and maintained clear of obstructions. Personnel will not pass under a raised load, nor will a suspended load be left unattended. Personnel will not be carried on lifting equipment, unless it is specifically designed to carry passengers.

All reciprocating, rotating, or other moving parts will be guarded at all times. Accessible fire extinguishers will be made available in all mechanical lifting devices. All material must be stored in tiers, racked, blocked, or otherwise secure to prevent sliding, falling, or collapse. All loads/material will be verified to be secure before transportation.

3.3.7 Confined Space/Excavation Hazards

Personnel entry into trenches or unshored (*e.g.,* lagging) excavations within the designated areas of concern will not be permitted. No other confined spaces are known to exist on Site. If entry into trenches or excavations is required, all work will stop until the CHASP has been revised to address the new hazards.

3.3.8 Working Near Equipment

Personnel working in the immediate vicinity of heavy equipment (*e.g.*, excavators, loaders, etc.) may encounter physical hazards resulting from contact with equipment. Field personnel should be aware of the presence of these hazards at all times and take appropriate action to avoid them. Due to the limited ability to communicate when wearing respiratory protection, the risk is increased. Workers must be careful to communicate with heavy equipment operators regarding their location, and should maintain a safe distance from operating equipment at all times. Prior to working around equipment, the site personnel will review appropriate hand signals with the operator.

Equipment will be equipped with back up alarms.

3.3.9 Electrical Safety

Personnel may utilize hand and power tools. The use of hand and power tools can present a variety of hazards, including physical harm from being struck by flying objects, being cut or struck by the tool, fire, and electrocution. Ground Fault Circuit Interrupters (GFCIs) are required for all portable electric tools.

3.3.10 Utilities

Prior to the start of any intrusive work, the location of above-ground and underground utilities and other structures will be completed by the contractor/subcontractor responsible for completing construction activities.

3.3.11 Vehicular Traffic

Portions of site activities (load in and load out) will be conducted in the street so vehicular and pedestrian traffic will be present. Appropriate precautions to protect the on-site workers and civilians should be used including the use of cones and traffic vests as appropriate.

3.4 Biological Hazards

During the course of the project, there is a potential for workers to come into contact with biological hazards such as animals and insects. As the potential for exposure to blood borne pathogens during site investigation is anticipated to be low, a Blood Borne Pathogen Exposure Plan (BBPEP) is not required. A BBPEP will be prepared if site operation requires its implementation.

3.4.1 Animals

During site operations, animals such as dogs, cats, pigeons, mice, and rats may be encountered. Workers shall use discretion and avoid all contact with animals. Bites and scratches from dogs and cats can be painful and if the animal is rabid, the potential for contracting rabies exists. Contact with rat and mice droppings may lead to contracting hantavirus. Inhalation of dried pigeon droppings may lead to psittacosis. Cryptococcosis and histoplasmosis are also diseases associated with exposure to dried bird droppings but these are less likely to occur in this occupational setting.

3.4.2 Insects

Insects, including bees, wasps, hornets, mosquitoes, spiders, and ticks may be present at the site. Some individuals may have a severe allergic reaction to an insect bite or sting that can result in a life threatening condition. In addition, mosquito bites may lead to St. Louis encephalitis or West Nile encephalitis.

3.4.3 Wound Care

A source of occupational exposure may occur when an employee gives First Aid and or CPR to an individual who had infectious blood. The occupational exposure occurs when there is the possibility for an employee's eyes, mucous membranes, non-intact skin (i.e., cut and abraded skin) to come into contact with potentially infectious materials from another employee. If an accident were to occur where First Aid would need to be administered, the person administering the First Aid will presume that any wounds and materials used are contaminated with BBP and should wear the appropriate PPE to prevent contact with these materials. Additionally, should the use of First Aid materials and or clothing that was potentially contaminated with BBP be encountered these materials should be property containerized and transported to the nearest hospital for proper disposal.

3.5 Task Hazard Analysis

The tasks to be completed during the proposed site work activities, as summarized in Section 1.3, are listed in Table 3 with a Hazard Analysis for each task.

4.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

4.1 Levels of Protection

PPE must protect workers from the specific hazards they are likely to encounter on site. Selection of the appropriate PPE must take into consideration: (1) identification of the hazards or suspected hazards; (2) potential exposure routes; and, (3) the performance of the PPE construction (materials and seams) in providing a barrier to these hazards. Based on anticipated site conditions and the proposed work activities to be performed at the Site, Level D Protection will be used. The upgrading/downgrading of these levels of protection will be based on continuous air monitoring results as described in Section 5.0. The decision to modify standard PPE will be made by the HSO after conferring with the Langan Project Manager. The levels of protection are described below.

- **Level D Protection**

  a. Safety glasses with sideshields or chemical splash goggles
  b. Safety boots/shoes (toe-protected)
  c. Hard hat
  d. Long sleeve work shirt and work pants
  e. Nitrile gloves
  f. Hearing protection (as needed)
  g. Reflective traffic vest

- **Level D Protection (Modified)**

  a. Safety glasses with sideshields or chemical splash goggles
  b. Safety boots/shoes (toe-protected)
  c. Disposable chemical-resistant boot covers
  d. Coveralls (polycoated Tyvek or equivalent to be worn when contact with wet contaminated soil, groundwater, or non-aqueous phase liquids is anticipated)
  e. Hard hat
  f. Long sleeve work shirt and work pants
  g. Nitrile gloves
  h. Hearing protection (as needed)
  i. Reflective traffic vest

- **Level C Protection**

  a. Full face-piece, air-purifying, cartridge*-equipped, NIOSH-approved respirator [*combo cartridge P100/OV/CL/HC/SD/CD/HS (escape)]
  b. Inner (latex) and outer (nitrile) chemical-resistant glove
  c. Chemical-resistant safety boots/shoes (toe-protected)
  d. Disposable chemical-resistant boot covers
  e. Hard hat
  f. Long sleeve work shirt and work pants

g. Coveralls (Tyvek or equivalent, poly-coated Tyvek will be worn when contact, or anticipated contact with wet contaminated soils, ground water, and/or non-aqueous phase liquids (NAPL) is anticipated)
h. Hearing protection (as needed)
i. Reflective traffic vest

The action levels used in determining the necessary levels of respiratory protection and upgrading to Level C are provided in Table 4. The written Respiratory Protection Program is maintained by Langan's H&S Department. The monitoring procedures and equipment are outlined in Section 5.0.

4.2 Respirator Fit-Test

All Langan employees and subcontractors performing site work who could be exposed to hazardous substances at the work site are in possession of a full face-piece, air-purifying respirator and have been successfully quantitative fit-tested within the past year. Quantitative fit-test records are maintained by Langan's H&S Department.

4.3 Respirator Cartridge Change-Out Schedule

Respiratory protection is required to be worn when certain action levels (Table 2) are reached. A respirator cartridge change-out schedule has been developed in order to comply with 29 CFR 1910.134. The respirator cartridge change-out schedule for this project is as follows:

- Cartridges shall be removed and disposed of at the end of each shift, when cartridges become wet or wearer experiences breakthrough, whichever occurs first.
- If the humidity exceeds 85%, then cartridges shall be removed and disposed of after 4 hours of use.

Respirators shall not be stored at the end of the shift with contaminated cartridges left on. Cartridges shall not be worn on the second day, no matter how short the time period was the previous day they were used.

5.0 AIR QUALITY MONITORING AND ACTIONS LEVELS

5.1 Monitoring During Site Operations

Atmospheric air monitoring results are used to provide data to determine when exclusion zones need to be established and when certain levels of personal protective equipment are required. For all instruments there are Site-specific action level criteria which are used in making field health and safety determinations. Other data, such as the visible presence of contamination or the steady state nature of air contaminant concentration, are also used in making field health and safety decisions. Therefore, the HSO may establish an exclusion zone or require a person to wear a respirator even though atmospheric air contaminant concentrations are below established CHASP action levels.

During site work involving disturbance of fill and/or native soil, real time air monitoring will be conducted for volatile organic compounds (VOCs). A photoionization detector (PID) and/or flame ionization detector (FID) will be used to monitor concentrations of VOCs at personnel breathing-zone height. Dust monitoring will be accomplished with an aerosol monitor. Air monitoring will be the responsibility of the HSO or designee. Air monitoring will be conducted approximately every 30 minutes during ground intrusive activities in the work zone on the project site. All manufacturers' instructions for instrumentation and calibration will be available onsite.

Subcontractors' air monitoring plans must be equal or more stringent as the Langan plan.

An air monitoring calibration log is provided in Attachment D of this CHASP.

5.1.1 Volatile Organic Compounds

Monitoring with a PID, such as a MiniRAE 2000 (10.6v) or equivalent will occur during intrusive work in the work zone. Colormetric Indicator Tubes for benzene may be used as backup for the PID, if measurements remain above background monitor every 2 hours. The HSO will monitor the employee breathing zone at least every 30 minutes, or whenever there is any indication that concentrations may have changed (odors, visible gases, etc.) since the last measurement. Instrument action levels for monitored gases are provided in Table 4.

5.1.2 Dust

During invasive procedures which have the potential for creating airborne dust, such as excavation of dry soils, a real time airborne dust monitor such as a Mini-Ram should be used to monitor for air particulates. The HSO will monitor the employee breathing zone at least every 30 minutes, or whenever there is any indication that concentrations may have changed (appearance of visible dust) since the last measurement. Instrument action levels for dust monitoring are provided in Table 4.

5.2 Monitoring Equipment Calibration and Maintenance

Instrument calibration shall be documented and included in a dedicated safety and health logbook or on separate calibration pages of the field book. All instruments shall be calibrated before and after each shift. Calibration checks may be used during the day to confirm instrument accuracy. Duplicate readings may be taken to confirm individual instrument response.

All instruments shall be operated in accordance with the manufacturers' specifications. Manufacturers' literature, including an operations manual for each piece of monitoring equipment will be maintained on site by the HSO for reference.

5.3 Determination of Background Levels

Background (BKD) levels for VOCs and dust will be established prior to intrusive activities within the work zone and at an upwind location. A notation of BKD levels will be referenced in the daily monitoring log. BKD levels are a function of prevailing conditions. BKD levels will be taken in an appropriate upwind location as determined by the HSO.

Table 4 lists the instrument action levels.

6.0 COMMUNITY HEALTH AND SAFETY CONSIDERATIONS

The potential impact of site work activities on the surrounding community (residential and business) is of concern. Precautions taken to reduce or prevent contamination from leaving the work areas include the following:

- All appropriate equipment will be decontaminated before leaving the Site;
- Work zone air monitoring for volatile organic compounds and dust will be conducted by Langan;
- Dust and vapor suppression techniques will be used as necessary; and,
- Work will be suspended at any time that contaminants are found to be migrating outside of the building and/or off-site at a concentration that exceeds the most stringent compound-specific action level as per this CHASP.

7.0 WORK ZONES AND DECONTAMINATION

7.1 Site Control

Work zones are intended to control the potential spread of contamination throughout the site and to assure that only authorized individuals are permitted into potentially hazardous areas.

Any person working in an area where the potential for exposure to site contaminants exists will only be allowed access after providing the HSO with proper training and medical documentation.

Exclusion Zone (EZ) - All activities which may involve exposure to site contaminants, hazardous materials and/or conditions should be considered an EZ. Decontamination of field equipment will also be conducted in the Contaminant Reduction Zone (CRZ) which will be located on the perimeter of the EZ. The EZ and the CRZ will be clearly delineated by cones, tapes or other means. The HSO may establish more than one EZ where different levels of protection may be employed or different hazards exist. The size of the EZ shall be determined by the HSO allowing adequate space for the activity to be completed, field members and emergency equipment.

7.2 Contamination Control

7.2.1 Personnel Decontamination Station

Personal hygiene, coupled with diligent decontamination, will significantly reduce the potential for exposure.

7.2.2 Minimization of Contact with Contaminants

During completion of all site activities, personnel should attempt to minimize the chance of contact with contaminated materials. This involves a conscientious effort to keep "clean" during site activities. All personnel should minimize kneeling, splash generation, and other physical contact with contamination as PPE is intended to minimize accidental contact. This may ultimately minimize the degree of decontamination required and the generation of waste materials from site operations.

Field procedures will be developed to control over spray and runoff and to ensure that unprotected personnel working nearby are not affected.

7.2.3 Personnel Decontamination Sequence

Decontamination will be performed by removing all PPE used in EZ and placing it in drums/trash cans at the CRZ. Baby wipes shall be available for wiping hands and face. Drums/trash cans will be labeled by the field crews in accordance with all local, state, and federal requirements. Management plans for contaminated PPE, tools and Investigative Derived Waste (i.e., soil cutting) are provided below.

7.2.4 Emergency Decontamination

If circumstances dictate that contaminated clothing cannot be readily removed, then remove gross contamination and wrap injured personnel with clean garments/blankets to avoid contaminating other personnel or transporting equipment. If the injured person can be moved, he/she will be decontaminated by site personnel as described above before emergency responders handle the victim. If the person cannot be moved because of the extent of the injury (a back or neck injury), provisions shall be made to ensure that emergency response personnel will be able to respond to the victim without being exposed to potentially hazardous atmospheric conditions. If the potential for inhalation hazards exist, such as with open excavation, this area will be covered with polyethylene sheeting to eliminate any potential inhalation hazards. All emergency personnel are to be immediately informed of the injured person's condition, potential contaminants, and provided with all pertinent data.

7.2.5 Hand-Held Equipment Decontamination

Hand-held equipment includes all monitoring instruments as stated earlier, samples, hand tools, and notebooks. The hand-held equipment is dropped at the first decontamination station to be decontaminated by one of the decontamination team members. These items must be decontaminated or discarded as waste prior to removal from the CRZ.

To aid in decontamination, monitoring instruments can be sealed in plastic bags or wrapped in polyethylene. This will also protect the instruments against contaminants. The instruments will be wiped clean using wipes or paper towels if contamination is visually evident. Sampling equipment, hand tools, etc. will be cleaned with non-phosphorous soap to remove any potentially contaminated soil, and rinsed with deionized water. All decontamination fluids will be containerized and stored on-site pending waste characterization sampling and appropriate off-site disposal.

7.2.6 Heavy Equipment Decontamination

All heavy equipment and vehicles arriving at the work site will be free from contamination from offsite sources. Any vehicles arriving to work that are suspected of being impacted will not be permitted on the work site. Potentially contaminated heavy equipment will not be permitted to leave the EZ unless it has been thoroughly decontaminated and visually inspected by the HSO or his designee.

7.3 Communications

The following communications equipment will be utilized as appropriate.

- Telephones - A cellular telephone will be located with the HSO for communication with the HSM and emergency support services/facilities.
- Hand Signals - Hand signals shall be used by field teams, along with the buddy system. The entire field team shall know them before operations commence and their use covered during site-specific training. Typical hand signals are the following:

Signal	Meaning
Hand gripping throat	Out of air, can't breathe
Grip on partner's wrist or placement of both hands around partner's waist	Leave area immediately, no debate
Hands on top of head	Need assistance
Thumbs up	Okay, I'm all right, I understand
Thumbs down	No, negative

8.0 MEDICAL SURVEILLANCE

All personnel who will be performing field work involving potential exposure to toxic and hazardous substances will be required to have passed an initial baseline medical examination, with annual follow-up medical exams thereafter, consistent with 29 CFR 1910.120(f). Medical evaluations will be performed by, or under the direction of, a physician board-certified in occupational medicine. Results of medical evaluations are maintained by Langan's H&S Department.

9.0 EMERGENCY RESPONSE PLAN

This section establishes procedures and provides information for use during a project emergency. Emergencies happen unexpectedly and quickly, and require an immediate response; therefore, contingency planning and advanced training of staff is essential. Specific elements of emergency support procedures that are addressed in the following subsections include communications, local emergency support units, preparation for medical emergencies, first aid for injuries incurred on site, record keeping, and emergency site evacuation procedures. In case of emergency, in addition to 911 the Langan Incident/Injury Hotline (973-560-4699) should be called as soon as possible.

9.1 Responsibilities

9.1.1 Health and Safety Officer (HSO)

The HSO is responsible for ensuring that all personnel are evacuated safely and that machinery and processes are shut down or stabilized in the event of a stop work order or evacuation. The HSO is responsible for ensuring the HSM are notified of all incidents, all injuries, near misses, fires, spills, releases or equipment damage. The HSO is required to immediately notify the HSM of any fatalities or catastrophes (three or more workers injured and hospitalized) so that the HSM can notify OSHA within the required time frame.

9.1.2 Emergency Coordinator

The HSO or their designated alternate will serve as the Emergency Coordinator. The Emergency Coordinator is responsible for ensuring that all personnel are evacuated safely and that machinery and processes are shut down or stabilized in the event of a stop work order or evacuation. They are also responsible for ensuring the HSM are notified of all incidents, all injuries, near misses, fires, spills, releases or equipment damage. The Emergency Coordinator is required to immediately notify the HSM of any fatalities or catastrophes (three or more workers injured and hospitalized.

The Emergency Coordinator shall locate emergency phone numbers and identify hospital routes prior *to beginning* work on the sites. The Emergency Coordinator shall make necessary arrangements to be prepared for any emergencies that could occur.

The Emergency Coordinator is responsible for implementing the Emergency Response Plan.

9.1.3 Site Personnel

Project site personnel are responsible for knowing the Emergency Response Plan and the procedures contained herein. Personnel are expected to notify the Emergency Coordinator of situations that could constitute a site emergency. Project site personnel, including all subcontractors will be trained in the Emergency Response Plan.

9.2 Communications

Once an emergency situation has been stabilized or as soon as practically possible, the HSO will contact the Langan Incident/Injury Hotline ((973)560-4699) and Project Manager of identify any emergency situation.

9.3 Local Emergency Support Units

In order to be able to deal with any emergency that might occur during investigative activities at the site, Attachment E will be available in the field vehicles and provided to all personnel conducting work within the EZ.

Figure 2 shows the hospital route map. Outside emergency number 911 and local ambulance should be relied on for response to medical emergencies and transport to emergency rooms. Due to traffic congestion that is prevalent in the New York metropolitan area, alternate hospital routes will need to be considered. The Emergency Coordinator will determine the appropriate route based on time of day and traffic patterns. Changes in the referenced primary facilities shall be documented with the CHASP Field Change Authorization Request Form (Attachment B).

The Emergency Phone Numbers listed are preliminary. Upon mobilization, the HSO shall verify all numbers and document the changes in the Site Logbook. Any changes shall also be documented with the CHASP Field Change Authorization Request Form.

Hospital route maps will be provided to all field personnel.

9.4 Pre-Emergency Planning

Langan will communicate directly with administrative personnel from the emergency room at the hospital in order to determine whether the hospital has the facilities and personnel needed to treat cases of trauma resulting from any of the contaminants expected to be found on the site. Instructions for finding the hospital will be posted conspicuously in the site office and in each site vehicle.

9.5 Emergency Medical Treatment

The procedures and rules in this CHASP are designed to prevent employee injury. However, should an injury occur, no matter how slight, it will be reported to the HSO on site immediately. First-aid equipment will be available on site at the following locations:

First Aid Kit:	Vehicles
Emergency Eye Wash:	Vehicles

During the site safety briefing, project personnel will be informed of the location of the first aid station(s) that has been set up. Unless they are in immediate danger, severely injured persons will not be moved until paramedics can attend to them. Some injuries, such as severe cuts and lacerations or burns, may require immediate treatment. Any first aid instructions that can be obtained from doctors or paramedics, before an emergency-response squad arrives at the site or before the injured person can be transported to the hospital, will be followed closely.

Personnel with current first aid and CPR certification will be identified.

Only in non-emergency situations will an injured person be transported to the hospital by means other than an ambulance.

<u>**Nearest hospital**</u>: **Staten Island University Hospital South Campus**
375 Seguine Avenue
Staten Island, NY 10309
(718) 226-2000
(directions from site to hospital found on Figure 2)

9.6 Non-Emergency Medical Treatment

In case of injury to personnel, which is not a medical emergency the employee will contact WorkCare at (1-888-449-7787). WorkCare provides access 24 hours / 7 days a week to experienced occupational health nurses and physicians who confer with employees at the onset of a work-related injury or illness. WorkCare will provide over the phone injury treatment or direct employees to medical treatment by third party provider, if appropriate.

9.7 Emergency Site Evacuation Routes and Procedures

All project personnel will be instructed on proper emergency response procedures and locations of emergency telephone numbers during the initial site safety meeting. If an emergency occurs as a result of the site investigation activities, including but not limited to fire, explosion or significant release of toxic gas into the atmosphere, the Langan Project Manager will be verbally notified immediately. All heavy equipment will be shut down and all personnel will evacuate the work areas and assemble at the nearest intersection to be accounted for and to receive further instructions.

9.8 Fire Prevention and Protection

In the event of a fire or explosion, procedures will include immediately evacuating the site and notification of the Langan Project Manager of the investigation activities. Portable fire extinguishers will be provided at the work zone. The extinguishers located in the various locations should also be identified prior to the start of work. No personnel will fight a fire beyond the stage where it can be put out with a portable extinguisher (incipient stage).

9.8.1 Fire Prevention

Fires will be prevented by adhering to the following precautions:

- Good housekeeping and storage of materials.
- Storage of flammable liquids and gases away from oxidizers.
- Shutting off engines to refuel.
- Grounding and bonding metal containers during transfer of flammable liquids.
- Use of UL approved flammable storage cans.
- Fire extinguishers rated at least 10 pounds ABC located on all heavy equipment, in all trailers and near all hot work activities.

The person responsible for the control of fuel source hazards and the maintenance of fire prevention and/or control equipment is the HSO.

9.9 Significant Vapor Release

Based on the proposed tasks, the potential for a significant vapor release is low. However, if a release occurs, the following steps will be taken:

- Move all personnel to an upwind location. All non-essential personnel shall evacuate.
- Upgrade to Level C Respiratory Protection.
- Downwind perimeter locations shall be monitored for volatile organics..
- If the release poses a potential threat to human health or the environment in the community, the Emergency Coordinator shall notify the Langan Project Manager.
- Local emergency response coordinators will be notified.

9.10 Overt Chemical Exposure

The following are standard procedures to treat chemical exposures. Other, specific procedures detailed on the Safety Data Sheet (SDS) will be followed, when necessary.

SKIN AND EYE:	Use copious amounts of soap and water from eye-wash kits and portable hand wash stations.
CONTACT:	Wash/rinse affected areas thoroughly, then provide appropriate medical attention. Skin shall also be rinsed for 15 minutes if contact with caustics, acids or hydrogen peroxide occurs. Affected items of clothing shall also be removed from contact with skin.

Providing wash water and soap will be the responsibility of each individual contractor or subcontractor on-site.

9.11 Decontamination During Medical Emergencies

If emergency life-saving first aid and/or medical treatment is required, normal decontamination procedures may need to be abbreviated or omitted. The HSO or designee will accompany contaminated victims to the medical facility to advise on matters involving decontamination when necessary. The outer garments can be removed if they do not cause delays, interfere with treatment or aggravate the problem. Respiratory equipment must always be removed. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed on site, a plastic barrier placed between the injured individual and clean surfaces should be used to help prevent contamination of the inside of ambulances and/or medical personnel. Outer garments may then be removed at the medical facility. No attempt will be made to wash or rinse the victim if his/her injuries are life threatening, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material which could also cause severe injury or loss of life to emergency response personnel. For minor medical problems or injuries, the normal decontamination procedures will be followed.

9.12 Incident Reporting

Once first aid and/or emergency response needs have been met, the following parties are to be contacted:

- WorkCare (1-888-449-7787)
- Langan Incident/Injury Report Hotline ((973)560-4699)
- Langan Project Manager, Chris McMahon (973-560-4861)
- Langan Health and Safety Manager, Tony Moffa (215-491-6500)
- The employer of any injured worker who is not a Langan employee

For emergencies involving personal injury and/or exposure including near-misses, the HSO or designee will complete and submit an Incident Report form (Attachment F) within 24 hours. If the employee involved is not a Langan employee, his employer shall receive a copy of the report.

9.13 Adverse Weather Conditions

In the event of adverse weather conditions, the HSO will determine if work will continue without potentially risking the safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

- Potential for heat stress and heat-related injuries.
- Potential for cold stress and cold-related injuries.
- Treacherous weather-related working conditions (hail, rain, snow, ice, high winds).
- Limited visibility (fog).
- Potential for electrical storms.
- Earthquakes.
- Other major incidents.

Site activities will be limited to daylight hours, or when suitable artificial light is provided, and acceptable weather conditions prevail. The HSO will determine the need to cease field operations or observe daily weather reports and evacuate, if necessary, in case of severe inclement weather conditions.

9.14 Spill Control and Response

All small spills/environmental releases shall be contained as close to the source as possible. Whenever possible, the SDS will be consulted to assist in determining proper waste characterization and the best means of containment and cleanup. For small spills, sorbent materials such as sand, sawdust or commercial sorbents should be placed directly on the substance to contain the spill and aid recovery. Any acid spills should be diluted or neutralized carefully prior to attempting recovery. Berms of earthen or sorbent materials can be used to contain the leading edge of the spills. All spill containment materials will be properly disposed. An exclusion zone of 50 to 100 feet around the spill area should be established depending on the size of the spill.

All contractor vehicles shall have spill kits on them with enough material to contain and absorb the worst-case spill from that vehicle. All vehicles and equipment shall be inspected prior to be admitted on site. Any vehicle or piece of equipment that develops a leak will be taken out of service and removed from the job site.

The following seven steps shall be taken by the Emergency Coordinator:

1. Determine the nature, identity and amounts of major spills.
2. Make sure all unnecessary persons are removed from the spill area.
3. Notify the HSO immediately.
4. Use proper PPE in consultation with the HSO.
5. If a flammable liquid, gas or vapor is involved, remove all ignition sources and use non-sparking and/or explosion-proof equipment to contain or clean up the spill (diesel-only vehicles, air-operated pumps, etc.)
6. If possible, try to stop the leak with appropriate material.
7. Remove all surrounding materials that can react or compound with the spill.

In addition to the spill control and response procedures described in this CHASP, Langan personnel will coordinate with the designated project manager relative to spill response and control actions. Notification to the Project Manager must be immediate and, to the extent possible, include the following information:

- Time and location of the spill.
- Type and nature of the material spilled.

- Amount spilled.
- Whether the spill has affected or has a potential to affect a waterway or sewer.
- A brief description of affected areas/equipment.
- Whether the spill has been contained.
- Expected time of cleanup completion. If spill cleanup cannot be handled by Langan's on-site personnel alone, such fact must be conveyed to the Project Manager immediately.

Langan shall not make any notification of spills to outside agencies. The client will notify regulatory agencies as per their reporting procedures.

9.15 Emergency Equipment

The following minimum emergency equipment shall be kept and maintained on site:

- Industrial first aid kit.
- Fire extinguishers (one per site).

9.16 Restoration and Salvage

After an emergency, prompt restoration of utilities, fire protection equipment, medical supplies and other equipment will reduce the possibility of further losses. Some of the items that may need to be addressed are:

- Refilling fire extinguishers.
- Refilling medical supplies.
- Recharging eyewashes and/or showers.
- Replenishing spill control supplies.

10.0 TRAINING

10.1 General Health and Safety Training

Completion of an initial 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training program (or its equivalent) as detailed in OSHA's

29 CFR 1910.120(e) is required for all employees who will perform work in areas where the potential for a toxic exposure exists. Annual 8-hour refresher training is also required to maintain competencies to ensure a safe work environment.

10.2 Site-Specific Training

Prior to commencement of site activities, all field personnel assigned to the project will have completed training that will specifically address the activities, procedures, monitoring, and equipment used in the site operations. It will include a documented verbal review of the entire CHASP and all the provisions within the CHASP document. Should any new employees arrive on-site, they will also be given a documented full CHASP review – or one that address the appropriate tasks that remain at the time of the new employee's arrival.

10.3 Onsite Safety Briefings

Project personnel and visitors will participate in documented daily on-site health and safety briefings ("Tailgate Talks") led by the HSO to assist site personnel in safely conducting their work activities. The briefings will include information on operations to be conducted that shift, changes in work practices or changes in the site's environmental conditions, as well as periodic reinforcement of previously discussed topics. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety inspections. The meetings will also be an opportunity for the work crews to be updated on monitoring results. Prior to starting any new activity, a training session will be held for crew members involved in the activity. The Safety Briefing form (Attachment A) can be used to facilitate this effort.

10.4 Hazard Communication

All material brought on-site will be in the appropriate containers and will be properly labeled. The SDS for unleaded gasoline, diesel fuel, and hydraulic fluid are attached. Langan's written Hazard Communication program, in compliance with 29 CFR 1910.1200, is maintained by Langan's H&S Department.

11.0 RECORDKEEPING

The following is a summary of required health and safety logs, reports and recordkeeping.

11.1 Field Change Authorization Request

A field change authorization request is to be completed for requesting a change to this CHASP (Attachment B). Any changes to the work to be performed that is not included in the CHASP will require an Addendum that is approved by the Langan Project Manager and Langan HSM to be prepared. Approved changes will be reviewed with all field personnel at a safety briefing.

11.2 Medical and Training Records

Copies or verification of training (40-hour, 8-hour, supervisor, site-specific training, documentation of three-day OJT, and respirator fit-test records) and medical clearance for Site work and respirator use will be maintained in the office and available upon request. Records for all subcontractor employees must also be available upon request. All employee medical records will be maintained by Langan's H&S Department.

11.3 Onsite Log

A log of personnel on site each day will be kept by the HSO or designee.

11.4 Daily Safety Meetings ("Tailgate Talks")

Completed Safety Briefing forms will be maintained by the HSO.

11.5 Exposure Records

All personal monitoring results, laboratory reports, calculations and air sampling data sheets are part of an employee exposure record. These records will be maintained by the HSO during site work. At the end of the project they will be maintained according to 29 CFR 1910.1020.

11.6 Hazard Communication Program/SDS

Safety Data Sheets (SDS) have been obtained for applicable substances and are included in this CHASP (Attachment G). Langan's written Hazard Communication program, in compliance with 29 CFR 1910.1200, is maintained by Langan's H&S Department.

11.7 Documentation

Employees are required to contact WorkCare at (1-888-449-7787) to document incidents/injuries which are not medical emergencies. Immediately following an incident or near miss, unless emergency medical treatment is required, either the employee or a coworker must contact the Langan Incident/Injury Hotline at (973)560-4699 and the client representative to report the incident or near miss. A written report must be completed and submitted to the client representative within 24 hours of the incident. For emergencies involving personnel injury and/or exposure, employee will complete and submit the Langan Incident/Injury Report to the Langan Corporate Health and Safety Manager as soon as possible following the incident. Accidents will be investigated in-depth to identify all causes and to recommend hazard control measures.

12.0 FIELD PERSONNEL REVIEW

This form serves as documentation that field personnel have been verbally given a full CHASP review by Langan personnel, and understand the provisions of this EHS Plan. It is maintained on site by the HSO as a project record.

Each field team member shall sign this section after Site-specific training is completed and before being permitted to work onsite.

Name (Print and Sign)	***Company***	***Date***

TABLES

TABLE 1
SUSPECTED CONTAMINANTS OF CONCERN
990-1026 ROSSVILLE AVENUE
STATEN ISLAND, NEW YORK

Contaminant of Concern	Affected Media
VOLATILES	
Cis-1,2-Dichloroethene	Soil / Soil Vapor / Groundwater
Tetrachloroethene (PCE)	Soil / Soil Vapor / Groundwater
Trans-1,2-Dichloroethene	Soil / Soil Vapor / Groundwater
Trichloroethene (TCE)	Soil / Soil Vapor / Groundwater
Vinyl Chloride	Soil / Soil Vapor / Groundwater
1,1,1-Trichloroethane	Soil Vapor / Groundwater
1,1-Dichloroethene	Soil Vapor
Chloroform	Groundwater

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TABLE 2
SELECTED POTENTIAL CHEMICAL EXPOSURE LIMITS AND HEALTH EFFECTS
990-1026 ROSSVILLE AVENUE
STATEN ISLAND, NEW YORK

Chemical	Permissible Exposure Limit	IDLH Limit	Exposure Routes	Exposure Symptoms
Cis-1,2-Dichloroethene	200 ppm	1,000 ppm	Inhalation, Ingestion, skin and/or eye contact	Irritate eyes, respiratory system; central nervous system depression
Tetrachloroethene (PCE)	100 ppm	150 ppm	Inhalation, Skin Absorption, Ingestion, skin and/or eye contact	Nausea, vomiting, abdominal pain, tremor fingers, jaundice, hepatitis, liver tenderness, dermatitis, monocytosis, kidney damage [potential occupational carcinogen]
Trans-1,2-Dichloroethene	200 ppm	1,000 ppm	Inhalation, Ingestion, skin and/or eye contact	Irritate eyes, respiratory system; central nervous system depression
Trichloroethene (TCE)	100 ppm	1,000 ppm	Inhalation, Skin Absorption, Ingestion, skin and/or eye contact	Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]
Vinyl Chloride	1 ppm	--	Inhalation, skin and/or eye contact	Lassitude (weakness, exhaustion); abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [potential occupational carcinogen]

TABLE 2
SELECTED POTENTIAL CHEMICAL EXPOSURE LIMITS AND HEALTH EFFECTS
990-1026 ROSSVILLE AVENUE
STATEN ISLAND, NEW YORK

Chemical	Permissible Exposure Limit	IDLH Limit	Exposure Routes	Exposure Symptoms
1,1,1-Trichloroethane	350 ppm	700 ppm	Inhalation, Ingestion, skin and/or eye contact	Irritation eyes, skin; headache, lassitude (weakness, exhaustion), central nervous system depression, poor equilibrium; dermatitis; cardiac arrhythmias; liver damage
1,1-Dichloroethene	–	–	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen]
Chloroform	50 ppm	500 ppm	Inhalation, skin absorption, ingestion, skin and/or eye contact	irritation eyes, skin; dizziness, mental dullness, nausea, confusion; headache, lassitude (weakness, exhaustion); anesthesia; enlarged liver; [potential occupational carcinogen]

--- No exposure limits listed in the NIOSH Pocket Guide to Chemical Hazards dated November 2010.

TABLE 3
HAZARD ANALYSIS
990-1026 ROSSVILLE AVENUE
STATEN ISLAND, NEW YORK

Task	Potential Risk	Description	Control Measure
1, 2, 3	Lifting equipment	Improper lifting/carrying of equipment and materials	Follow safe lifting and general material handling
1	Noise	Loud sounds caused by the machines during drilling, or excavation	Wear proper PPE (hearing protection)
1, 3	Working near heavy machinery	Close proximity to drill rig and/or construction equipment	Be aware of surroundings, wear safety vest and hard hat
1, 2, 3	Slips, trips, and falls	Any number of injuries from slips, trips, and falls in carrying out these tasks	Good housekeeping at site, constant awareness and focus on the task
1, 3	Inhalation of Dust	Breathing in visible dust from earthwork using drills or excavators	Wear proper PPE, monitor air for dust concentrations, use dust suppression techniques
1, 2, 3	Inhalation of Volatiles	Breathing in volatiles from earthwork using drills or excavators causing dust	Wear proper PPE, monitor air for volatile concentrations, use dust suppression techniques
1	Utilities	Hitting utility lines during drilling and or excavating	Use proper mark out of underground utilities before beginning earthwork
1, 2, 3	Skin contact with contaminated material	Material falls on skin; gets in eye	Wear proper PPE; follow safe work practices
1, 2, 3	Ingestion of contaminated material	Material falls on skin; gets into mouth	Wear proper PPE; follow safe work practices
1, 2, 3	Skin and eye contact with contaminated material	Material falls on skin; gets in eye	Wear proper PPE; follow safe work practices
1, 2, 3	Heat Stress	Stress or exhaustion related to high temperatures	Hydrate and rest as needed
1, 2, 3	Cold Stress	Stress or exhaustion related to low temperatures; hypothermia	Wear proper PPE; follow safe work practices
1, 2, 3	Bites and stings	Bee stings, ticks, snake bites	Wear proper PPE, be watchful, follow safe work practices
1, 2, 3	Lacerations and abrasions	Many opportunities working with hand tools	Inspect equipment being used for sharp edges, wear proper PPE; follow safe work practices

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TABLE 4
INSTRUMENTATION ACTION LEVELS
990-1026 ROSSVILLE AVENUE
STATEN ISLAND, NEW YORK

Instrument	Action Level	Level of Protection / Action Required
PID	Background to 5 ppm	Level D/No respirator; no further action required
	> 5 ppm for > 5 minutes	1. Temporarily discontinue all activities and evaluate potential causes of the excessive readings. If these levels persist and cannot be mitigated (i.e., by slowing drilling or excavation activities), contact HSO to review conditions and determine source and appropriate response action. 2. If PID readings remain above 5 ppm, temporarily discontinue work and upgrade to Level C protection. 3. If sustained PID readings fall below 1 ppm, downgrading to Level D protection may be permitted
	> 5 ppm but < 150 ppm for > 5 minutes	Level C/ 1. Discontinue all work; all workers shall move outside of the work zone. 2. Evaluate potential causes of the excessive readings and allow work area to vent until VOC concentrations fall below 5 ppm. 3. Level C protection will continue to be used until PID readings fall below 1 ppm.
	> 30 ppm (steady state condition) within work zone	Stop Work / Suppress Emissions / Evacuate and re-evaluate.
	> 150 ppm	Evacuate the work zone

Total Dust Aerosol Monitor	> 0.100 mg/m^{3} above BKD (steady state condition) at work zone for 15-minutes or visible dust.	Stop Work / Implement dust control / Continue dust monitoring if dust levels are less than 150 mg/m3
	< 0.150 mg/m3 above BKD (following dust suppression measures)	Stop Work / implement dust control, continue work once levels are <150 mg/m3
	>5 mg/m3	Level C

Notes:

1. 1 ppm level based on OSHA Permissible Exposure Limit (PEL) for benzene.
2. 5 ppm level based on OSHA Short Term Exposure Limit (STEL) maximum exposure for vinyl chloride for any 15 minute period.
3. 150 ppm level based on NIOSH Immediately Dangerous to Life and Health (IDLH) for tetrachloroethylene

TABLE 5
PERSONAL PROTECTIVE EQUIPMENT
990-1026 ROSSVILLE AVENUE
STATEN ISLAND, NEW YORK

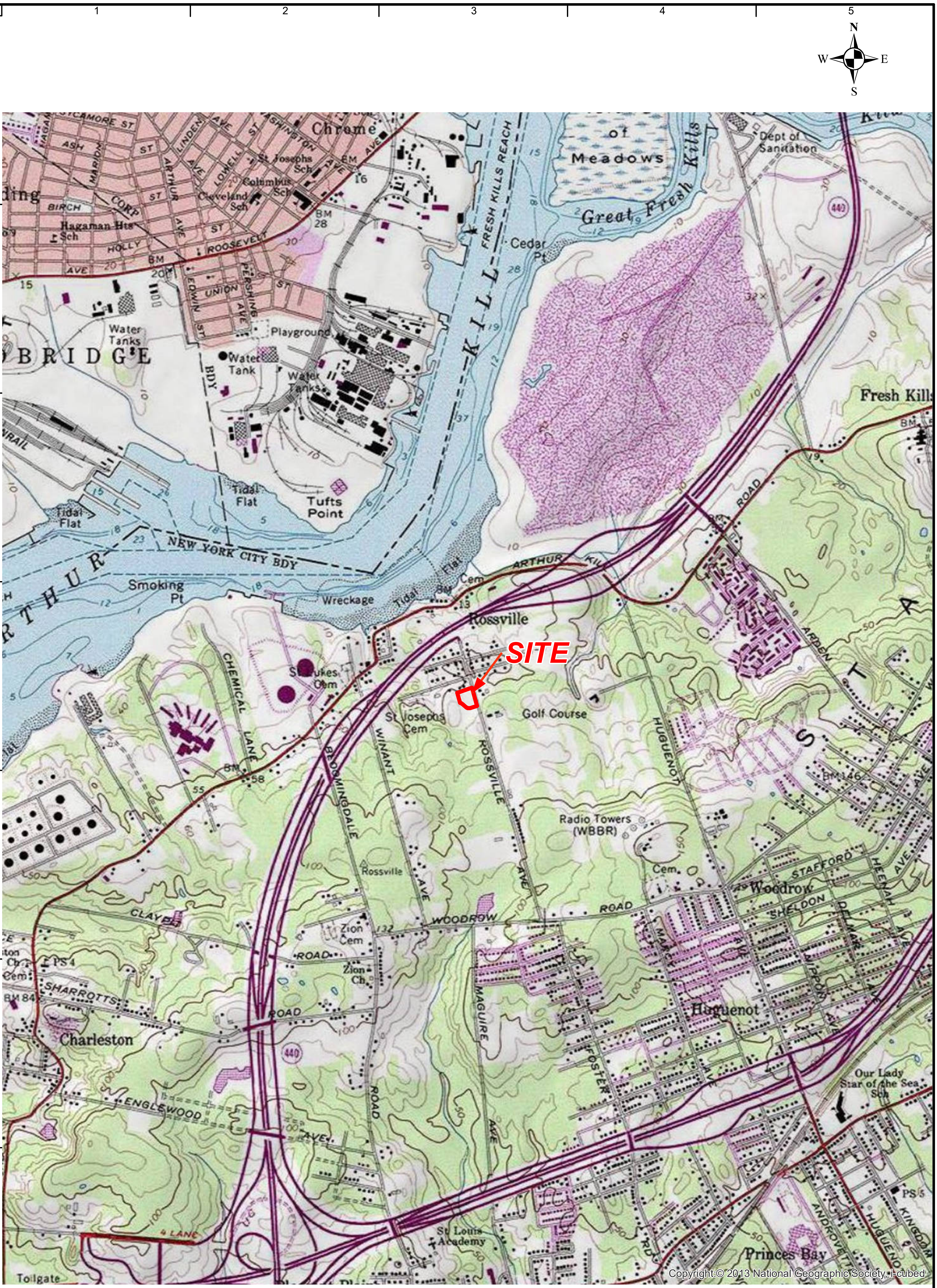
Respiratory Protection*:*

Level D:	No respirator required.
Level C:	Half-face, Air Purifying Respirator (APR) with combination HEPA (dusts, fumes, aerosols) and organic vapor cartridges. The respirator will be NIOSH-approved.
Level C - supplemental by task	Fullface, Air Purifying Respirator (APR) with combination HEPA (dusts, fumes, aerosols), acid gas, organic vapor cartridges. The respirator will be NIOSH-approved.

Personal Protective Clothing*:*

Level D:	Hard-hat, traffic vest (if working on or adjacent to the roadway), long sleeve work shirt & work pants of natural fibers, safety glasses or goggles, steel-toed boots, hearing protection (if needed), nitril inner gloves and leather outer gloves.
Level D - supplemental PPE by task	Tyvek disposal suit
Level C:	Chemically resistant outer boots and Chemical resistant Tyvek disposal suite.

FIGURES



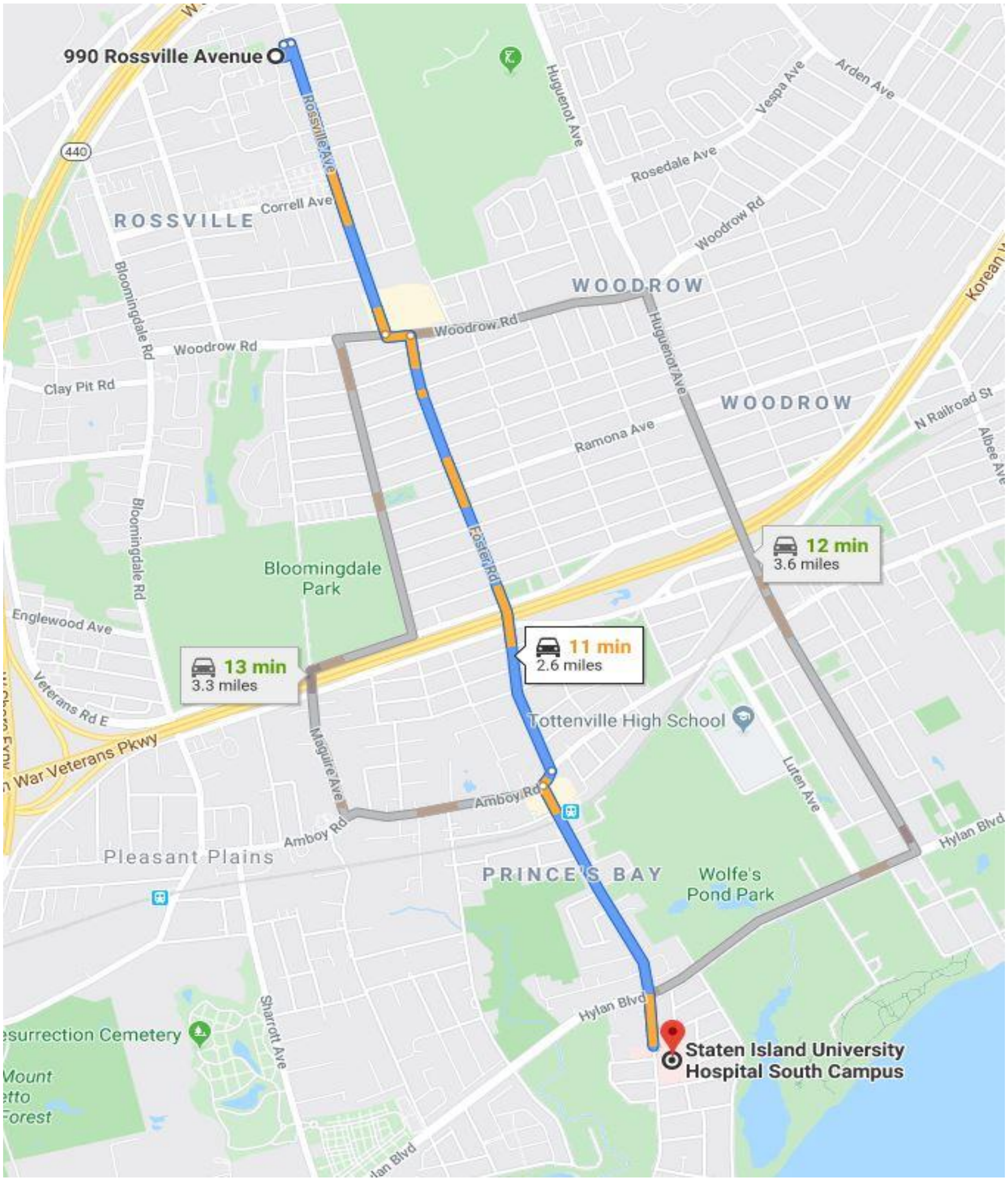
Notes:
1. USGS Topographic basemap is provided through Langan's Esri ArcGIS software licensing and ArcGIS Online.
2. Parcel information from MapPLUTO 18v2 copyrighted by the New York City Department of Planning, last updated 2018.

2,000 0 2,000

SCALE IN FEET

LANGAN	Project	Drawing Title	Project No.	Figure
300 Kimball Drive, Parsippany, NJ 07054 T: 973.560.4900 F: 973.560.4901 www.langan.com	990-1026 ROSSVILLE AVENUE BLOCK No. 7054, LOT No. 518 CITY OF STATEN ISLAND	USGS SITE LOCATION MAP	100849501	1
Langan Engineering & Environmental Services, Inc. Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C. Langan International LLC Collectively known as Langan			Date: 2/28/2020	
			Scale: 1 " = 2,000 '	
NJ CERTIFICATE OF AUTHORIZATION No. 24GA27996400	RICHMOND COUNTY NEW YORK		Drawn By: KMB	

Path: \\langan.com\data\PAR\data5\100849501\Project Data\ArcGIS\Export\PDF\Env_Figures\2020-02 CHASP\Figure 1 - Site Location Map.mxd Date: 2/28/2020 User: ibaker Time: 12:05:53 PM



Emergency Route to Staten Island University Hospital South Campus (Phone # (718) 226-2000) :

1 Turn right onto Rossville Ave
2 Turn left onto Woodrow Road
3 Turn right onto Foster Road
4 Turn right onto Amboy Road
5 Turn left onto Seguine Ave

MAP REFERENCE: Google Maps

LANGAN

Project			
990-1026 Rossville Ave EMERGENGY HOSPITAL ROUTE MAP			
Staten Island			New York
Project	DATE	SCALE	FIGURE NO.
100849501	1/20/2020	NTS	2

ATTACHMENT A

Health and Safety Briefing Statement

ATTACHMENT A

HEALTH AND SAFETY BRIEFING STATEMENT

The following personnel were present at a pre-job safety briefing conducted at __________(time) on ______________ (date) at ______________________________(location), and have read this Health and Safety Plan for the above Site and are familiar with its provisions:

Name	Signature

Fully charged ABC class fire extinguisher available on Site? __________

Fully stocked First Aid Kit available on Site? __________

All project personnel advised of location of nearest phone? __________

All project personnel advised of location of designated medical facility? __________

____

Name of Field Team Leader or Site Safety Officer

____

Signature Date

ATTACHMENT B

Field Procedures Change Authorization Form

ATTACHMENT B

FIELD PROCEDURES CHANGE AUTHORIZATION FORM

Section to be changed:____

Duration of Authorization Requested　　　　　Date:________________________

________ Today only

________ Duration of Task

________ Other____

____

____
Description of Procedures Modification:

____

____

____

Justification:

Person Requesting Change	Verbal Authorization Received From:
Name	Name　　　　Time
Title	Title
Signature	

Approvals:

____

____

____

ATTACHMENT C

Unsafe Conditions and Practices Form

ATTACHMENT C

UNSAFE CONDITIONS AND PRACTICES FORM

DESCRIPTION OF CIRCUMSTANCES REGARDING UNSAFE CONDITION OR PRACTICE:

____

____

____

____

____

____

____

IS THIS CONDITION EXISTING OR POTENTIAL?_______________________________________

REPORTED TO: ____

REPORTED BY:____

DATE REPORTED:____

COMMENTS:____

____

____

ATTACHMENT D

Calibration Log

ATTACHMENT D

PROJECT:_____________

DATE:________________

CALIBRATION LOG

Time	Inst Type	Inst #	Media	Initial Reading	Span #	Calib Reading	Performed By:

ATTACHMENT E

Emergency Notification Numbers

ATTACHMENT E

EMERGENCY NOTIFICATION NUMBERS

The following list provides names and telephone numbers for emergency contact personnel.

ORGANIZATION	CONTACT	TELEPHONE
New York City Police		911
New York City Fire		911
Staten Island University Hospital South Campus		718-226-2000
WorkCare (Non-Emergency Medical Treatment)		1-888-449-7787
Langan Incident/Injury Hotline		973-560-4699
Langan Project Manager	Chris McMahon	201-218-2339
CHEMTREC	(US)	800-262-8200
	(worldwide)	703-741-5500
TSCA HOTLINE		202-554-1404
RCRA HOTLINE		800-424-9346
CDC		800-232-4636
	(regional poison control)	800-222-1222
BUREAU OF ALCOHOL, TOBACCO & FIREARMS		800-800-3855
	(local)	202-648-7777
NATIONAL RESPONSE CENTER		800-424-8802
PESTICIDE INFORMATION SERVICE		800-858-7378
BUREAU OF EXPLOSIVES, A.A. RAILWAYS		202-639-2265
	(Support Services)	719-584-7151
FEDERAL EXPRESS - HAZARDOUS MATERIAL INFO		800-463-3339 *call and say 'Hazardous Materials'

ATTACHMENT F

Accident / Incident Report Form

ATTACHMENT F

INCIDENT REPORT

LANGAN EMPLOYEE EXPOSURE/INJURY INCIDENT REPORT
(Submit a Separate Report for Each Employee and/or Incident)

Date: ______________________

Employee's Name:______________________________________ Employee No:________________

Sex: M _____ F _____ Age: ______

Region: ____ Location:____________________

Project: ____ Project No: __________________

Incident:____

Type: Possible Exposure ______ Exposure _______ Physical Injury ______

Location: ____

Date of Incident: ____________________________ Time of Incident: ________________________

Date of Report Incident: ____

Person(s) to Whom Incident was Reported: ____

Weather Conditions During Incident: Temperature _________ Humidity _________

Wind Speed and Direction: ______________________ Cloud Cover: ___________________________

Clear: ______________________________________ Precipitation: ___________________________

Materials Potentially Encountered: ____

Chemical (give name of description - liquid, solid, gas, vapor, fume, mist):

____

____

Radiological:____

Other: ____

Nature of the Exposure/Injury: (State the nature of the exposure/injury in detail and list the parts of the body affected. Attach extra sheets if necessary).

____

____

____

____

____

Did you receive medical care? Yes _______ No _______ If so, when _______________________

Where? On-Site ________________ Off-Site _______________

By Whom: Name of Paramedic: ____

Name of Physician: ____

Other: ____

If Off-Site, name facility (hospital, clinic, etc):____

____

Length of stay at the facility?____

Was the Site Safety Officer contacted? Yes _______ No _______ When?_________

Was the Corporate Health and Safety Officer contacted? Yes _______ No _______

If so, who was the contact?____

Did the exposure/injury result in permanent disability? Yes ________ No ________

If so, explain:____

____

____

____

Has the employee returned to work? Yes ________ No ________

List the names of other persons affected during this incident:

____

____

____

____

____

____

____

List the names of persons who witnessed the exposure/injury incident:

____
____
____
____
____
____
____

Possible cause of the exposure/injury incident: ____

____
____
____
____
____

What was the name and title of the field team leader or immediate supervisor at the site of the incident?

____

Was the operation being conducted under an established Health and Safety Plan?

Yes ___________ No ____________ If yes, attach a copy. If no, explain

____
____
____
____
____
____

Describe protective equipment and clothing used by the employee:

____
____
____
____
____
____

Did any limitations in safety equipment or protective clothing contribute to or affect exposure? If so, explain:

____
____
____

What was the employee doing when the exposure/injury occurred? (Describe briefly as Site Reconnaissance, Site Characterization, or Sampling, etc.):

____

____

____

____

Where exactly on site or off site did the exposure/injury occur?

____

____

____

____

____

How did the exposure/injury occur? (Describe fully what factors led up to and/or contributed to the incident):

____

____

____

____

____

Name of person(s) initiating report, job title, phone number:

____

____

____

Employee Signature ______________________ Date ____________

Site Safety Officer Signature or Field Team Leader Signature ______________________ Date ____________

ATTACHMENT G

Safety Data Sheets
(SDS)

LANGAN

SAFETY DATA SHEET

Creation Date 22-Sep-2009 **Revision Date** 25-Apr-2019 **Revision Number** 6

1. Identification

Product Name	**Vinylidene chloride, stabilized**
Cat No. :	**AC172290000; AC172290010; AC172290025; AC172290250**
CAS-No	75-35-4
Synonyms	1,1-Dichloroethylene
Recommended Use	Laboratory chemicals.
Uses advised against	Food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 1
Acute oral toxicity	Category 4
Acute Inhalation Toxicity - Vapors	Category 4
Serious Eye Damage/Eye Irritation	Category 2
Carcinogenicity	Category 2
Specific target organ toxicity - (repeated exposure)	Category 2

Label Elements

Signal Word
Danger

Hazard Statements
Extremely flammable liquid and vapor
Harmful if swallowed
Causes serious eye irritation
Harmful if inhaled

Suspected of causing cancer
May cause damage to organs through prolonged or repeated exposure

Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Use only outdoors or in a well-ventilated area
Wear eye/face protection
Do not breathe dust/fume/gas/mist/vapors/spray
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Response
IF exposed or concerned: Get medical attention/advice
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
Ingestion
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth
Fire
In case of fire: Use CO_2, dry chemical, or foam for extinction
Storage
Store locked up
Store in a well-ventilated place. Keep cool
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Toxic to aquatic life with long lasting effects

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Vinylidene chloride	75-35-4	>95
4-Methoxyphenol	150-76-5	0.02

4. First-aid measures

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention.
Inhalation	Move to fresh air. If breathing is difficult, give oxygen. Obtain medical attention.
Ingestion	Do not induce vomiting. Obtain medical attention.
Most important symptoms and effects	Breathing difficulties. . Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Water spray. Carbon dioxide (CO_2). Dry chemical. Use water spray to cool unopened containers. Chemical foam. Cool closed containers exposed to fire with water spray.
Unsuitable Extinguishing Media	No information available
Flash Point	-25 °C / -13 °F
Method -	No information available
Autoignition Temperature	520 °C / 968 °F
Explosion Limits	
Upper	16.5%
Lower	8.4%
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Extremely flammable. Vapors may travel to source of ignition and flash back. Vapors may form explosive mixture with air. Containers may explode when heated. Vapors may form explosive mixtures with air.

Hazardous Combustion Products
Hydrogen chloride gas Carbon monoxide (CO) Carbon dioxide (CO_2) Formaldehyde peroxides
Protective Equipment and Precautions for Firefighters
Vapors are heavier than air and may spread along floors. As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	4	1	N/A

6. Accidental release measures

Personal Precautions	Remove all sources of ignition. Take precautionary measures against static discharges.
Environmental Precautions	Do not flush into surface water or sanitary sewer system. See Section 12 for additional ecological information. Avoid release to the environment. Collect spillage.
Methods for Containment and Clean Up	Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment. Do not let this chemical enter the environment.

7. Handling and storage

Handling	Ensure adequate ventilation. Wear personal protective equipment. Avoid contact with skin and eyes. Take precautionary measures against static discharges. Do not ingest. Use only

in area provided with appropriate exhaust ventilation. Use explosion-proof equipment. Use only non-sparking tools. Avoid shock and friction. Avoid breathing dust/fume/gas/mist/vapors/spray. Keep away from open flames, hot surfaces and sources of ignition. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded.

Storage Refrigerator/flammables. Keep away from heat and sources of ignition. Protect from light. May form explosive peroxides on prolonged storage. Keep under nitrogen. Keep containers tightly closed in a dry, cool and well-ventilated place.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Vinylidene chloride	TWA: 5 ppm	(Vacated) TWA: 1 ppm (Vacated) TWA: 4 mg/m³		TWA: 5 ppm
4-Methoxyphenol	TWA: 5 mg/m³	(Vacated) TWA: 5 mg/m³	TWA: 5 mg/m³	TWA: 5 mg/m³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Use explosion-proof electrical/ventilating/lighting/equipment. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection 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 and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection 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.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	aromatic
Odor Threshold	No information available
pH	7 2.5 g/l aq.sol
Melting Point/Range	-122 °C / -187.6 °F
Boiling Point/Range	31.2 - 32 °C / 88.2 - 89.6 °F @ 760 mmHg
Flash Point	-25 °C / -13 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	16.5%
Lower	8.4%
Vapor Pressure	665 mbar @ 20 °C
Vapor Density	3.4 (Air = 1.0)

Specific Gravity	1.218
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	520 °C / 968 °F
Decomposition Temperature	No information available
Viscosity	.377 mPa.s at 15 °C
Molecular Formula	C2 H2 Cl2
Molecular Weight	96.94

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability May form explosive peroxides. Hazardous polymerization may occur upon depletion of inhibitor. Moisture sensitive. Air sensitive. Light sensitive.

Conditions to Avoid Keep away from open flames, hot surfaces and sources of ignition. Excess heat. Exposure to air. Exposure to light. Incompatible products. Exposure to moist air or water.

Incompatible Materials Strong oxidizing agents, Strong bases, Powdered metal salts, oxygen, Peroxides, Metals, copper, Powdered metals, Acids

Hazardous Decomposition Products Hydrogen chloride gas, Carbon monoxide (CO), Carbon dioxide (CO_2), Formaldehyde, peroxides

Hazardous Polymerization Hazardous polymerization may occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information
Oral LD50 Category 4. ATE = 300 - 2000 mg/kg.
Vapor LC50 Category 4. ATE = 10 - 20 mg/l.
Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Vinylidene chloride	LD50 = 1500 mg/kg (Rat) LD50 = 200 mg/kg (Rat)	Not listed	LC50 = 1.66 mg/L (Rat) 4 h LC50 = 6350 ppm (Rat) 4 h
4-Methoxyphenol	1600 mg/kg (Rat)	LD50 > 2000 mg/kg (Rabbit)	Not listed

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation May cause eye, skin, and respiratory tract irritation

Sensitization No information available

Carcinogenicity Limited evidence of a carcinogenic effect. The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Vinylidene chloride	75-35-4	Group 2B	Not listed	Not listed	X	Not listed
4-Methoxyphenol	150-76-5	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects Ames test: positive.

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated. See actual entry in RTECS for complete information.

12. Ecological information

Ecotoxicity
The product contains following substances which are hazardous for the environment. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Vinylidene chloride	Not listed	LC50: 85 - 117 mg/L, 96h flow-through (Pimephales promelas) LC50: 161 - 179 mg/L, 96h static (Pimephales promelas) LC50: 57 - 91 mg/L, 96h static (Lepomis macrochirus)	EC50 > 2000 mg/L 17 h	LC50: 62 - 110 mg/L, 48h Static (Daphnia magna) LC50: 9.0 - 14.0 mg/L, 48h Static (Daphnia magna)
4-Methoxyphenol	Not listed	LC50: = 84.3 mg/L, 96h flow-through (Pimephales promelas) LC50: = 28.5 mg/L, 96h flow-through (Oncorhynchus mykiss)	EC50 = 3.66 mg/L 5 min EC50 = 4.30 mg/L 15 min EC50 = 4.61 mg/L 30 min	Not listed

Persistence and Degradability No information available

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its volatility.

Component	log Pow
Vinylidene chloride	2.02
4-Methoxyphenol	1.3

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Vinylidene chloride - 75-35-4	U078	-

14. Transport information

DOT
UN-No UN1303

Proper Shipping Name	VINYLIDENE CHLORIDE, STABILIZED
Hazard Class	3
Packing Group	I

TDG

UN-No	UN1303
Proper Shipping Name	VINYLIDENE CHLORIDE, STABILIZED
Hazard Class	3
Packing Group	I

IATA

UN-No	UN1303
Proper Shipping Name	VINYLIDENE CHLORIDE, STABILIZED
Hazard Class	3
Packing Group	I

IMDG/IMO

UN-No	UN1303
Proper Shipping Name	VINYLIDENE CHLORIDE, STABILIZED
Hazard Class	3
Subsidiary Hazard Class	P
Packing Group	I

15. Regulatory information

United States of America Inventory

Component	CAS-No	TSCA	TSCA Inventory notification - Active/Inactive	TSCA - EPA Regulatory Flags
Vinylidene chloride	75-35-4	X	ACTIVE	-
4-Methoxyphenol	150-76-5	X	ACTIVE	-

Legend:
TSCA - Toxic Substances Control Act, (40 CFR Part 710)
X - Listed
'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories
Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Australia (AICS), China (IECSC), Korea (ECL).

Component	CAS-No	DSL	NDSL	EINECS	PICCS	ENCS	AICS	IECSC	KECL
Vinylidene chloride	75-35-4	X	-	200-864-0	X	X	X	X	KE-10122
4-Methoxyphenol	150-76-5	X	-	205-769-8	X	X	X	X	KE-23353

U.S. Federal Regulations

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Vinylidene chloride	75-35-4	>95	1.0

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Vinylidene chloride	X	100 lb	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Vinylidene chloride	X		-

OSHA - Occupational Safety and Health Administration: Not applicable

CERCLA: This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Vinylidene chloride	100 lb 1 lb	-

California Proposition 65: This product does not contain any Proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Vinylidene chloride	75-35-4	Carcinogen	0.88 µg/day	Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Vinylidene chloride	X	X	X	X	X
4-Methoxyphenol	X	X	X	-	X

U.S. Department of Transportation
Reportable Quantity (RQ): N
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security: This product contains the following DHS chemicals:
Legend - STQs = Screening Threshold Quantities, APA = A placarded amount

Component	DHS Chemical Facility Anti-Terrorism Standard
Vinylidene chloride	Release STQs - 10000lb

Other International Regulations

Mexico - Grade: No information available

16. Other information

Prepared By: Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 22-Sep-2009
Revision Date 25-Apr-2019
Print Date 25-Apr-2019
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

Version 5.5
Revision Date 05/18/2018
Print Date 02/20/2020

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : 1,1,1-Trichloroethane

Product Number : T54704
Brand : Aldrich
Index-No. : 602-013-00-2

CAS-No. : 71-55-6

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : +1-703-527-3887 (CHEMTREC)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Acute toxicity, Inhalation (Category 4), H332
Skin irritation (Category 2), H315
Carcinogenicity (Category 2), H351

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Warning

Hazard statement(s)

H315	Causes skin irritation.
H332	Harmful if inhaled.
H351	Suspected of causing cancer.

Precautionary statement(s)

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves.

P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P321	Specific treatment (see supplemental first aid instructions on this label).
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula	:	C2H3Cl3
Molecular weight	:	133.41 g/mol
CAS-No.	:	71-55-6
Index-No.	:	602-013-00-2

Hazardous components

Component	Classification	Concentration
1,1,1-Trichloroethane		
	Acute Tox. 4; Skin Irrit. 2; Eye Irrit. 2A; Ozone 1; H315, H319, H332, H420	90 - 100 %
1,4-Dioxane		
	Flam. Liq. 2; Eye Irrit. 2A; Carc. 2; STOT SE 3; H225, H319, H335, H351	1 - 5 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of 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
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
No data available

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up
Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
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.
Storage class (TRGS 510): 6.1D: Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
1,1,1-Trichloroethane	71-55-6	TWA	350 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Liver damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	450 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Liver damage Substances for which there is a Biological Exposure Index or Indices		

		(see BEI® section) Not classifiable as a human carcinogen		
		C	350 ppm 1,900 mg/m3	USA. NIOSH Recommended Exposure Limits
		See Appendix C 15 minute ceiling value		
		TWA	350 ppm 1,900 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		PEL	350 ppm 1,900 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		STEL	450 ppm 2,450 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		C	800 ppm	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
1,4-Dioxane	123-91-1	TWA	20 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Liver damage Confirmed animal carcinogen with unknown relevance to humans Danger of cutaneous absorption		
		TWA	25 ppm 90 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		Skin notation		
		TWA	100 ppm 360 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		Skin designation The value in mg/m3 is approximate.		
		C	1 ppm 3.6 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A 30 minute ceiling value		
		PEL	0.28 ppm 1 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		Skin		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
	-	Methyl chloroform	40parts per million	In end-exhaled air	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Prior to last shift of workweek			
		Trichloroacetic acid	10 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of the workweek (After four or five consecutive working days with exposure)			
		Total trichloroethanol	30 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			

		Total trichloroethanol	1 mg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face 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 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.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

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).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid, clear Colour: colourless
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	-35.0 °C (-31.0 °F)
f)	Initial boiling point and boiling range	72.0 - 75.0 °C (161.6 - 167.0 °F)
g)	Flash point	No data available
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 15 %(V) Lower explosion limit: 7.5 %(V)
k)	Vapour pressure	133.3 hPa (100.0 mmHg) at 20.0 °C (68.0 °F)
l)	Vapour density	No data available
m)	Relative density	1.34 g/cm3
n)	Water solubility	1.25 g/l at 23 °C (73 °F)
o)	Partition coefficient: n-octanol/water	log Pow: 2.49

p)	Auto-ignition temperature	537.0 °C (998.6 °F)
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information
No data available

10. STABILITY AND REACTIVITY

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.
Contains the following stabiliser(s):
1,4-Dioxane (>1 - <=3 %)

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
No data available

10.5 Incompatible materials
Strong oxidizing agents, Potassium, Magnesium, Sodium/sodium oxides, Zinc, Strong bases

10.6 Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - 9,600 mg/kg
Remarks: Cardiac:Pulse rate. Nutritional and Gross Metabolic:Weight loss or decreased weight gain.

LD50 Oral - Mouse - 6,000 mg/kg
Remarks: Cardiac:Pulse rate. Nutritional and Gross Metabolic:Weight loss or decreased weight gain.

LC50 Inhalation - Mouse - 2 h - 3911 ppm
Remarks: Behavioral:Excitement.

Dermal: No data available

LD50 Intraperitoneal - Rat - 3,593 mg/kg

LD50 Intraperitoneal - Mouse - 2,568 mg/kg

LD50 Subcutaneous - Mouse - 16.0 mg/kg
Remarks: Drowsiness Behavioral:Ataxia.

LD50 Intraperitoneal - Dog - 3,100 mg/kg
Remarks: Liver:Liver function tests impaired.

Skin corrosion/irritation
Skin - Rabbit
Result: Skin irritation - 24 h

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
No data available

Carcinogenicity

IARC:	2B - Group 2B: Possibly carcinogenic to humans (1,4-Dioxane)
NTP:	RAHC - Reasonably anticipated to be a human carcinogen (1,4-Dioxane)
OSHA:	No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity
No data available

No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: KJ2975000

burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea, Vomiting, Exposure to and/or consumption of alcohol may increase toxic effects., prolonged or repeated exposure can cause:, narcosis, Liver injury may occur., Kidney injury may occur.
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Pimephales promelas (fathead minnow) - 42.3 mg/l - 96 h

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential

Bioaccumulation	Lepomis macrochirus (Bluegill) - 28 d - 0.0734 mg/l Bioconcentration factor (BCF): 9

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

No data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 2831 Class: 6.1 Packing group: III
Proper shipping name: 1,1,1-Trichloroethane
Reportable Quantity (RQ): 1000 lbs
Poison Inhalation Hazard: No

IMDG

IATA
UN number: 2831 Class: 6.1 Packing group: III
Proper shipping name: 1,1,1-Trichloroethane

15. REGULATORY INFORMATION

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
1,4-Dioxane	123-91-1	2007-03-01
1,1,1-Trichloroethane	71-55-6	2007-07-01

SARA 311/312 Hazards
Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
1,1,1-Trichloroethane	71-55-6	2007-07-01
1,4-Dioxane	123-91-1	2007-03-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
1,1,1-Trichloroethane	71-55-6	2007-07-01
1,4-Dioxane	123-91-1	2007-03-01

	CAS-No.	Revision Date
1,1,1-Trichloroethane	71-55-6	2007-07-01
1,4-Dioxane	123-91-1	2007-03-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
1,1,1-Trichloroethane	71-55-6	2007-07-01
1,4-Dioxane	123-91-1	2007-03-01

California Prop. 65 Components

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the State of California to cause cancer. 1,4-Dioxane	123-91-1	2007-09-28

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Carc.	Carcinogenicity
Eye Irrit.	Eye irritation

Flam. Liq.	Flammable liquids
H225	Highly flammable liquid and vapour.
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H332	Harmful if inhaled.
H335	May cause respiratory irritation.
H351	Suspected of causing cancer.
H420	Harms public health and the environment by destroying ozone in the upper atmosphere.
Ozone	Hazardous to the ozone layer
Skin Irrit.	Skin irritation
STOT SE	Specific target organ toxicity - single exposure

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

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 Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 5.5 Revision Date: 05/18/2018 Print Date: 02/20/2020

SAFETY DATA SHEET

Version 6.1
Revision Date 01/13/2020
Print Date 02/20/2020

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name	:	Chloroethane
Product Number	:	295310
Brand	:	Aldrich
Index-No.	:	602-009-00-0
CAS-No.	:	75-00-3

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses	:	Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company	:	Sigma-Aldrich Inc. 3050 Spruce Street ST. LOUIS MO 63103 UNITED STATES
Telephone	:	+1 314 771-5765
Fax	:	+1 800 325-5052

1.4 Emergency telephone number

Emergency Phone #	:	+1-703-527-3887

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Flammable gases (Category 1), H220
Gases under pressure (Liquefied gas), H280
Carcinogenicity (Category 2), H351
Short-term (acute) aquatic hazard (Category 3), H402
Long-term (chronic) aquatic hazard (Category 3), H412

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)

H220	Extremely flammable gas.
H280	Contains gas under pressure; may explode if heated.
H351	Suspected of causing cancer.
H412	Harmful to aquatic life with long lasting effects.

Precautionary statement(s)

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P273	Avoid release to the environment.
P281	Use personal protective equipment as required.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P377	Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381	Eliminate all ignition sources if safe to do so.
P405	Store locked up.
P410 + P403	Protect from sunlight. Store in a well-ventilated place.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Synonyms : Ethyl chloride

Formula : C_2H_5Cl

Molecular weight : 64.51 g/mol

CAS-No. : 75-00-3

EC-No. : 200-830-5

Index-No. : 602-009-00-0

Component	Classification	Concentration
Chloroethane		
	Flam. Gas 1; Press. Gas Liquefied gas; Carc. 2; SA ; Aquatic Acute 3; Aquatic Chronic 3; H220, H280, H351, , H402, H412	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of 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
Flush eyes with water as a precaution.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Carbon oxides, Hydrogen chloride gas

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
Use water spray to cool unopened containers.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapours, 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.
For personal protection see section 8.

6.2 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.

6.3 Methods and materials for containment and cleaning up
Clean up promptly by sweeping or vacuum.

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: Handling and storage

7.1 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.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place.

Contents under pressure.
Storage class (TRGS 510): 2A: Gases

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Chloroethane	75-00-3	TWA	100 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Liver damage Confirmed animal carcinogen with unknown relevance to humans Danger of cutaneous absorption		
		Handle with caution in the workplace. See Appendix C		
		TWA	1,000 ppm 2,600 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		PEL	100 ppm 264 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		Skin		

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face 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 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.

Full contact
Material: Fluorinated rubber
Minimum layer thickness: 0.7 mm
Break through time: 480 min
Material tested:Vitoject® (KCL 890 / Aldrich Z677698, Size M)

Splash contact
Material: Fluorinated rubber
Minimum layer thickness: 0.7 mm
Break through time: 480 min
Material tested:Vitoject® (KCL 890 / Aldrich Z677698, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

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.

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).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: Liquefied gas Colour: colourless
b)	Odour	No data available

c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	-139.0 °C (-218.2 °F)
f)	Initial boiling point and boiling range	12.3 °C 54.1 °F at 1,013 hPa
g)	Flash point	-50.0 °C (-58.0 °F) - closed cup
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 15 %(V) Lower explosion limit: 3.16 %(V)
k)	Vapour pressure	1323.4 hPa at 20.0 °C (68.0 °F) 3,975.8 hPa at 55.0 °C(131.0 °F)
l)	Vapour density	No data available
m)	Relative density	0.921 g/cm3 at 0 - 4 °C (32 - 39 °F)
n)	Water solubility	5.74 g/l at 20 °C (68 °F) - soluble
o)	Partition coefficient: n-octanol/water	log Pow: 1.43
p)	Auto-ignition temperature	519 °C (966 °F)
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information

Surface tension 21.18 mN/m at 5 °C (41 °F)

SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
Heat, flames and sparks.

10.5 Incompatible materials
Strong oxidizing agents, Sodium/sodium oxides, Potassium, and its alloys

10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas
Other decomposition products - No data available
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
No data available
LC50 Inhalation - Rat - male and female - 4 h - > 19000 ppm
(OECD Test Guideline 403)
Dermal: No data available
No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity

Mouse - male and female
Result: negative
Micronucleus test

Mouse - female
Result: negative
DNA damage DNA repair

Carcinogenicity
This product is or contains a component that has been reported to be possibly carcinogenic based on its IARC, ACGIH, NTP, or EPA classification.
Limited evidence of carcinogenicity in animal studies

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.
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 on OSHA's list of regulated carcinogens.

Reproductive toxicity
No data available
Overexposure may cause reproductive disorder(s) based on tests with laboratory animals.

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: KH7525000

abdominal cramps, Vomiting, Headache, Cough, intoxication, Incoordination., Dizziness, Damage of the:, Liver, Kidney, It is readily absorbed through lungs and skin, but is also rapidly given off through the lungs., Exposure can aggravate:, Dermatitis, Consumption of alcohol may increase toxic effects., At high concentrations:, cardiac arrest, Acts as a simple asphyxiant by displacing air., Notes to physician: the use of adrenaline as a stimulant should be avoided due to the sensitizing effect of chloroethane on the myocardium., To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Lungs -

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to daphnia and other aquatic invertebrates	static test EC50 - Daphnia magna (Water flea) - 58 mg/l - 48 h (Directive 67/548/EEC, Annex V, C.2.)
Toxicity to algae	static test EC50 - Desmodesmus subspicatus (green algae) - 118 mg/l - 72 h (Directive 67/548/EEC, Annex V, C.3.)

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
Harmful to aquatic life with long lasting effects.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

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.

SECTION 14: Transport information

DOT (US)
UN number: 1037 Class: 2.1
Proper shipping name: Ethyl chloride
Reportable Quantity (RQ): 100 lbs
Poison Inhalation Hazard: No

IMDG
UN number: 1037 Class: 2.1 EMS-No: F-D, S-U
Proper shipping name: ETHYL CHLORIDE

IATA
UN number: 1037 Class: 2.1
Proper shipping name: Ethyl chloride
IATA Passenger: Not permitted for transport

SECTION 15: Regulatory information

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Chloroethane	75-00-3	2007-07-01

SARA 311/312 Hazards
Fire Hazard, Sudden Release of Pressure Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Chloroethane	75-00-3	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Chloroethane	75-00-3	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Chloroethane	75-00-3	2007-07-01

California Prop. 65 Components

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the State of California to cause cancer.Chloroethane	75-00-3	2007-09-28

SECTION 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 Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

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Version: 6.1 Revision Date: 01/13/2020 Print Date: 02/20/2020

SAFETY DATA SHEET

Creation Date 22-Sep-2009 **Revision Date** 10-Feb-2015 **Revision Number** 1

1. Identification

Product Name **cis-1,2-Dichloroethylene**

Cat No. : **AC113380000; AC113380025; AC113380100; AC113380500**

Synonyms cis-Acetylene dichloride.

Recommended Use Laboratory chemicals.

Uses advised against No Information available

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Entity / Business Name
Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Acute oral toxicity	Category 4
Acute Inhalation Toxicity - Vapors	Category 4
Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	

Label Elements

Signal Word
Danger

Hazard Statements
Highly flammable liquid and vapor
Harmful if swallowed
Harmful if inhaled
Causes serious eye irritation
Causes skin irritation
May cause respiratory irritation

Precautionary Statements
Prevention
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Avoid breathing dust/fume/gas/mist/vapors/spray
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Take precautionary measures against static discharge
Do not eat, drink or smoke when using this product
Response
Call a POISON CENTER or doctor/physician if you feel unwell
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor/physician if you feel unwell
Skin
IF ON SKIN: Wash with plenty of soap and water
Take off contaminated clothing and wash before reuse
If skin irritation occurs: Get medical advice/attention
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
Ingestion
Rinse mouth
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Fire
Explosion risk in case of fire
Fight fire with normal precautions from a reasonable distance
Evacuate area
Storage
Store in a well-ventilated place. Keep cool
Store in a closed container
Store locked up
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
None identified

3. Composition / information on ingredients

Component	CAS-No	Weight %
cis-1,2-Dichloroethylene	156-59-2	97

4. First-aid measures

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention.

Inhalation	Move to fresh air. If breathing is difficult, give oxygen. Obtain medical attention.
Ingestion	Do not induce vomiting. Obtain medical attention.
Most important symptoms/effects	Breathing difficulties. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Water spray. Carbon dioxide (CO_2). Dry chemical. Use water spray to cool unopened containers. chemical foam.
Unsuitable Extinguishing Media	No information available
Flash Point	6 °C / 42.8 °F
Method -	No information available
Autoignition Temperature	440 °C / 824 °F
Explosion Limits	
Upper	12.80%
Lower	9.70%
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Flammable. Vapors may travel to source of ignition and flash back.

Hazardous Combustion Products
Hydrogen chloride gas Carbon monoxide (CO) Carbon dioxide (CO_2)
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	3	0	N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment. Remove all sources of ignition. Take precautionary measures against static discharges. Avoid contact with skin, eyes and clothing.
Environmental Precautions	See Section 12 for additional ecological information.
Methods for Containment and Clean Up	Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

7. Handling and storage

Handling	Ensure adequate ventilation. Wear personal protective equipment. Use explosion-proof equipment. Use only non-sparking tools. Avoid contact with skin, eyes and clothing. Avoid breathing dust/fume/gas/mist/vapours/spray. Avoid ingestion and inhalation. Keep away from open flames, hot surfaces and sources of ignition. Take precautionary measures against static discharges.
Storage	Keep in a dry, cool and well-ventilated place. Keep container tightly closed. Keep away from heat and sources of ignition. Flammables area.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
cis-1,2-Dichloroethylene	TWA: 200 ppm		

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
cis-1,2-Dichloroethylene			TWA: 200 ppm

Legend

ACGIH - American Conference of Governmental Industrial Hygienists

Engineering Measures Ensure adequate ventilation, especially in confined areas. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection 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 and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection 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.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	aromatic
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-80 °C / -112 °F
Boiling Point/Range	60 °C / 140 °F @ 760 mmHg
Flash Point	6 °C / 42.8 °F
Evaporation Rate	No information available
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	12.80%
Lower	9.70%
Vapor Pressure	201 mmHg @ 25 °C
Vapor Density	3.34 (Air = 1.0)
Relative Density	1.280
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	440 °C / 824 °F
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	C2 H2 Cl2
Molecular Weight	96.94

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Keep away from open flames, hot surfaces and sources of ignition. Exposure to air. Exposure to light. Incompatible products. Exposure to moist air or water.

Incompatible Materials Bases

Hazardous Decomposition Products Hydrogen chloride gas, Carbon monoxide (CO), Carbon dioxide (CO_2)

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information No acute toxicity information is available for this product
Component Information
Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Irritating to eyes, respiratory system and skin

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
cis-1,2-Dichloroethylene	156-59-2	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Respiratory system
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated. See actual entry in RTECS for complete information.

12. Ecological information

Ecotoxicity
Do not empty into drains. Do not flush into surface water or sanitary sewer system.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
cis-1,2-Dichloroethylene	Not listed	Not listed	EC50 = 721 mg/L 5 min EC50 = 905 mg/L 30 min	Not listed

Persistence and Degradability No information available
Bioaccumulation/ Accumulation No information available.

Mobility No information available.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No	UN1150
Proper Shipping Name	1,2-DICHLOROETHYLENE
Hazard Class	3
Packing Group	II

TDG

UN-No	UN1150
Proper Shipping Name	1,2-DICHLOROETHYLENE
Hazard Class	3
Packing Group	II

IATA

UN-No	1150
Proper Shipping Name	1,2-DICHLOROETHYLENE
Hazard Class	3
Packing Group	II

IMDG/IMO

UN-No	1150
Proper Shipping Name	1,2-DICHLOROETHYLENE
Hazard Class	3
Packing Group	II

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
cis-1,2-Dichloroethylene	X	-	X	205-859-7	-		-	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313 Not applicable

SARA 311/312 Hazardous Categorization

Acute Health Hazard	Yes
Chronic Health Hazard	No
Fire Hazard	Yes

Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act Not applicable

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA

Component	Hazardous Substances RQs	CERCLA EHS RQs
cis-1,2-Dichloroethylene	1000 lb	-

California Proposition 65 This product does not contain any Proposition 65 chemicals

State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
cis-1,2-Dichloroethylene	X	-	X	-	-

U.S. Department of Transportation

Reportable Quantity (RQ):	N
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

Canada
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class
B2 Flammable liquid
D1B Toxic materials
D2B Toxic materials

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date	22-Sep-2009
Revision Date	10-Feb-2015
Print Date	10-Feb-2015
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally

Harmonized System of Classification and Labeling of Chemicals (GHS)

Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of SDS

SAFETY DATA SHEET

Creation Date 10-Dec-2009 **Revision Date** 26-May-2017 **Revision Number** 4

1. Identification

Product Name **Tetrachloroethylene**

Cat No. : **AC445690000; ACR445690010; AC445690025; AC445691000**

Synonyms Perchloroethylene

Recommended Use Laboratory chemicals.
Uses advised against Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Skin Sensitization	Category 1
Carcinogenicity	Category 1B
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, Blood.	

Label Elements

Signal Word
Danger

Hazard Statements
Causes skin irritation
Causes serious eye irritation
May cause an allergic skin reaction
May cause drowsiness or dizziness
May cause cancer
May cause damage to organs through prolonged or repeated exposure

Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Contaminated work clothing should not be allowed out of the workplace
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Response
IF exposed or concerned: Get medical attention/advice
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN: Wash with plenty of soap and water
Take off contaminated clothing and wash before reuse
If skin irritation or rash occurs: Get medical advice/attention
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Toxic to aquatic life with long lasting effects
WARNING! This product contains a chemical known in the State of California to cause cancer.

3. Composition / information on ingredients

Component	CAS-No	Weight %
Tetrachloroethylene	127-18-4	>95

4. First-aid measures

General Advice If symptoms persist, call a physician.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician.

Inhalation Move to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur.

Ingestion Clean mouth with water and drink afterwards plenty of water.

Most important symptoms/effects	None reasonably foreseeable. May cause allergic skin reaction. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. Containers may explode when heated.

Hazardous Combustion Products
Chlorine Hydrogen chloride gas Phosgene
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	0	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Ensure adequate ventilation.
Environmental Precautions	Do not flush into surface water or sanitary sewer system.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling	Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Ensure adequate ventilation. Avoid ingestion and inhalation.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Protect from sunlight.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Tetrachloroethylene	TWA: 25 ppm STEL: 100 ppm	(Vacated) TWA: 25 ppm (Vacated) TWA: 170 mg/m³ Ceiling: 200 ppm TWA: 100 ppm	IDLH: 150 ppm	TWA: 100 ppm TWA: 670 mg/m³ TWA: 200 ppm TWA: 1250 mg/m³ STEL: 200 ppm STEL: 1340 mg/m³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Use only under a chemical fume hood. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection 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 and body protection Long sleeved clothing.

Respiratory Protection 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.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Characteristic, sweet
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-22 °C / -7.6 °F
Boiling Point/Range	120 - 122 °C / 248 - 251.6 °F @ 760 mmHg
Flash Point	No information available
Evaporation Rate	6.0 (Ether = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	18 mbar @ 20 °C
Vapor Density	No information available
Density	1.619
Specific Gravity	1.625
Solubility	0.15 g/L water (20°C)
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	> 150°C
Viscosity	0.89 mPa s at 20 °C
Molecular Formula	C_2Cl_4
Molecular Weight	165.83

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Incompatible products. Excess heat. Exposure to moist air or water.

Incompatible Materials Strong acids, Strong oxidizing agents, Strong bases, Metals, Zinc, Amines, Aluminium

Hazardous Decomposition Products Chlorine, Hydrogen chloride gas, Phosgene

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information
Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Tetrachloroethylene	LD50 = 2629 mg/kg (Rat)	LD50 > 10000 mg/kg (Rat)	LC50 = 27.8 mg/L (Rat) 4 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Irritating to eyes and skin

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Tetrachloroethylene	127-18-4	Group 2A	Reasonably Anticipated	A3	X	A3

IARC: (International Agency for Research on Cancer)
IARC: (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans

NTP: (National Toxicity Program)
NTP: (National Toxicity Program)
Known - Known Carcinogen
Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen

ACGIH: (American Conference of Governmental Industrial Hygienists)
A1 - Known Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Animal Carcinogen
ACGIH: (American Conference of Governmental Industrial Hygienists)

Mexico - Occupational Exposure Limits - Carcinogens
Mexico - Occupational Exposure Limits - Carcinogens
A1 - Confirmed Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Confirmed Animal Carcinogen
A4 - Not Classifiable as a Human Carcinogen
A5 - Not Suspected as a Human Carcinogen

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Central nervous system (CNS)
STOT - repeated exposure Kidney Liver Blood

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing

Endocrine Disruptor Information

Component	EU - Endocrine Disrupters Candidate List	EU - Endocrine Disruptors - Evaluated Substances	Japan - Endocrine Disruptor Information
Tetrachloroethylene	Group II Chemical	Not applicable	Not applicable

Other Adverse Effects Tumorigenic effects have been reported in experimental animals.

12. Ecological information

Ecotoxicity

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Tetrachloroethylene	EC50: > 500 mg/L, 96h (Pseudokirchneriella subcapitata)	LC50: 4.73 - 5.27 mg/L, 96h flow-through (Oncorhynchus mykiss) LC50: 11.0 - 15.0 mg/L, 96h static (Lepomis macrochirus) LC50: 8.6 - 13.5 mg/L, 96h static (Pimephales promelas) LC50: 12.4 - 14.4 mg/L, 96h flow-through (Pimephales promelas)	EC50 = 100 mg/L 24 h EC50 = 112 mg/L 24 h EC50 = 120.0 mg/L 30 min	EC50: 6.1 - 9.0 mg/L, 48h Static (Daphnia magna)

Persistence and Degradability Insoluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility . Is not likely mobile in the environment due its low water solubility. Will likely be mobile in the environment due to its volatility.

Component	log Pow
Tetrachloroethylene	2.88

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Tetrachloroethylene - 127-18-4	U210	-

14. Transport information

DOT

UN-No UN1897
Proper Shipping Name TETRACHLOROETHYLENE
Hazard Class 6.1
Packing Group III

TDG

UN-No UN1897
Proper Shipping Name TETRACHLOROETHYLENE
Hazard Class 6.1
Packing Group III

IATA

UN-No UN1897
Proper Shipping Name TETRACHLOROETHYLENE
Hazard Class 6.1

Packing Group	III

IMDG/IMO

UN-No	UN1897
Proper Shipping Name	TETRACHLOROETHYLENE
Hazard Class	6.1
Subsidiary Hazard Class	P
Packing Group	III

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Tetrachloroethylene	X	X	-	204-825-9	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b)	Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Tetrachloroethylene	127-18-4	>95	0.1

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Tetrachloroethylene	-	-	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Tetrachloroethylene	X		-

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive

Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Tetrachloroethylene	100 lb 1 lb	-

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Tetrachloroethylene	127-18-4	Carcinogen	14 µg/day	Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Tetrachloroethylene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant Y
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 10-Dec-2009
Revision Date 26-May-2017
Print Date 26-May-2017
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

1. Identification

Product identifier: Trichloroethylene

Other means of identification
Product No.: 9464, 8600, 9458, 9454

Recommended use and restriction on use

Recommended use: Not available.
Restrictions on use: Not known.

Manufacturer/Importer/Supplier/Distributor Information

Manufacturer

Company Name:	Avantor Performance Materials, Inc.
Address:	3477 Corporate Parkway, Suite 200 Center Valley, PA 18034
Telephone:	
	Customer Service: 855-282-6867
Fax:	
Contact Person:	Environmental Health & Safety
e-mail:	info@avantormaterials.com

Emergency telephone number:
24 Hour Emergency: 908-859-2151

Chemtrec: 800-424-9300

2. Hazard(s) identification

Hazard Classification

Health Hazards

Skin Corrosion/Irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2A
Germ Cell Mutagenicity	Category 2
Carcinogenicity	Category 1B
Specific Target Organ Toxicity - Single Exposure	Category 3

Environmental Hazards

Chronic hazards to the aquatic environment	Category 3

Label Elements

Hazard Symbol:

Signal Word: Danger

Hazard Statement: May cause cancer.
Suspected of causing genetic defects.
Causes serious eye irritation.
Causes skin irritation.
Harmful to aquatic life with long lasting effects.

Precautionary Statement

Prevention: Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves/protective clothing/eye protection/face protection. Wash hands thoroughly after handling. Avoid breathing dust/fume/gas/mist/vapors/spray. Avoid release to the environment.

Response: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention. IF ON SKIN: Wash with plenty of soap and water. Take off contaminated clothing and wash before reuse. Call a POISON CENTER or doctor/physician if you feel unwell. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.

Storage: Store locked up. Store in a well-ventilated place. Keep container tightly closed.

Disposal: Dispose of contents/container to an appropriate treatment and disposal facility in accordance with applicable laws and regulations, and product characteristics at time of disposal.

Other hazards which do not result in GHS classification: None.

3. Composition/information on ingredients

Substances

Chemical Identity	Common name and synonyms	CAS number	Content in percent (%)*
TRICHLOROETHYLENE		79-01-6	99 - 100%

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

General information: Get medical advice/attention if you feel unwell. Show this safety data sheet to the doctor in attendance.

Ingestion: Rinse mouth. Get medical attention if symptoms occur. Do not induce vomiting without advice from poison control center. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs.

Inhalation: Move to fresh air. Get medical attention if symptoms persist. If breathing stops, provide artificial respiration.

Skin Contact: Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention if irritation persists after washing. Wash contaminated clothing before reuse. Destroy or thoroughly clean contaminated shoes.

Eye contact: Immediately flush with plenty of water for at least 15 minutes. If easy to do, remove contact lenses. Get medical attention if irritation persists after washing.

Most important symptoms/effects, acute and delayed

Symptoms: Irritating to eyes, respiratory system and skin.

Indication of immediate medical attention and special treatment needed

Treatment: Treat symptomatically. Symptoms may be delayed.

5. Fire-fighting measures

General Fire Hazards: In case of fire and/or explosion do not breathe fumes.

Suitable (and unsuitable) extinguishing media

Suitable extinguishing media: Use fire-extinguishing media appropriate for surrounding materials.

Unsuitable extinguishing media: Do not use water jet as an extinguisher, as this will spread the fire.

Specific hazards arising from the chemical: Contact with metals may evolve flammable hydrogen gas. Fire may produce irritating, corrosive and/or toxic gases.

Special protective equipment and precautions for firefighters

Special fire fighting procedures: Move containers from fire area if you can do so without risk. Use water spray to keep fire-exposed containers cool. Cool containers exposed to flames with water until well after the fire is out.

Special protective equipment for fire-fighters: Firefighters must use standard protective equipment including flame retardant coat, helmet with face shield, gloves, rubber boots, and in enclosed spaces, SCBA.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures: Keep unauthorized personnel away. Use personal protective equipment. See Section 8 of the MSDS for Personal Protective Equipment. Ventilate closed spaces before entering them. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.

Methods and material for containment and cleaning up: Absorb spill with vermiculite or other inert material, then place in a container for chemical waste. Clean surface thoroughly to remove residual contamination. Dike far ahead of larger spill for later recovery and disposal.

Notification Procedures: Dike for later disposal. Prevent entry into waterways, sewer, basements or confined areas. Stop the flow of material, if this is without risk. Inform authorities if large amounts are involved.

Environmental Precautions: Do not contaminate water sources or sewer. Prevent further leakage or spillage if safe to do so. Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling: Use personal protective equipment as required. Do not breathe mist or vapor. Do not taste or swallow. Do not eat, drink or smoke when using the product. Use only with adequate ventilation. Wash hands thoroughly after handling. See Section 8 of the MSDS for Personal Protective Equipment. Avoid contact with eyes. Avoid contact with skin. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves/protective clothing/eye protection/face protection. Avoid breathing dust/fume/gas/mist/vapors/spray. Wash contaminated clothing before reuse.

Conditions for safe storage, including any incompatibilities: Store locked up. Keep in a cool, well-ventilated place. Store in a dry place.

8. Exposure controls/personal protection

Control Parameters

Occupational Exposure Limits

Chemical Identity	Type	Exposure Limit Values		Source
TRICHLOROETHYLENE	TWA	10 ppm		US. ACGIH Threshold Limit Values (2011)
	STEL	25 ppm		US. ACGIH Threshold Limit Values (2011)
	REL	25 ppm		US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	TWA	50 ppm	270 mg/m3	US. OSHA Table Z-1-A (29 CFR 1910.1000) (1989)
	STEL	200 ppm	1,080 mg/m3	US. OSHA Table Z-1-A (29 CFR 1910.1000) (1989)
	TWA	100 ppm		US. OSHA Table Z-2 (29 CFR 1910.1000) (02 2006)
	Ceiling	200 ppm		US. OSHA Table Z-2 (29 CFR 1910.1000) (02 2006)
	MAX. CONC	300 ppm		US. OSHA Table Z-2 (29 CFR 1910.1000) (02 2006)
	AN ESL		54 µg/m3	US. Texas. Effects Screening Levels (Texas Commission on Environmental Quality) (12 2010)

Biological Limit Values

Chemical Identity	Exposure Limit Values	Source
TRICHLOROETHYLENE (Trichloroacetic acid: Sampling time: End of shift at end of work week.)	15 mg/l (Urine)	ACGIH BEL (03 2013)
TRICHLOROETHYLENE (Trichloroethanol, without hydrolysis: Sampling time: End of shift at end of work week.)	0.5 mg/l (Blood)	ACGIH BEL (03 2013)

Appropriate Engineering Controls No data available.

Individual protection measures, such as personal protective equipment

General information: Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. An eye wash and safety shower must be available in the immediate work area.

Eye/face protection:	Wear safety glasses with side shields (or goggles) and a face shield.
Skin Protection	
Hand Protection:	Chemical resistant gloves
Other:	Wear suitable protective clothing.
Respiratory Protection:	In case of inadequate ventilation use suitable respirator.
Hygiene measures:	Provide eyewash station and safety shower. Observe good industrial hygiene practices. Wash hands before breaks and immediately after handling the product. Do not eat, drink or smoke when using the product. Wash contaminated clothing before reuse.

9. Physical and chemical properties

Appearance	
Physical state:	Liquid
Form:	Liquid
Color:	Colorless
Odor:	Ether-like odor
Odor threshold:	No data available.
pH:	No data available.
Melting point/freezing point:	-84.7 °C
Initial boiling point and boiling range:	87.2 °C
Flash Point:	Not applicable
Evaporation rate:	No data available.
Flammability (solid, gas):	No data available.
Upper/lower limit on flammability or explosive limits	
Flammability limit - upper (%):	10.5 %(V) 90 %(V)
Flammability limit - lower (%):	8 %(V) 12.5 %(V)
Explosive limit - upper (%):	No data available.
Explosive limit - lower (%):	No data available.
Vapor pressure:	9.2 kPa (25 °C)
Vapor density:	4.53 AIR=1
Relative density:	1.47 (20 °C)
Solubility(ies)	
Solubility in water:	1 g/l (20 °C)
Solubility (other):	acetone: Soluble ethanol: Soluble
Partition coefficient (n-octanol/water):	2.61
Auto-ignition temperature:	420 °C
Decomposition temperature:	No data available.
Viscosity:	No data available.
Other information	
Molecular weight:	131.39 g/mol (C_2HCl_3)

10. Stability and reactivity

Reactivity:	No dangerous reaction known under conditions of normal use.

Chemical Stability:	Material is stable under normal conditions.
Possibility of Hazardous Reactions:	Hazardous polymerization does not occur.
Conditions to Avoid:	Heat, sparks, flames. Light. Moisture. Contact with incompatible materials.
Incompatible Materials:	Strong oxidizing agents. Alkalies. Caustics. Chemically active metals.
Hazardous Decomposition Products:	By heating and fire, toxic vapors/gases may be formed. Oxides of Carbon. Phosgene.

11. Toxicological information

Information on likely routes of exposure

Ingestion:	May be harmful if swallowed.
Inhalation:	May be harmful if inhaled.
Skin Contact:	Causes skin irritation.
Eye contact:	Causes serious eye irritation.

Information on toxicological effects

Acute toxicity (list all possible routes of exposure)

Oral
Product: LD 50 (Rat): 4,920 mg/kg

Dermal
Product: No data available.

Inhalation
Product: LC 50 (Rat, 4 h): 12000 ppm

Repeated Dose Toxicity
Product: No data available.

Skin Corrosion/Irritation
Product: Causes skin irritation.

Serious Eye Damage/Eye Irritation
Product: Causes serious eye irritation.

Respiratory or Skin Sensitization
Product: Not a skin sensitizer.

Carcinogenicity
Product: May cause cancer.

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:

TRICHLOROETHYLENE	Overall evaluation: 1. Carcinogenic to humans.

US. National Toxicology Program (NTP) Report on Carcinogens:

TRICHLOROETHYLENE	Reasonably Anticipated to be a Human Carcinogen.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050):
No carcinogenic components identified

Germ Cell Mutagenicity

In vitro
Product: Suspected of causing genetic defects.

In vivo
Product: Suspected of causing genetic defects.

Reproductive Toxicity
Product: No components toxic to reproduction

Specific Target Organ Toxicity - Single Exposure
Product: May cause respiratory irritation. May cause drowsiness or dizziness.

Specific Target Organ Toxicity - Repeated Exposure
Product: No data available.

Aspiration Hazard
Product: Not classified

Other Effects: None known.

12. Ecological information

Ecotoxicity:

Acute hazards to the aquatic environment:

Fish
Product: No data available.

Specified substance(s):
TRICHLOROETHYLENE
LC 50 (Fathead minnow (Pimephales promelas), 96 h): 31.4 - 71.8 mg/l Mortality
LC 50 (Bluegill (Lepomis macrochirus), 96 h): 39 - 54 mg/l Mortality
EC 50 (Fathead minnow (Pimephales promelas), 96 h): 18.4 - 28.5 mg/l Intoxication

Aquatic Invertebrates
Product: No data available.

Specified substance(s):
TRICHLOROETHYLENE
LC 50 (Water flea (Daphnia magna), 48 h): 12 - 26 mg/l Mortality

Chronic hazards to the aquatic environment:

Fish
Product: No data available.

Aquatic Invertebrates
Product: No data available.

Toxicity to Aquatic Plants
Product: No data available.

Persistence and Degradability

Biodegradation
Product: There are no data on the degradability of this product.

BOD/COD Ratio
Product: No data available.

Bioaccumulative Potential
Bioconcentration Factor (BCF)
Product: No data available on bioaccumulation.

Partition Coefficient n-octanol / water (log Kow)
Product: Log Kow: 2.61

Mobility in Soil: The product is water soluble and may spread in water systems.

Other Adverse Effects: Harmful to aquatic life with long lasting effects.

13. Disposal considerations

Disposal instructions: Discharge, treatment, or disposal may be subject to national, state, or local laws.

Contaminated Packaging: Since emptied containers retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

UN Number:	UN 1710
UN Proper Shipping Name:	Trichloroethylene
Transport Hazard Class(es)	
Class(es):	6.1
Label(s):	6.1
Packing Group:	III
Marine Pollutant:	No

IMDG

UN Number:	UN 1710
UN Proper Shipping Name:	TRICHLOROETHYLENE
Transport Hazard Class(es)	
Class(es):	6.1
Label(s):	6.1
EmS No.:	F-A, S-A
Packing Group:	III
Marine Pollutant:	No

IATA

UN Number:	UN 1710
Proper Shipping Name:	Trichloroethylene
Transport Hazard Class(es):	
Class(es):	6.1
Label(s):	6.1
Marine Pollutant:	No
Packing Group:	III

15. Regulatory information

US Federal Regulations

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)
None present or none present in regulated quantities.

CERCLA Hazardous Substance List (40 CFR 302.4):
TRICHLOROETHYLENE Reportable quantity: 100 lbs.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories

X	Acute (Immediate)	X	Chronic (Delayed)		Fire		Reactive		Pressure Generating

SARA 302 Extremely Hazardous Substance
None present or none present in regulated quantities.

SARA 304 Emergency Release Notification

Chemical Identity	RQ
TRICHLOROETHYLENE	100 lbs.

SARA 311/312 Hazardous Chemical

Chemical Identity	Threshold Planning Quantity
TRICHLOROETHYLENE	500 lbs

SARA 313 (TRI Reporting)

Chemical Identity	Reporting threshold for other users	Reporting threshold for manufacturing and processing
TRICHLOROETHYLENE	10000 lbs	25000 lbs.

Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3)
TRICHLOROETHYLENE Reportable quantity: 100 lbs.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):
None present or none present in regulated quantities.

US State Regulations

US. California Proposition 65
TRICHLOROETHYLENE Carcinogenic.
TRICHLOROETHYLENE Male reproductive toxin.
TRICHLOROETHYLENE Developmental toxin.

US. New Jersey Worker and Community Right-to-Know Act
TRICHLOROETHYLENE Listed

US. Massachusetts RTK - Substance List
TRICHLOROETHYLENE Listed

US. Pennsylvania RTK - Hazardous Substances
TRICHLOROETHYLENE Listed

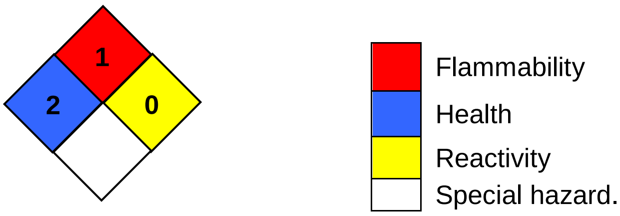
US. Rhode Island RTK
TRICHLOROETHYLENE Listed

Inventory Status:

Australia AICS:	On or in compliance with the inventory
Canada DSL Inventory List:	On or in compliance with the inventory
EINECS, ELINCS or NLP:	On or in compliance with the inventory
Japan (ENCS) List:	On or in compliance with the inventory
China Inv. Existing Chemical Substances:	Not in compliance with the inventory.
Korea Existing Chemicals Inv. (KECI):	On or in compliance with the inventory
Canada NDSL Inventory:	Not in compliance with the inventory.
Philippines PICCS:	On or in compliance with the inventory
US TSCA Inventory:	On or in compliance with the inventory
New Zealand Inventory of Chemicals:	On or in compliance with the inventory
Japan ISHL Listing:	On or in compliance with the inventory
Japan Pharmacopoeia Listing:	Not in compliance with the inventory.

16.Other information, including date of preparation or last revision

NFPA Hazard ID



Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe

Issue Date:	01-08-2015
Revision Date:	No data available.
Version #:	1.1
Further Information:	No data available.

Disclaimer:

THE INFORMATION PRESENTED IN THIS MATERIAL SAFETY DATA SHEET (MSDS/SDS) WAS PREPARED BY TECHNICAL PERSONNEL BASED ON DATA THAT THEY BELIEVE IN THEIR GOOD FAITH JUDGMENT IS ACCURATE. HOWEVER, THE INFORMATION PROVIDED HEREIN IS PROVIDED “AS IS,” AND AVANTOR PERFORMANCE MATERIALS MAKES AND GIVES NO REPRESENTATIONS OR WARRANTIES WHATSOEVER, AND EXPRESSLY DISCLAIMS ALL WARRANTIES REGARDING SUCH INFORMATION AND THE PRODUCT TO WHICH IT RELATES, WHETHER EXPRESS, IMPLIED, OR STATUTORY, INCLUDING WITHOUT LIMITATION<(>,<)> WARRANTIES OF ACCURACY, COMPLETENESS, MERCHANTABILITY, NON-INFRINGEMENT, PERFORMANCE, SAFETY, SUITABILITY, STABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, AND ANY WARRANTIES ARISING FROM COURSE OF DEALING, COURSE OF PERFORMANCE, OR USAGE OF TRADE. THIS MSDS/SDS IS INTENDED ONLY AS A GUIDE TO THE APPROPRIATE PRECAUTIONARY HANDLING OF THE MATERIAL BY A PROPERLY TRAINED PERSON USING THIS PRODUCT, AND IS NOT INTENDED TO BE COMPREHENSIVE AS TO THE MANNER AND CONDITIONS OF USE, HANDLING, STORAGE, OR DISPOSAL OF THE PRODUCT. INDIVIDUALS RECEIVING THIS MSDS/SDS MUST ALWAYS EXERCISE THEIR OWN INDEPENDENT JUDGMENT IN DETERMINING THE APPROPRIATENESS OF SUCH ISSUES. ACCORDINGLY, AVANTOR PERFORMANCE MATERIALS ASSUMES NO LIABILITY WHATSOEVER FOR THE USE OF OR RELIANCE UPON THIS INFORMATION. NO SUGGESTIONS FOR USE ARE INTENDED AS, AND NOTHING HEREIN SHALL BE CONSTRUED AS, A RECOMMENDATION TO INFRINGE ANY EXISTING PATENTS OR TO VIOLATE ANY FEDERAL, STATE, LOCAL, OR FOREIGN LAWS. AVANTOR PERFORMANCE MATERIALS REMINDS YOU THAT IT IS YOUR LEGAL DUTY TO MAKE ALL INFORMATION IN THIS MSDS/SDS AVAILABLE TO YOUR EMPLOYEES.

SAFETY DATA SHEET

Creation Date 16-Sep-2014 **Revision Date** 23-Jan-2018 **Revision Number** 3

1. Identification

Product Name	**trans-1,2-Dichloroethylene, stabilized**
Cat No. :	**AC406840000; AC406840250; AC406842500**
CAS-No	156-60-5
Synonyms	trans-Acetylene dichloride
Recommended Use	Laboratory chemicals.
Uses advised against	Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Acute oral toxicity	Category 4
Acute Inhalation Toxicity - Vapors	Category 4

Label Elements

Signal Word
Danger

Hazard Statements
Highly flammable liquid and vapor
Harmful if swallowed
Harmful if inhaled

Precautionary Statements
Prevention
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Avoid breathing dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Wear protective gloves/protective clothing/eye protection/face protection
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor/physician if you feel unwell
Ingestion
Rinse mouth
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Explosion risk in case of fire
Fight fire with normal precautions from a reasonable distance
Evacuate area
Storage
Store in a well-ventilated place. Keep cool
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Harmful to aquatic life with long lasting effects

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
trans-1,2-Dichloroethylene	156-60-5	>95

4. First-aid measures

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention.

Inhalation Remove from exposure, lie down. Move to fresh air. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Obtain medical attention. If not breathing, give artificial respiration.

Ingestion Do not induce vomiting. Obtain medical attention.

Most important symptoms and effects Breathing difficulties. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Water spray. Carbon dioxide (CO_2). Dry chemical. Chemical foam. Use water spray to cool unopened containers. Cool closed containers exposed to fire with water spray.

Unsuitable Extinguishing Media No information available

Flash Point 6 °C / 42.8 °F

Method - No information available

Autoignition Temperature 440 °C / 824 °F

Explosion Limits
- **Upper** 12.80%
- **Lower** 9.70%
- **Sensitivity to Mechanical Impact** No information available
- **Sensitivity to Static Discharge** No information available

Specific Hazards Arising from the Chemical
Flammable. Vapors may travel to source of ignition and flash back. Containers may explode when heated. Vapors may form explosive mixtures with air. Thermal decomposition can lead to release of irritating gases and vapors. Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products
Hydrogen chloride gas Carbon monoxide (CO) Carbon dioxide (CO_2) Phosgene

Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	3	0	N/A

6. Accidental release measures

Personal Precautions Remove all sources of ignition. Take precautionary measures against static discharges. Use personal protective equipment. Ensure adequate ventilation.

Environmental Precautions Do not flush into surface water or sanitary sewer system. See Section 12 for additional ecological information. Avoid release to the environment. Collect spillage.

Methods for Containment and Clean Up Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

7. Handling and storage

Handling Wear personal protective equipment. Ensure adequate ventilation. Avoid contact with skin and eyes. Use only in area provided with appropriate exhaust ventilation. Use explosion-proof equipment. Use only non-sparking tools. Keep away from open flames, hot surfaces and sources of ignition. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded. Take precautionary measures against static discharges.

Storage Keep in a dry, cool and well-ventilated place. Keep container tightly closed. Keep away from heat and sources of ignition. Flammables area. Keep container tightly closed in a dry and well-ventilated place.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
trans-1,2-Dichloroethylene	TWA: 200 ppm			

Legend

ACGIH - American Conference of Governmental Industrial Hygienists

Engineering Measures Ensure adequate ventilation, especially in confined areas. Use explosion-proof electrical/ventilating/lighting/equipment.

Personal Protective Equipment

Eye/face Protection 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 and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection 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.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	aromatic
Odor Threshold	No information available
pH	6.5-7.2
Melting Point/Range	-50 °C / -58 °F
Boiling Point/Range	48 °C / 118.4 °F @ 760 mmHg
Flash Point	6 °C / 42.8 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	12.80%
Lower	9.70%
Vapor Pressure	331 mmHg @ 25 °C
Vapor Density	3.34 (Air = 1.0)
Specific Gravity	1.260
Solubility	Immiscible with water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	440 °C / 824 °F
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	C2 H2 Cl2
Molecular Weight	96.94

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Keep away from open flames, hot surfaces and sources of ignition. Exposure to air. Exposure to light. Incompatible products. Exposure to moist air or water.

Incompatible Materials Bases, Strong acids, Strong oxidizing agents

Hazardous Decomposition Products Hydrogen chloride gas, Carbon monoxide (CO), Carbon dioxide (CO_2), Phosgene

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information
Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
trans-1,2-Dichloroethylene	LD50 = 1235 mg/kg (Rat)	>5 g/kg (Rabbit)	LC50 = 24100 ppm (Rat) 4 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
trans-1,2-Dichloroethylene	156-60-5	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity
Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment. The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
trans-1,2-Dichloroethylene	Not listed	LC50: = 135 mg/L, 96h static	Not listed	Not listed

		(Lepomis macrochirus)		

Persistence and Degradability Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its volatility.

Component	log Pow
trans-1,2-Dichloroethylene	1.48

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
trans-1,2-Dichloroethylene - 156-60-5	U079	-

14. Transport information

DOT

UN-No UN1150
Proper Shipping Name 1,2-DICHLOROETHYLENE
Hazard Class 3
Packing Group II

TDG

UN-No UN1150
Proper Shipping Name 1,2-DICHLOROETHYLENE
Hazard Class 3
Packing Group II

IATA

UN-No UN1150
Proper Shipping Name 1,2-DICHLOROETHYLENE
Hazard Class 3
Packing Group II

IMDG/IMO

UN-No UN1150
Proper Shipping Name 1,2-DICHLOROETHYLENE
Hazard Class 3
Packing Group II

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
trans-1,2-Dichloroethylene	X	X	-	205-860-2	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants

that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313 Not applicable

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
trans-1,2-Dichloroethylene	-	-	-	X

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
trans-1,2-Dichloroethylene	1000 lb 1 lb	-

California Proposition 65 This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
trans-1,2-Dichloroethylene	X	-	X	-	-

U.S. Department of Transportation

Reportable Quantity (RQ): N
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 16-Sep-2014
Revision Date 23-Jan-2018
Print Date 23-Jan-2018
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer

End of SDS

SAFETY DATA SHEET

Vinyl Chloride

Airgas
an Air Liquide company

Section 1. Identification

GHS product identifier	:	Vinyl Chloride
Chemical name	:	vinyl chloride
Other means of identification	:	chloroethylene; Ethene, chloro-; Chloroethene; Vinyl chloride, monomer; Ethene, chloro- (vinyl chloride); Vinyl chloride monomer; Monochloroethylene; Monochloroethene; Ethylene monochloride; VCM; VC
Product type	:	Gas.
Product use	:	Synthetic/Analytical chemistry.
Synonym	:	chloroethylene; Ethene, chloro-; Chloroethene; Vinyl chloride, monomer; Ethene, chloro- (vinyl chloride); Vinyl chloride monomer; Monochloroethylene; Monochloroethene; Ethylene monochloride; VCM; VC
SDS #	:	001067
Supplier's details	:	Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
24-hour telephone	:	1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture :
FLAMMABLE GASES - Category 1
GASES UNDER PRESSURE - Liquefied gas
CARCINOGENICITY - Category 1
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (liver) - Category 2

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements :
Extremely flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
May cause frostbite
May displace oxygen and cause rapid suffocation.
May cause cancer.
May cause damage to organs through prolonged or repeated exposure. (liver)

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Approach suspected leak area with caution.

Prevention : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves. Wear eye or face protection. Wear protective clothing. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Do not breathe gas.

Section 2. Hazards identification

Response : Get medical attention if you feel unwell. IF exposed or concerned: Get medical attention. Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

Storage : Store locked up. Protect from sunlight. Store in a well-ventilated place.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazards not otherwise classified : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : vinyl chloride

Other means of identification : chloroethylene; Ethene, chloro-; Chloroethene; Vinyl chloride, monomer; Ethene, chloro- (vinyl chloride); Vinyl chloride monomer; Monochloroethylene; Monochloroethene; Ethylene monochloride; VCM; VC

Product code : 001067

CAS number/other identifiers

CAS number : 75-01-4

Ingredient name	%	CAS number
vinyl chloride	100	75-01-4

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Continue to rinse for at least 10 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Section 4. First aid measures

Eye contact	: No specific data.
Inhalation	: No specific data.
Skin contact	: No specific data.
Ingestion	: No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician	: Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.
Specific treatments	: No specific treatment.
Protection of first-aiders	: No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media	: Use an extinguishing agent suitable for the surrounding fire.
Unsuitable extinguishing media	: None known.
Specific hazards arising from the chemical	: Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.
Hazardous thermal decomposition products	: Decomposition products may include the following materials: carbon dioxide carbon monoxide halogenated compounds
Special protective actions for fire-fighters	: Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.
Special protective equipment for fire-fighters	: Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel	: Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.
For emergency responders	: If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Section 6. Accidental release measures

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Do not get in eyes or on skin or clothing. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.
Use only non-sparking tools. Empty containers retain product residue and can be hazardous. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Do not breathe gas. Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Store locked up. Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
vinyl chloride	**ACGIH TLV (United States, 3/2017).** TWA: 1 ppm 8 hours. **OSHA PEL (United States, 6/2016).** STEL: 5 ppm 15 minutes. TWA: 1 ppm 8 hours. **OSHA PEL 1989 (United States, 3/1989).** STEL: 5 ppm 15 minutes. TWA: 1 ppm 8 hours.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Section 8. Exposure controls/personal protection

Environmental exposure controls	: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures	: Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.
Eye/face protection	: Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection	: Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.
Body protection	: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.
Other skin protection	: Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Respiratory protection	: Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state	: Gas. [COLORLESS GAS OR LIQUID (BELOW 7 F) WITH A PLEASANT ODOR AT HIGH CONCENTRATIONS. [NOTE: SHIPPED AS A LIQUEFIED COMPRESSED GAS.]
Color	: Colorless.
Odor	: Characteristic.
Odor threshold	: Not available.
pH	: Not available.
Melting point	: -153.8°C (-244.8°F)
Boiling point	: -13.4°C (7.9°F)
Critical temperature	: 158.45°C (317.2°F)
Flash point	: Closed cup: -78°C (-108.4°F) Open cup: -78°C (-108.4°F)
Evaporation rate	: Not available.
Flammability (solid, gas)	: Not available.
Lower and upper explosive (flammable) limits	: Lower: 3.8% Upper: 29.3%

Section 9. Physical and chemical properties

Vapor pressure	:	Not available.
Vapor density	:	2.2 (Air = 1)
Specific Volume (ft ^{3}/lb)	:	6.25
Gas Density (lb/ft ^{3})	:	0.16129 (21.1°C / 70 to °F)
Relative density	:	Not applicable.
Solubility	:	Not available.
Solubility in water	:	1.1 g/l
Partition coefficient: n-octanol/water	:	1.38
Auto-ignition temperature	:	472°C (881.6°F)
Decomposition temperature	:	Not available.
Viscosity	:	Not applicable.
Flow time (ISO 2431)	:	Not available.
Molecular weight	:	62.5 g/mole

Aerosol product

Heat of combustion	:	-18924336 J/kg

Section 10. Stability and reactivity

Reactivity	:	No specific test data related to reactivity available for this product or its ingredients.
Chemical stability	:	The product is stable.
Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
Conditions to avoid	:	Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.
Incompatible materials	:	Oxidizers
Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.
Hazardous polymerization	:	Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Section 11. Toxicological information

Classification

Product/ingredient name	OSHA	IARC	NTP
vinyl chloride	+	1	Known to be a human carcinogen.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
vinyl chloride	Category 2	Not determined	liver

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : May cause damage to organs through prolonged or repeated exposure.

Carcinogenicity : May cause cancer. Risk of cancer depends on duration and level of exposure.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Section 11. Toxicological information

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
vinyl chloride	1.38	-	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

United States - RCRA Toxic hazardous waste "U" List

Ingredient	CAS #	Status	Reference number
Vinyl chloride; Ethene, chloro-	75-01-4	Listed	U043

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1086	UN1086	UN1086	UN1086	UN1086
UN proper shipping name	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED

Section 14. Transport information

Transport hazard class(es)	2.1 	2.1 	2.1 	2.1 	2.1 
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Additional information

DOT Classification : **Reportable quantity** 1 lbs / 0.454 kg. Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements.
Limited quantity Yes.
Quantity limitation Passenger aircraft/rail: Forbidden. Cargo aircraft: 150 kg.
Special provisions 21, B44, T50

TDG Classification : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2).
Explosive Limit and Limited Quantity Index 0.125
ERAP Index 3000
Passenger Carrying Road or Rail Index Forbidden

IATA : **Quantity limitation** Passenger and Cargo Aircraft: Forbidden. Cargo Aircraft Only: 150 kg.

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined
Clean Water Act (CWA) 307: vinyl chloride
Clean Air Act (CAA) 112 regulated flammable substances: vinyl chloride

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

Section 15. Regulatory information

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	vinyl chloride	75-01-4	100
Supplier notification	vinyl chloride	75-01-4	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : This material is listed.

New York : This material is listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

California Prop. 65

⚠ **WARNING**: This product can expose you to Vinyl chloride, which is known to the State of California to cause cancer. For more information go to www.P65Warnings.ca.gov.

Ingredient name	No significant risk level	Maximum acceptable dosage level
Vinyl chloride	Yes.	-

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Inventory list

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Europe : This material is listed or exempted.

Japan : **Japan inventory (ENCS)**: This material is listed or exempted.
Japan inventory (ISHL): This material is listed or exempted.

Malaysia : This material is listed or exempted.

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Taiwan : This material is listed or exempted.

Thailand : Not determined.

Turkey : This material is listed or exempted.

Section 15. Regulatory information

United States : This material is listed or exempted.

Viet Nam : Not determined.

Section 16. Other information

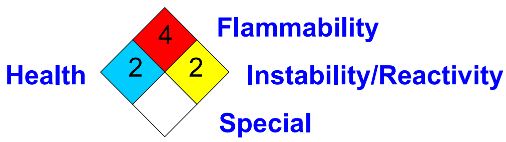
Hazardous Material Information System (U.S.A.)

Health	*	2
Flammability		4
Physical hazards		2

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
FLAMMABLE GASES - Category 1	Expert judgment
GASES UNDER PRESSURE - Liquefied gas	Expert judgment
CARCINOGENICITY - Category 1	Expert judgment
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (liver) - Category 2	Expert judgment

History

Date of printing : 7/9/2018

Date of issue/Date of revision : 7/9/2018

Date of previous issue : 10/11/2016

Version : 0.02

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

Section 16. Other information

References : Not available.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

ATTACHMENT H

Jobsite Safety Inspection Checklist

LANGAN

JOBSITE SAFETY INSPECTION CHECKLIST

Client: _____________________________ Inspection Date: _______________________

Site: _______________________________ Inspector: _____________________________

Employees: ____

Notes:____

____

____

Check one of the following: **A:** Acceptable **NA**: Not Applicable **D**: Deficiency

	A	NA	D	Remarks
GENERAL				
Appropriate PPE being worn by Langan employees and subcontractors?				
Air monitoring instruments calibrated daily and results recorded on the Daily Instrument Calibration check sheet?				
Air monitoring readings recorded on the air monitoring data sheet/field log book?				
Incident reporting procedures known?				
Site security an issue?				
Vehicle /pedestrian traffic issue?				
Adequate size/type fire extinguisher supplied?				
Evidence that drilling operator is responsible for the safety of his rig.				
First Aid kit available?				
PERSONAL PROTECTIVE EQUIPMENT				
Eye Protection?				
Head protection?				
Safety Shoes?				
Safety vests?				
Hand protection?				
Other?				
Deficiencies??				
HOUSEKEEPING				
Work area kept clean/tidy to minimize potential hazards?				
Waste being disposed of quickly and properly				
Adequate lighting for job?				
Portable water available?				
HAND TOOLS				
Are tools in good condition and properly used? (INSPECT)				
Are proper tools being used?				
Are tools safety stored when not in use?				
Have tools been inspected prior to use?				
Are employees familiar with using tools?				
Is additional PPE required for tools? Available?				
POWER TOOLS				
Are tools in good condition and properly used? (INSPECT)				
Are tools properly grounded?				
Safety guards in place and used correctly?				
Competent instruction / supervision?				
Cords include in inspection?				

HAZWOPER				
Employees have current 40-hr./8-hr./Supervisor HAZWOPER training?				
Project staff medically cleared to work in hazardous waste sites and fit-tested to wear respirators, if needed?				
Respiratory protection readily available?				
Subcontract workers have current 40-hr./8-hr./Spvsr. HAZWOPER training, as appropriate?				
Subcontract workers medically cleared to work on site, and fit-tested for respirator wear?				
Subcontract workers have respirators readily available?				
HEALTH & SAFETY PLAN				
HASP available on site for inspection?				
Health & Safety Compliance agreement (in HASP) appropriately signed by Langan employees and subcontractors?				
Hospital route map with directions posted on site?				
Emergency Notification List posted on site?				
Personnel trained in CPR/First Aid on site?				
MSDSs readily available, and all workers knowledgeable about the specific chemicals and compounds to which they may be exposed?				
Project site safe practices ("Standing Orders") posted?				
Health & Safety Incident Report forms available?				
Decontamination procedures being followed as outlined in HASP?				
UNDERGROUND UTILITY				
Mark outs of underground utilities done prior to initiating any subsurface activities?				
Underground utilities located and authorities contacted before digging?				
Visually observed mark-outs?				
Is subsurface work within three feet of underground utilities?				
- Is so, is or was soft dig techniques used?				
Drilling performed in areas free from underground utilities?				
EXCAVATION / TRENCH				
Are excavations/trenches over 5 feet deep sloped, shored or a trench box used?				
Operations supervised by a Competent Person?				
Is Competent Person preforming daily inspections of excavation/trench?				
Adequate barricades in place?				
Have underground utilities been identified?				
Ladders / means of egress in trench with 25-foot of every worker?				
Has PE designed or approved protective system?				
Excavated material and other objects placed more than 2 feet away from excavation edge?				
Public protected from exposure to open excavation?				
CONFINED / PERMIT-ENTRY CONFINED SPACE				
People entering the excavation regarding it as a permit-required confined space and following appropriate procedures?				
Confined space entry permit is completed and posted?				
All persons knowledgeable about the conditions and characteristics of the confined space?				
All persons engaged in confined space operations have been trained in safe entry and rescue (non-entry)?				
Full body harnesses, lifelines, and hoisting apparatus available for rescue needs?				
Attendant and/or supervisor certified in basic first aid and CPR?				
Confined space atmosphere checked before entry and continuously while the work is going on?				
Results of confined space atmosphere testing recorded?				
Evidence of coordination with off-site rescue services to perform entry rescue, if needed?				
ELECTRICAL SAFETY				
Equipment at least 10 feet from overhead power lines?				
Is equipment grounded?				
GFCI used and tested where required?				
Are extension cords rated for this work being used and are they properly maintained?				
Electrical dangers posted at site?				

FLAMMABLE LIQUIDS				
Are flammable liquids used at site?				
Are flammable liquids stored in appropriate containers?				
Are flammable liquids kept away from combustion sources?				
Do flammable liquid containers have warning labels?				
LADDERS				
Are ladders used at site?				
Were ladders inspected prior to use?				
Are ladders in good working condition?				
Are ladders secured to prevent slipping, sliding or falling?				
Do side rails extend three feet above top of landing area?				
Are top two steps of stepladders being used?				
Is extension on ladder facing out?				
Are ladders sufficient for task?				
Are ladders sufficient for task?				

Unsafe acts observed? ____

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Additional remarks ____

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Notes:____

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Distribution: Project Manager - Name: ___________________________
Health & Safety Officer - Name: ____________________________
Health & Safety Manager- Name: Anthony Moffa, CHMM

ATTACHMENT I

Langan Guidelines

ATTACHMENT I

Langan Guidelines

GENERAL

- No smoking, eating, or drinking in this work zone.
- Upon leaving the work zone, personnel will thoroughly wash their hands and face.
- Minimize contact with contaminated materials through proper planning of work areas and decontamination areas, and by following proper procedures. Do not place equipment on the ground. Do not sit on contaminated materials.
- No open flames in the work zone.
- Only properly trained and equipped personnel are permitted to work in potentially contaminated areas.
- Always use the appropriate level of personal protective equipment (PPE).
- Maintain close contact with your buddy in the work zone
- Contaminated material will be contained in the Exclusion Zone (EZ).
- Report any unusual conditions.
- Work areas will be kept clear and uncluttered. Debris and other slip, trip, and fall hazards will be removed as frequently as possible.
- The number of personnel and equipment in the work zone will be kept to an essential minimum.
- Be alert to the symptoms of fatigue and heat/cold stress, and their effects on the normal caution and judgment of personnel.
- Conflicting situations which may arise concerning safety requirements and working conditions must be addressed and resolved quickly by the site HSO.

TOOLS AND HEAVY EQUIPMENT

- Do not, under any circumstances, enter or ride in or on any backhoe bucket, materials hoist, or any other device not specifically designed to carrying passengers.
- Loose-fitting clothing or loose long hair is prohibited around moving machinery.
- Ensure that heavy equipment operators and all other personnel in the work zone are using the same hand signals to communicate.
- Drilling/excavating within 10 feet in any direction of overhead power lines is prohibited.
- The locations of all underground utilities must be identified and marked out prior to initiating any subsurface activities.
- Check to insure that the equipment operator has lowered all blades and buckets to the ground before shutting off the vehicle.
- If the equipment has an emergency stop device, have the operator show all personnel its location and how to activate it.
- Help the operator ensure adequate clearances when the equipment must negotiate in tight quarters; serve as a signalman to direct backing as necessary.
- Ensure that all heavy equipment that is used in the Exclusion Zone is kept in that zone until the job is done, and that such equipment is completely decontaminated before moving it into the clean area of the work zone.
- Samplers must not reach into or get near rotating equipment such as the drill rig. If personnel must work near any tools that could rotate, the equipment operator must completely shut down the rig prior to initiating such work. It may be necessary to use a remote sampling device.

APPENDIX D

INTERIM REMEDIAL MEASURE WORK PLAN IMPLEMENTATION SCHEDULE

IRMWP Implementation Schedule
990-1026 Rossville Avenue
Staten Island, New York
Langan Project No. 100849501

Item #	Action	2020										
		FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	IRMWP Preparation and Submission											
2	NYSDEC IRMWP Review and Approval											
4	IRMWP Implementation											
5	CCR Preparation and Submission											
6	NYSDEC CCR Review and Approval											

<u>Notes:</u>

1. IRMWP = Interim Remedial Measures Work Plan
2. NYSDEC = New York State Department of Environmental Conservation
3. CCR = Construction Completion Report