INTERIM REMEDIAL MEASURE WORK PLAN

for

23-10 QUEENS PLAZA SOUTH

Block 425, Lot 5
Long Island City, Queens County, New York
BCP Site No. C241160

Prepared For:

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1.0 INTRODUCTION

1.1 General

QPS 23-10 Development LLC (the Volunteer) entered into a Brownfield Cleanup Agreement (BCA) with the New York State Department of Environmental Conservation (NYSDEC) on August 8, 2014 to investigate and remediate a 27,269-square-foot property located at 23-10 Queens Plaza South (Block 425, Lot 5) in the county of Queens, Long Island City, New York (the "Site"). A site location map is provided as Figure 1.

Subsequent to the submittal of this Interim Remedial Measure (IRM) Work Plan, a Remedial Action Work Plan (RAWP) will be developed to address final submembrane depressurization (SMD) system design, remedial performance monitoring, and remedial closure. To initiate the remediation, the Volunteer directed Langan to prepare this IRM Work Plan to address known environmental conditions and potential contaminant sources at the Site. The scope of this IRM Work Plan includes the following:

- Decommissioning and removal of one registered, 10,000-gallon aboveground storage tank (AST) (Petroleum Bulk Storage [PBS] No. 2-017345);
- Cleaning of the cellar slab with oil-removing and oil-absorbent products, and removal of any petroleum-containing drums, barrels, or other storage containers representing a threat of possible release to the environment;
- Demolition of the existing cellar slab and excavation as practical to about 2.5 feet below slab grade (bsg) to allow for field screening of exposed soil, installation of a submembrane depressurization piping and site cap;
- Decommissioning and removal of four unregistered, 550-gallon underground storage tanks (USTs), and any unknown USTs;
- Additional excavation to the extent practical to remove grossly-impacted media, if encountered;
- Excavation, to the extent practicable, in the southwestern portion of the Site to remove light non-aqueous phase liquid (LNAPL) and grossly-impacted soil. If excavation becomes impractical, recovery sumps/wells would be installed, and LNAPL would be removed periodically using conventional LNAPL recovery technology;
- A design verification investigation consisting of collection of baseline groundwater samples from the existing monitoring wells, advancement of up to three soil borings, and collection of up to six soil samples for analysis of volatile organic compounds (VOC) and total organic carbon (TOC) to refine the assumptions of the remediation design;

- In-situ groundwater treatment via a one-time injection of up an electron donor (HRC®) and an activated carbon product (PlumeStop™) to rapidly reduce dissolved chlorinated VOC (CVOC) concentrations in groundwater and stimulate continued biodegradation;
- Post-injection groundwater sampling and remediation performance monitoring to demonstrate containment/stabilization of the CVOC plume and reduction in CVOC concentrations, in accordance with Part 375-1.8(d);
- Collection of endpoint confirmation soil samples from the base of the excavation;
- Backfilling of excavations, as necessary;
- Installation of subslab piping and gravel permeation layer for a submembrane depressurization system, and placing the new concrete slab; and
- Registration of all unregistered USTs under PBS No. 2-017345.

Locations of the known ASTs and USTs are shown on the site plan provided as Figure 2.

This IRM Work Plan has been prepared in accordance with requirements of the New York State Brownfield Cleanup Program (BCP) and NYSDEC's May 2010 Division of Environmental Remediation (DER)-10 - Technical Guidance for Site Investigation and Remediation. The IRM will be completed in advance of completing a final remedy in accordance with the definition of an IRM (May 2010 DER-10):

> ***"Interim remedial measure" or "IRM"*** *means activities to address both emergency and non-emergency site conditions, which can be undertaken without extensive investigation and evaluation, to prevent, mitigate or remedy environmental damage or the consequences of environmental damage attributable to a site, including, but not limited to, the following activities: construction of diversion ditches; collection systems; drum removal; leachate collection systems; construction of fences or other barriers; installation of water filters; provision of alternative water systems; the removal of source areas; or plume control.*

1.2 Site Description

The Site (Block 425, Lot 5) is located at 23-10 Queens Plaza South in Long Island City, New York (Figure 1) and consists of a trapezoidal lot encompassing an area of 27,269 square feet Improved with a four-story concrete building with a cellar and partial sub-cellar. The majority of the Site building is currently vacant; however, a portion of the first floor is used as field offices for the construction site on the adjacent Lot 1. The Site is in an area primarily characterized by mixed commercial and industrial use with recent residential development and is bordered by

Queens Plaza South to the north, 24th Street to the east, Lot 1 followed by 42nd Road to the south, and 23rd Street to the west.

Ground surface elevations were obtained from a survey drawing by Earl B. Lovell – S. P. Belcher, Inc., dated February 26, 2013. Elevations presented herein are measured in feet and relative to the Queens Highway Datum (QHD), which is 1.625 feet below the North American Vertical Datum of 1988 (NAVD88).

The top of the cellar slab in the Site building is about el 11.0. Depths in this work plan are given in feet bsg, which refers to the depth below the top of the cellar slab. Sidewalk grades generally increase from the southwest corner to the northeast corner. The 23rd Street sidewalk elevation ranges from about el 13.4 at the southwest corner to about el 15.5 at the northwest corner. Sidewalk grades along Queens Plaza South range from about el 15.5 at the northwest corner to about el 20.6 at the northeast corner. Sidewalk grades along 24th street range from about el 20.6 at the northeast corner to about el 16.7 at the southeast corner.

1.3 Redevelopment Plan

The proposed redevelopment includes the renovation of the existing building to convert it into commercial space and parking. The cellar will be renovated for use as a commercial space, the first and second floors will be used for parking and an office lobby, and the third floor will be converted to office space. The fourth floor will be demolished to meet floor area ratio (FAR) requirements.

1.4 Site History

The Site is located in a historically industrial area and has been used for manufacturing and as a garage since as early as 1936. The Sanborn map dated 1936 indicates two gasoline tanks in the northwestern portion of the Site. In addition, geophysical anomalies indicative of USTs were identified in the northwest corner of the Site building during the September 2012 Phase II Environmental Site Investigation (ESI) and July 2013 subsurface investigation (SI). A fill port identified along the 23rd Street sidewalk and a vent pipe identified along the 24th Street sidewalk fronting the Site are possibly associated with these USTs. There is no record of UST removal or abandonment; therefore, these USTs likely remain. In addition, an AST is located within a vault in the northeast corner of the cellar.

1.5 Summary of Remedial Investigation Report Findings

A Remedial Investigation Report (RIR), dated June 2015, was prepared by Langan using data and findings from a July 2013 SI that was completed during due diligence, and incorporated previous environmental data from a Phase II ESI report, dated November 8, 2012 and performed in September 2012 by Cardno ATC Associates, Inc. Additional groundwater sampling was conducted in October 2014 to evaluate dissolved concentrations of metals in groundwater. Supplemental off-site soil, soil vapor, and groundwater sampling was completed in May 2015 to evaluate potential off-site sources.

The September 2012 Phase II ESI conducted by ATC included the following:

1. Geophysical survey;
2. Advancement of nine soil borings and collection of nine grab soil samples for laboratory analysis; and
3. Installation of three temporary groundwater monitoring wells and collection of two groundwater samples for laboratory analysis.

The July 2013 SI conducted by Langan included the following:

1. Geophysical survey to identify boring, monitoring well, and soil vapor sample locations, physical obstructions and subsurface utilities and structures;
2. Advancement of seven soil borings and collection of fifteen grab soil samples for laboratory analysis;
3. Installation of seven groundwater monitoring wells and collection of seven groundwater samples for laboratory analysis; and
4. Installation of seven soil vapor probes and collection of one ambient air sample, one outdoor air sample, and seven soil vapor samples for laboratory analysis.

The supplemental groundwater sampling event conducted on October 8, 2014 consisted of the collection of six filtered and unfiltered groundwater samples from monitoring wells installed during the July 2013 SI, plus one duplicate, for laboratory analysis of total and dissolved metals.

The May 2015 supplemental off-site investigation included the following:

1. Advancement of four soil borings and collection of four soil samples;
2. Installation of three monitoring wells and collection of four groundwater samples, including one duplicate sample; and
3. Installation of four soil vapor sampling points and collection of four soil vapor samples and one outdoor air sample.

The findings and conclusions of the RIR are as follows:

- Stratigraphy: Overburden consists of a historic fill layer beneath the cellar slab extending to depths of up to about 8 feet bsg. The historic fill layer generally consists of brown, coarse to fine sand with varying amounts of silt, gravel, and concrete fragments. A layer of glacial till consisting of gray and brown silt with varying amounts of gravel, sand, and clay was encountered below the fill. Based on the findings of the July 2013 Geotechnical Engineering Study conducted by Langan for the south-adjacent lot, bedrock depth is estimated to range from about 14 to 21 feet bsg and consists of hard to very hard, slightly weathered to fresh, coarse- to fine-grained, quartz-mica-garnet gneiss of the Ravenwood Granodiorite.

- Hydrogeology: Synoptic groundwater level measurements were collected on August 14, 2013. Groundwater depths ranged from about 4.06 to 6.89 feet bsg. The groundwater elevation is highest in the eastern portion of the Site and flows west-southwest. Regional groundwater is presumed to flow west towards the East River.

- Historic Fill/Soil: Soil contains concentrations of VOCs, semivolatile organic compounds (SVOC), and metals at concentrations that exceed their respective NYSDEC Part 375 Unrestricted or Restricted-Residential Use soil cleanup objectives (SCO). Copper and lead were detected in one or more soil samples at concentrations above their respective Commercial Use SCOs.

- USTs and ASTs: Four gasoline USTs and a former pump island were identified in the northwest corner of the Site building during the 2013 geophysical survey. In addition, vent pipes along the east side of the Site building were identified. Based on field observations and analytical results, the USTs have not impacted surrounding soil or groundwater. A 10,000-gallon AST containing fuel oil was identified within the northeast corner of the Site building.

- LNAPL: Free product was observed in monitoring well MW11 during the October 2014 supplemental groundwater sampling event. Additionally, a PID reading of 137 parts per million (ppm) was recorded in the headspace and petroleum-related VOCs were detected in groundwater at one location. Based on analytical results, the LNAPL is likely from an old release and impacts to soil and groundwater have degraded.

- Chlorinated VOC-Impacted Groundwater: CVOCs were detected at concentrations exceeding NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 Class GA Ambient Water Quality Standards and Guidance Values (SGVs) in groundwater. The CVOC concentrations in groundwater were greatest in the northern portion of the Site. All soil borings were advanced to refusal, likely encountering the shallow bedrock, and there was no evidence of a CVOC source area. There were no detections of CVOCs at concentrations above their respective Unrestricted Use SCOs in any of the soil samples collected during the September 2012 Phase II ESI and the SI. CVOC concentrations in groundwater do not indicate the presence of DNAPL in the subsurface. The source of CVOCs is likely due to incidental releases during former manufacturing/industrial processes. Groundwater sample results from off-site monitoring wells were not indicative of an off-site source or significant down-gradient off-site migration.

- Soil Vapor: Soil vapor sampling results indicate the presence of several VOCs above the anticipated range of background concentrations.

- Supplemental Off-site Sampling Results: Supplemental off-site soil, groundwater, and soil vapor sampling was conducted to evaluate potential up-gradient sources of contamination and down-gradient migration of Site contaminants of concern (COC). Off-site soil vapor samples were collected to the north, east, and west of the Site. Results from the off-site sampling showed soil vapor concentrations of Site COCs were two orders of magnitude lower than on-site concentrations. In the south-adjacent property, soil vapor concentrations of Site COCs were consistent with on-site soil vapor results. The off-site investigation did not reveal up-gradient sources or down-gradient migration of Site COCs in soil or groundwater.

2.0 SUMMARY OF INTERIM REMEDIAL MEASURE

The proposed IRM consists of the following tasks:

- Decommissioning and removal of one registered, 10,000-gallon aboveground storage tank (AST) (Petroleum Bulk Storage [PBS] No. 2-017345);
- Cleaning of the cellar slab with oil-removing and oil-absorbent products, and removal of any petroleum-containing drums, barrels, or other storage containers representing a threat of possible release to the environment;
- Demolition of the existing cellar slab and excavation as practical to about 2.5 feet below slab grade (bsg) to allow for field screening of exposed soil, installation of a submembrane depressurization piping and site cap;
- Decommissioning and removal of four unregistered, 550-gallon underground storage tanks (USTs), and any unknown USTs;
- Additional excavation to the extent practical to remove grossly-impacted media, if encountered;
- Excavation, to the extent practicable, in the southwestern portion of the Site to remove light non-aqueous phase liquid (LNAPL) and grossly-impacted soil. If excavation becomes impractical, recovery sumps/wells would be installed, and LNAPL would be removed periodically using conventional LNAPL recovery technology;
- A design verification investigation consisting of collection of baseline groundwater samples from the existing monitoring wells, advancement of up to three soil borings, and collection of up to six soil samples for analysis of volatile organic compounds (VOC) and total organic carbon (TOC) to refine the assumptions of the remediation design;
- In-situ groundwater treatment via a one-time injection of up an electron donor (HRC®) and an activated carbon product (PlumeStop™) to rapidly reduce dissolved chlorinated VOC (CVOC) concentrations in groundwater and stimulate continued biodegradation;
- Post-injection groundwater sampling and remediation performance monitoring to demonstrate containment/stabilization of the CVOC plume and reduction in CVOC concentrations, in accordance with Part 375-1.8(d);
- Collection of endpoint confirmation soil samples from the base of the excavation;
- Backfilling of excavations, as necessary;
- Installation of subslab piping and gravel permeation layer for a submembrane depressurization system, and placing the new concrete slab; and

- Registration of all unregistered USTs under PBS No. 2-017345.

The IRM described herein will be performed in accordance with applicable federal, state, and city regulations. An estimated IRM schedule is provided in Appendix A. A Construction Health and Safety Plan (CHASP) is provided as Appendix B.

2.1 Objectives and Rationale

The objectives of the IRM are as follows:

- Remove petroleum contamination and prevent additional environmental impacts to Site media (soil, groundwater, and soil vapor) through the removal of the ASTs, USTs, associated fuel lines, and storage drums;
- To the extent practicable, restore groundwater quality to meet applicable standards and guidance and prevent the off-site migration of the on-site plume in accordance with Part 375-1.8(d);
- Remove known subsurface contamination through LNAPL recovery, excavation of grossly-impacted media; and
- With the cellar slab removed, install the submembrane piping and gravel permeation layer for the SMD system.

The IRM will address CVOC-contaminated groundwater via in-situ remediation. To mitigate the environmental impact, reduce vapor intrusion potential and protect human health, the remedy will need to stabilize and contain the CVOC-impacted groundwater plume.

CVOC-impacted groundwater will be treated via temporary injection points with a combination of activated carbon suspended in water and an electron donor product. PlumeStop™ Liquid Activated Carbon™ is a commercially available proprietary product made by Regenesis, Inc., and consists of fine particles of activated carbon suspended in water. In the short term, the liquid activated carbon rapidly reduces dissolved concentrations of CVOCs through adsorption, capturing the contaminant in place and preventing any further mobility. The Liquid Activated Carbon™ also provides sites for attached growth of bioremediation culture, facilitating the natural attenuation of the CVOCs via reductive dechlorination. In the long term, as the sorbed CVOCs degrade, new sorption sites become available to further reduce dissolved CVOC concentrations. Groundwater sample results revealed PCE daughter products (TCE, cis-1,2-dichloroethene, and vinyl chloride) are present in groundwater, indicating that the breakdown of PCE is occurring naturally. An electron donor product, such as Hydrogen Release Compound (HRC®), also made by Regenesis, will be used to accelerate the bioremediation component of the remedy. HRC® gradually releases lactic acid, providing a consistent supply of the electron donor needed in the anaerobic biodegradation of CVOCs.

2.1.1 Site Preparation

Site preparation, to be completed by the Contractor for implementation of the proposed IRM, will include, but not be limited to, the establishment of work zones, addition of support facilities, construction of decontamination facilities, and implementation of site security measures (i.e. erection of security fencing around work zones and staging areas). All work is anticipated to be conducted inside the cellar of the existing Site building; therefore, erosion and sediment controls will not be implemented.

Seven monitoring wells are present within the cellar of the Site building, as shown on Figure 2. Existing monitoring well MW07 will be reinstalled and all monitoring wells will be protected to prevent damage during the slab demolition and excavation.

Prior to intrusive activities, Dig Safely New York (811) will be contacted by the Contractor a minimum of three business days in advance of the work. Dig Safely New York will be informed of the nature of the work and the intent to perform excavation.

2.1.2 Aboveground Storage Tank Removal

Removal of one 10,000-gallon AST, associated fuel lines, and appurtenances is included in the IRM. The AST will be rendered inert and cleaned prior to off-site transport. The decommissioned AST registration will be updated with the NYSDEC PBS unit and affidavits of closure will be obtained by a New York City Fire Department (FDNY) licensed UST Installer/Remover. NYSDEC will be notified at least 10 days in advance of any AST removal, which will be performed in accordance with NYSDEC CP-51 Soil Cleanup Guidance and other applicable NYSDEC AST closure requirements.

2.1.3 Cellar Slab Demolition

The current cellar slab will be demolished and removed as part of the IRM. Portions of the cellar slab may remain intact to protect utilities, structural columns and foundation walls. Previous investigations and site reconnaissance noted petroleum staining due to improper storage conditions throughout the Site. In addition, the source of CVOC impacts are suspected to be from prior Site use; slab removal will enable field screening of surficial soils to assess and remove potential CVOC-impacted soil. Removal of the slab and excavation as practical of underlying shallow historic fill will also enable installation of subslab utilities in clean backfill. Prior to demolition, the slab will be cleaned with absorbent pads and granular floor sweep. Materials used to clean the slab will be containerized in 55-gallon drums and disposed of properly at an off-site facility. Drums and other petroleum storage containers representing a threat of release to the environment will also be cleaned and removed from the Site.

2.1.4 Monitoring Well Protection/Replacement

The monitoring well network will be useful for future monitoring, and therefore will need to be protected during implementation of the IRM Work Plan. If any of the monitoring wells are damaged, they will be replaced in kind by re-drilling at the exact location of the well. Monitoring wells that are no longer needed will be decommissioned in accordance with the NYSDEC CP-43 Groundwater Monitoring Well Decommissioning Policy. If feasible, the monitoring wells will be decommissioned by pulling out the casing and grouting the borehole. Otherwise, the wells will be decommissioned by tremie-filling them with grout, removing the well covers, grouting the well locations, and cutting the wells at the base of the Site-wide excavation.

2.1.5 Underground Storage Tank Removal

Four 550-gallon USTs are located in the northwestern portion of the Site, and removal of the USTs and associated fuel lines is included in the IRM. If additional unknown USTs are encountered, they will be decommissioned and removed. Removal of the USTs will be performed in accordance with NYSDEC CP-51 Soil Cleanup Guidance and other applicable NYSDEC UST closure requirements.

Upon completion of UST removal, excavations will be inspected for the presence of petroleum-impacted soil and groundwater. LNAPL observed in the vicinity of the UST excavations will be removed using vacuum methods (or methods selected by the Contractor and approved by the Remediation Engineer [RE] in conjunction with NYSDEC), to the extent possible without causing an unstable condition, and disposed of off-site in accordance with all applicable regulations at a permitted disposal facility.

Following removal of USTs, the USTs will be registered and closed in the NYSDEC PBS database and FDNY affidavits of closure will be obtained by a licensed UST Installer/Remover.

2.1.6 Soil Excavation

Soil will be excavated Site-wide to a depth of about 2.5 feet bsg as practical. Following the cellar slab removal, the surface soil will be screened with a PID equipped with a 10.6 eV lamp. If grossly-impacted soil is observed at the surface in accessible portions of the Site, it will be excavated to the extent practical. Excavation is considered impractical if it results in structural concerns, impacts utilities, extends outside of the property line, requires extensive support of excavation design or underpinning, or results in groundwater infiltration requiring dewatering. Any grossly-impacted materials, including but not limited to soil, concrete, and asphalt, will be segregated and disposed of at a permitted off-site disposal facility in accordance with applicable regulations.

2.1.7 LNAPL Recovery and Recovery Sump Installation

LNAPL was observed in monitoring well MW11, located in the southwestern portion of the Site, during the October 2014 supplemental groundwater sampling event. LNAPL will be recovered and removed as part of the IRM. Excavation will be conducted in the MW11 vicinity to observe the conditions at the groundwater table, recover potential LNAPL floating on groundwater, and remove grossly-impacted soil. Excavation will continue, to the extent practicable, until the LNAPL and grossly-impacted soil are removed.

Endpoint samples will be collected in accordance with DER-10. If excavation becomes impractical, recovery sumps/wells would be installed, and LNAPL would be recovered periodically using conventional LNAPL recovery technology. Recovery sumps will be installed by first excavating test pits to about 1 foot below the groundwater depth (about 7 feet bsg). A two-foot-diameter perforated pipe, screened at the water table, will be installed at the center of each test pit, and the annulus will be backfilled with drainage stone or sand. The sumps will be installed flush with the subgrade. Recoverable LNAPL will be extracted from the recovery wells using conventional LNAPL recovery technology, such as absorbent socks/pads, skimmer pumps, or by vacuum. All extracted oil/water will be containerized in 55-gallon drums or immediately into a vacuum truck. The recovered oil/water mixture that is stored in drums will be periodically removed using vacuum trucks and disposed of at a preapproved licensed disposal facility. Absorbent socks/pads will be replaced as needed, and used socks/pads will be containerized in 55-gallon drums storing investigation-derived waste.

If all recoverable LNAPL is not removed before the SMD system and new cellar slab are installed, the sumps will be converted to 4-inch-diameter recovery wells. The proposed recovery sump/well locations are shown on Figure 3.

2.1.8 Design Verification Investigation

2.1.8.1 Groundwater Sampling

CVOC-impacted groundwater will be addressed via in-situ remediation. During the IRM, pre-remediation baseline groundwater samples will be collected from six monitoring wells (MW05 through MW10). Monitoring wells will be purged and sampled in accordance with the EPA’s low-flow groundwater sampling procedure to allow for collection of a representative sample (“Low Stress [low flow] Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells”, EQASOP-GW 001, January 19, 2010). A submersible monsoon pump and dedicated polyethylene tubing will be used to purge the wells and collect the samples and the pump will be decontaminated with Alconox prior to sample collection.

Purging will consist of pumping a minimum volume equal to the stabilized drawdown volume plus the pump's tubing volume and waiting until the physical and chemical parameters (e.g., temperature, dissolved oxygen, oxygen reduction potential [ORP], turbidity, and pH) stabilized. Purge water and other investigation-derived waste will be containerized in 55-gallon drums in preparation for off-site disposal at a permitted waste disposal facility. After purging is complete, groundwater samples will be collected directly from the low-flow sampling pump discharge.

Five samples, plus required quality assurance/quality control (QA/QC) samples, will be collected. The sample bottles will be sealed, labeled, and placed in a cooler containing ice for delivery to a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified laboratory for analysis. The samples will be analyzed for Target Compound List (TCL) and NYSDEC Part 375 list VOCs using EPA Method 8260. Two samples (collected from MW10 and MW05) will be additionally analyzed for biomolecular parameters including quantitative polymerase chain reaction (qPCR) analysis of Dehalococcoides (DHC), Dehalobacter (DHB), TCE and VC reductase, and bacterial plate count. The Quality Assurance Project Plan (QAPP) is included as Appendix C, and the monitoring well locations are shown on Figure 2.

2.1.8.2 Soil Investigation

An environmental drilling subcontractor will advance up to three soil borings to further evaluate soil and collect samples to refine design assumptions of soil type and fraction organic carbon (foc). A plan showing the proposed boring locations is shown on Figure 4. A Langan engineer will document the work, screen the soil samples for environmental impacts, and collect environmental samples for laboratory analyses. Work will comply with the safety guidelines outlined in the CHASP (Appendix B).

The soil borings will be advanced to bedrock refusal using a direct push drill rig. Soil will be screened continuously to the boring termination depth for organic vapors with a PID equipped with a 10.6 electron volt (eV) bulb, and for visual and olfactory indications of environmental impacts (e.g., staining and odor). Soil descriptions will be recorded in a field log.

Up to two grab soil samples will be collected for laboratory analysis from within the groundwater table at each boring location. The samples will be collected in laboratory-supplied containers and will be sealed, labeled, and placed in a cooler containing ice (to maintain a temperature of approximately 4 degrees Celsius) for delivery to an NYSDOH ELAP-certified analytical laboratory. Soil samples will be analyzed for VOCs and TOC. QA/QC procedures to be followed are described in the QAPP provided as Appendix C.

2.1.9 In-Situ Groundwater Treatment

CVOC-impacted groundwater will be treated via temporary injection points with a combination of PlumeStop™ Liquid Activated Carbon™ and HRC®. PlumeStop™ has been shown to distribute widely under low injection pressures and will continue to provide sorption-based biodegradation for years after the initial application. The electron donor HRC® will also be applied to groundwater through the injection wells/points. Each injection will be conducted by using a direct-push drill rig to advance a hollow rod into the subsurface. The injected fluid enters the formation through a screened portion at the bottom of the hollow rod. PlumeStop™ will be injected first and will utilize a "top down" approach; HRC® will be injected after PlumeStop™ injection is complete using a "bottom up" approach. In a "top down" approach, injections begin at the top of the target treatment zone (TTZ) and continue as the hollow rod is driven into the subsurface. In a bottom up approach, the injection begins at the bottom of the targeted treatment interval, and continue as the hollow rod is lifted out of the borehole. Based on the findings of the RI, a single injection event is planned for treatment of CVOC-impacted groundwater.

The TTZ is based on groundwater sampling results from the RI, the groundwater flow direction, and the depth of the unconfined aquifer above bedrock. The TTZ encompasses an area of about 13,200 square feet and extends from about 5 to 18 feet below slab grade (bsg); however, the bottom of the TTZ will vary in areas where refusal is encountered at bedrock above 18 feet bsg. Upon completion of the injections, the boreholes will be backfilled to grade with grout.

The injection scope includes 53 temporary injection points, which are shown on Figure 4. At each injection point, about 760 gallons of PlumeStop™ and 6.3 gallons of HRC® will be injected. The injection scope is based on assumptions of foc, porosity, and soil density. These assumptions are based on the results of grain size analyses performed on the adjoining site to the south, and will be refined during the design verification investigation. Hydraulic conductivity was estimated based on data obtained from a slug test performed on the south-adjacent site, BCP Site No. C241152, and the hydraulic gradient was estimated based on two synoptic rounds of groundwater depth measurements. A design summary, including assumptions and approximate injection volumes, and a technical overview of PlumeStop™ are included in Appendix D.

2.1.10 In-Situ Groundwater Treatment Performance Monitoring

Post-injection groundwater samples will be collected from six monitoring wells (MW05 through MW10), with the first sampling event taking place about 30 days after the injections are completed. The samples will be submitted to an NYSDOH ELAP-certified laboratory for analysis of VOCs. A second sampling event will be conducted 90 days following the first post-injection sampling event. The Construction Completion Report will include results of the first two performance monitoring events.

After the second post-injection sampling event, groundwater monitoring will continue on a quarterly basis until the requirements of the RAWP and Site Management Plan (SMP) are met. The numbers of wells to be monitored may be reduced based on a review of the results and with the NYSDEC's written concurrence.

Any additional groundwater monitoring requirements will be addressed in the forthcoming RAWP and SMP.

2.1.11 Post-Excavation Confirmation Sampling

Post-excavation samples will be collected from the excavation sidewalls and bottom in accordance with NYSDEC DER-10 to evaluate soil/fill remaining in place. In the location of the known USTs, and in any location where unknown additional USTs are removed, five samples will be collected from each excavation and will consist of one sample per excavation sidewall and a sample from each excavation base. For the Site-wide excavation, confirmation soil sample collection would be completed from the excavation base at a frequency of one sample per 1,700 square feet, and no sidewall samples would be collected because the existing structure will prevent access to off-site soil. If additional excavation below the Site-wide excavation cut is required to remove grossly-impacted soil, confirmation samples will be collected at a frequency of one per 900 square-feet of base and one per 30 feet of sidewall.

Based on these criteria, about 18 base and 4 sidewall confirmation samples, plus required QA/QC samples, would be collected. Samples will be collected from areas with the greatest apparent contamination as evidenced by odors, staining, and/or PID readings. The Quality Assurance Project Plan is included as Appendix C. Proposed confirmation sample locations are shown on Figure 3.

Samples will be analyzed for Part 375 List VOCs, SVOCs and metals and compared to the Part 375 Commercial Use Soil Cleanup Objectives (SCO) and Protection of Groundwater SCOs. Protection of Groundwater SCOs will only apply to analytes that were detected in groundwater samples during the RI at concentrations above their respective TOGS Class GA SGVs. Additional excavation may be required by NYSDEC based on the results of confirmation samples; however, dewatering will not be conducted in support of remedial excavations. No off-site excavation is proposed. Soil samples will not be collected from locations saturated with groundwater.

2.1.12 Submembrane Depressurization System

Installation of SMD system components is included in the IRM. The SMD system design is conceptual at this stage, and a formal design will be included in the RAWP for public comment. The proposed SMD system layout is shown in Figure 5 and the draft design details are provided as Appendix E.

The cellar slab will be removed as part of this Plan, creating an opportunity to install the subslab portions of the SMD system. Prior to construction of the new cellar slab, the horizontal and riser stick-up piping, gravel permeation layer, and vapor barrier membrane will be installed to mitigate potential soil vapor intrusion into the planned building. The vapor barrier membrane will be a minimum of 20 mils thick and would be installed above the gravel permeation layer. The new cellar slab will be placed directly on top of the vapor barrier membrane.

The SMD system will be developed in general accordance with the New York State Department of Health (NYSDOH) October 2006 Guidance for Evaluation of Soil Vapor Intrusion in the State of New York and the New York City Mechanical Code Section MC 512 (2008). The final SMD system design will include a submembrane collection layer (a minimum 8-inch layer of ¾-inch clean stone) with horizontal perforated collection pipes, riser pipes to convey the collected vapor to the roof, and a roof-mounted blower system that will maintain a constant negative pressure through the piping and collection layer.

2.2 Remedial Activity Oversight

The implementation of the IRM will be overseen by a field engineer, geologist, or scientist under the supervision of the Remediation Engineer (RE). The RE is responsible for documenting that the contractor performs the work as specified in the IRM Work Plan and provides the proper documentation required by NYSDEC. These contractor documents will be submitted to the NYSDEC in the Construction Completion Report (CCR); which is described in Section 3.0.

The RE will provide full-time oversight of the IRM activities. The activities that occur during the IRM will be properly documented in monthly BCP progress reports and in the CCR as described in Section 3.0.

2.3 Soil Screening Methods

Visual, olfactory and instrumental soil screening and assessment will be performed by a field engineer, geologist, or scientist during excavations into known or potentially impacted material. Instrumental screening will be performed with a PID equipped with a 10.6 electron Volt (eV) bulb and will be calibrated daily.

2.4 Waste Characterization

Waste characterization samples will be collected from excavated material generated during implementation of the IRM per disposal facility requirements. This activity will be coordinated by the RE and overseen by a field engineer, geologist, or scientist under the supervision of the RE. Samples will be collected to be representative of the material requiring disposal at a frequency consistent with disposal facility requirements. Samples may be collected from stockpiled excavated materials.

Waste characterization samples will be submitted to an NYSDOH ELAP-certified laboratory for analysis in accordance with the QAPP provided in Appendix C. Excavated material will be transported off-site and disposed at a permitted facility.

2.5 Material Load Out and Transport

Non-hazardous material will be handled, transported and disposed of by a licensed hauler in accordance with applicable 6 NYCRR Part 360, General Provisions and 6 NYCRR Part 364, Waste Transporter Permits regulations and other applicable federal, state and local regulations. 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. Petroleum-impacted material will be transported by a waste removal contactor who possesses a valid New York State Part 364 Waste Transporter Permit. 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.

The field engineer, geologist, or scientist, under the supervision of the RE, will oversee the load-out of excavated material. Once the loading of a container, dump truck, or trailer has been completed, the material will be transported to the approved off-site disposal facility. Loaded vehicles leaving the Site will be appropriately lined, securely covered, and manifested in accordance with appropriate federal, state, local, and New York State Department of Transportation (NYSDOT) requirements (or other applicable transportation requirements). If loads contain wet material capable of producing free liquid, truck liners will be used. Queuing of trucks on adjacent streets will not be allowed.

A stabilized construction entrance will be maintained on-site. For the majority of IRM Work Plan scope, the construction entrance will consist of the existing concrete ramp in the northwestern corner. When the entrance ramp is removed, a stabilized construction entrance consisting of a gravel-based egress path will be maintained on site. Replacement of the gravel, as needed, will be performed to minimize the potential for the trucks to track soil off-site upon egress.

The RE will be responsible for ensuring that outbound trucks do not track soil off-site upon their departure. A truck wash/cleaning area will be constructed and operated as deemed necessary by the RE. In addition, the RE will be responsible for ensuring that all egress points for truck and equipment transport from the Site will be free of dirt and other materials derived from the Site during remediation and development. Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to Site-derived materials. Proposed inbound and outbound truck routes are shown on Figure 5.

2.6 Material Off-Site Disposal

The RE will review submittals for proposed disposal facilities 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 off-site disposal in accordance with receiving facility requirements and in conformance with applicable permits. Sampling and analytical methods, sampling frequency, analytical results and QA/QC methods will be reported in the CCR upon completion of the IRM and in the Final Engineering Report (FER) upon completion of the final remedy. All waste characterization data available for soil/material to be disposed at a given facility will be submitted to the disposal facility with suitable explanation prior to shipment and receipt.

2.7 Backfill Import and Placement

If necessary, excavation extending below the depth required to install the SMD system will be backfilled. It is anticipated that all excavated soil and soil cuttings will be transported and disposed of off-site.

Import material used to backfill the excavations will comply with DER-10 Section 5.4(e). If soil is imported, it will be sampled in accordance with Table 5.4(e)4 Reuse of Soil and analytical results will comply with the concentrations listed in DER-10, Appendix 5, for Restricted Residential Use. Gravel, rock or stone may be imported if it contains less than 10% by weight material which would pass through a size 80 sieve, contains no material greater than 4 inches in diameter, and is sourced from a permitted mine or quarry. Recycled concrete aggregate (RCA) may be imported if it contains less than 10% by weight material which would pass through a size 80 sieve and is sourced from an NYSDEC Part 360 registered facility. RCA and gravel, rock or stone will not require chemical testing as long as the above-listed requirements are met. Prior to its use on site, documentation regarding the source(s) of imported fill material must be provided to the NYSDEC Division of Environmental Remediation (DER) for approval in accordance with DER-10, Section 5.4(e)6.

Prior to its placement, imported material will be screened for evidence of contamination (visual, olfactory and instrument). Material from industrial sites, spill sites, other environmental remediation sites and/or other potentially impacted sites will not be imported to the Site. The import material will also meet applicable structural fill requirements. All materials proposed for import onto the Site will be approved by the RE and will be in compliance with provisions in this IRM Work Plan prior to receipt at the Site.

2.8 Dust, Odor, Vapor and Nuisance Control Plan

This dust, odor, organic vapor and nuisance control plan was developed in accordance with the NYSDOH Generic Community Air Monitoring Plan (CAMP) and Occupational Safety and Health Administration (OSHA) standards for construction (29 Code of Federal Regulations [CFR] 1926). Remediation and construction activities will be monitored for dust and odors by the RE's field engineer, scientist, or geologist. Continuous monitoring on the perimeter of the work zones for odor, VOCs, and dust will be required for all ground intrusive activities, such as soil excavation and handling activities.

The work zone is defined as the general area in which machinery is operating in support of remediation activities. A portable PID will be used to monitor the work zone during AST and UST removal and for periodic monitoring for VOCs during post-excavation soil sampling.

The Site perimeter will be monitored for fugitive dust emissions by visual observations as well as instrumentation measurements. Particulate or dust will be monitored continuously with real-time field instrumentation that will meet, at a minimum, the performance standards from DER-10 Appendix 1B.

Action levels for site worker respiratory use are set forth in Section 6.0 of the CHASP, included in Appendix B. Action levels for the protection of the community and visitors are discussed below in Section 2.7.1, and in the CAMP, which is included in Appendix F.

2.8.1 Dust, Odor and Vapor Control

Work practices to minimize odors and organic vapors include limiting the time that the excavations remain open, wetting exposed fill or soil, minimizing stockpiling of impacted-source soil, and minimizing the handling of impacted material. Offending odor and organic vapor controls may include the application of foam suppressants or tarps over the odor or petroleum source areas. Foam suppressants may include biodegradable foams that are applied over the source material for short-term control of the odor.

VOCs will be monitored with a handheld PID in accordance with the CHASP and CAMP. 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. Level C respiratory protection may be donned in accordance with the HASP if untrained personnel are not present and the action level is exceeded. The following actions will be taken based on VOC levels measured:

- If total VOC levels exceed 5 parts per million (ppm) above background for the 15-minute average at the perimeter, work activities will be temporarily halted and monitoring continued. If levels readily decrease (per instantaneous readings) below 5 ppm above background, work activities will resume with continued monitoring.

- If total VOC levels at the downwind perimeter of the hot zone persist at levels in excess of 5 ppm above background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps work activities will resume provided that the total organic vapor level 200 feet downwind of the hot zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less – but in no case less than 20 feet, is below 5 ppm above background for the 15-minute average.

- If the total VOC level is above 25 ppm at the perimeter of the hot zone, activities will be shut down.

The following actions will be taken based on visual observations and measured dust levels using a quantitative meter following minimum performance standards from DER-10 Appendix 1B:

- If the downwind particulate level is 100 µg/m³ greater than background (upwind perimeter) 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 downwind PM10 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, downwind PM10 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 downwind PM10 concentration to within 150 µg/m³ of the upwind level and in preventing visible dust migration.

This plan will be implemented to control emissions of VOCs and nuisance odors. Specific VOC and odor control methods to be used on a routine basis will include limiting the time that the excavations remain open, minimizing stockpiling of impacted-source soil, and minimizing the handling of impacted material. If nuisance odors or vapors exceeding action levels set forth in the IRM Work Plan are identified off-site, work will be halted and the source of odors will be identified and corrected. Work will not resume until all VOCs or nuisance odors 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 all odor and vapor controls, including the halting of work, will be the responsibility of the Remediation Contractor under the oversight of the RE, who is responsible for certifying the CCR.

2.9 Construction Health and Safety Plan

The RE prepared a site-specific CHASP for the IRM, which is included as Appendix B. The CHASP provides a mechanism for establishing on-site safe working conditions, safety organization, procedures, and personal protective equipment (PPE) 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). The HASP 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; and
- Material Safety Data Sheets.

2.10 Notification

The NYSDEC will be notified at least 7 calendar days prior to commencement of IRM-related work. A preconstruction meeting will be coordinated between the RE, the Remediation Contractor, and the NYSDEC. This meeting must be coordinated prior to the implementation of this IRM Work Plan.

3.0 REPORTING

Upon completion of the IRM, a CCR will be prepared and submitted to the NYSDEC. The RE responsible for certifying all reports will be an individual licensed to practice engineering in the State of New York. Jason J. Hayes, P.E. of Langan will have this responsibility. Should Mr. Hayes 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 as PDFs. Laboratory analytical data for documentation samples will be submitted in an electronic data deliverable (EDD) format that complies with the NYSDEC's electronic data warehouse standards.

3.1 Daily Reports

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

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

Daily reports are not intended to be the mode of communication for notification to the NYSDEC of emergencies (accident, spill), requests for changes to the IRM Work Plan or other sensitive or time critical information; however, such conditions will also be included in the daily reports. Emergency conditions and changes to the IRM Work Plan will be addressed directly to the NYSDEC Project Manager via personal communication. If site conditions warrant, the RE may request to change from daily to weekly reports that include the above information.

3.2 Monthly Progress Reports

Upon approval of the IRM Work Plan, monthly progress reports will be generated and submitted to the NYSDEC. Monthly progress reports are not intended to notify the NYSDEC of emergencies (accident, spill), request changes to the IRM Work Plan, or communicate other sensitive or time-critical information. Regardless, such conditions will also be included in the monthly progress reports. Emergency conditions and changes to the IRM will be communicated directly to the NYSDEC Project Manager. If Site conditions warrant, the RE may request to change from monthly to quarterly reports that include the above information. Monthly reports will include:

- A summary of significant activities undertaken during the reporting period;
- An update on pending/planned significant activities remaining;
- A discussion of any proposed scope or schedule revisions;
- A summary of any sampling conducted during the reporting period;
- A list of deliverables submitted during the reporting period;
- Information regarding the percentage of completion of the IRM Work Plan;
- An update on any unforeseen problems and/or delays, including a discussion of the proposed corrective action(s);
- A summary of Community Participation Plan activities during the reporting period; and
- A summary of any relevant miscellaneous information regarding site activities that do not fall under the above categories.

3.3 Construction Completion Report

A CCR will be submitted to the NYSDEC Project Managers within 120 days of completing the IRM. The CCR will document the implementation of the IRM. The CCR will be incorporated into and referenced in the FER for the Site when issued. 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 IRM Work Plan;
    c. Dust, odor, and vapor control measures were implemented during invasive work and conformed with the IRM Work Plan; and
    d. Remediation waste was transported and disposed in accordance with the IRM Work Plan.
    e. Source approval and sampling of imported acceptable fill (not anticipated) was completed in a manner consistent with the methodology of the IRM Work Plan;
2. Description of any problems encountered and their resolutions;
3. Description of changes in the IRM from the elements provided in the IRM Work Plan and associated design documents and the reasons for them;
4. Description of the deviations from the approved IRM Work Plan;

5. Listing of waste streams, quantity of materials disposed, and where they were disposed;
6. List of the remediation standards applied to the remedial actions;
7. Documentation NYSDEC Petroleum Bulk Storage PBS database registry and closure;
8. Affidavits of closure submitted to FDNY for all ASTs and USTs;
9. Description of source and quality of fill;
10. A summary of all residual impacted material left on the site;
11. A tabular summary of all sampling results and all material characterization results and other sampling and chemical analysis performed as part of the IRM;
12. Written and photographic documentation of all remedial work performed under this remedy;
13. Copies of all the submitted progress reports;
14. Certifications, manifests, and bills of lading for excavated materials transported off-site;
15. An accounting of the destination of all material removed from the site, including excavated impacted soil, historic fill, solid waste, hazardous waste, non-regulated material, and fluids; and
16. Documentation associated with disposal of all material must also include records and approvals for receipt of the material.

4.0 CERTIFICATION

I Jason J. Hayes, P.E. certify that I am currently a NYS registered professional engineer as defined in 6 NYCRR Part 375 and that this Interim Remedial Measure 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).

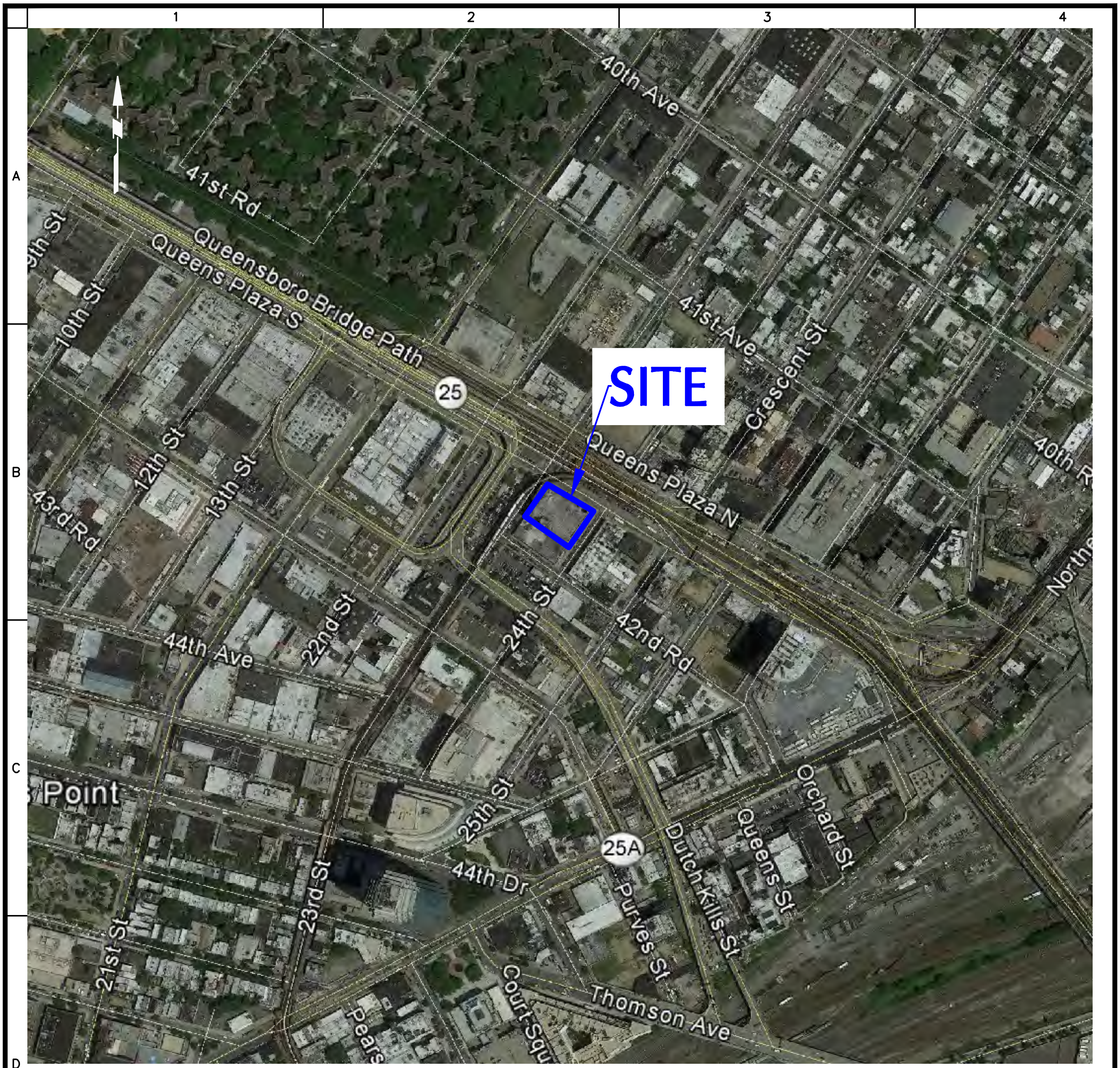
JASON JAMES HAYES
089491

4/2015

Jason J. Hayes, P.E.

NYS P.E. # 089491

FIGURES



LEGEND:

▱ SITE BOUNDARY

NOTES:

1. BASE MAP TAKEN FROM GOOGLE EARTH (IMAGE DATE 6/2/2011)

LANGAN

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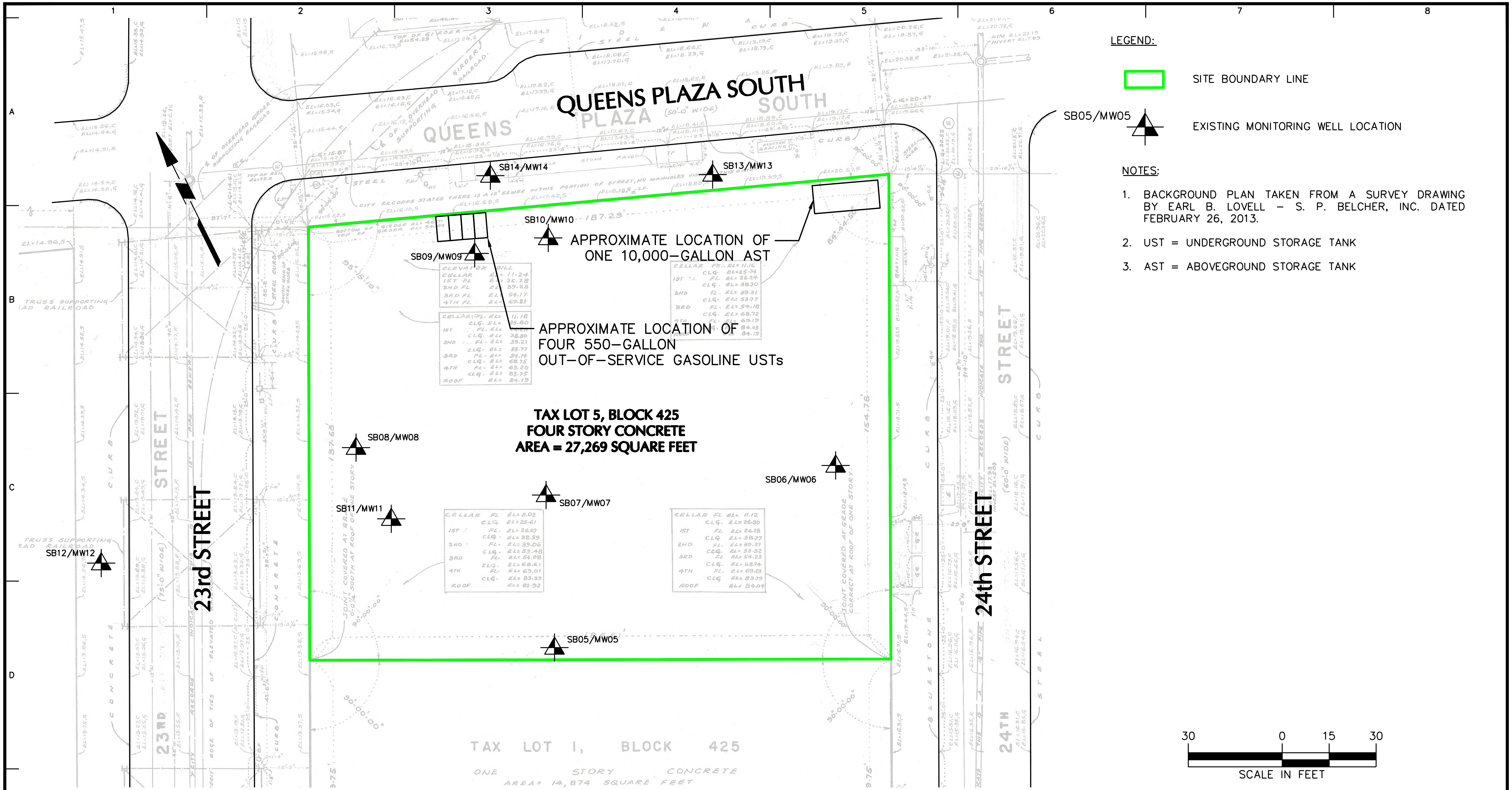
Project	23-10 QUEENS PLAZA SOUTH BLOCK No. 425, LOT No. 5 LONG ISLAND CITY QUEENS NEW YORK
Figure Title	SITE LOCATION MAP
Project No.	170244603
Date	5/26/2015
Scale	NTS
Drawn By	PM
Submission Date	-
Figure No.	1
Sheet	1 of 6

Filename: \\langan.com\data\NY\data6\170244601\Cadd Data - 170244601\2D-DesignFiles\Environmental\IRM WP\23-10 QPS\Figure 1 - Site Location Map - revised.dwg Date: 7/1/2015 Time: 16:55 User: pmcmahon Style Table: Langan.stb Layout: ANSIA-BP



LEGEND:

🟩	SITE BOUNDARY LINE
SB05/MW05	EXISTING MONITORING WELL LOCATION

NOTES:

1. BACKGROUND PLAN TAKEN FROM A SURVEY DRAWING BY EARL B. LOVELL – S. P. BELCHER, INC. DATED FEBRUARY 26, 2013.
2. UST = UNDERGROUND STORAGE TANK
3. AST = ABOVEGROUND STORAGE TANK

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.

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23-10 QUEENS PLAZA SOUTH

BLOCK No. 425, LOT No. 5
LONG ISLAND CITY
QUEENS NEW YORK

Figure Title

SITE PLAN

Project No.
170244603

Date
01/06/2013

Scale
1" = 30'

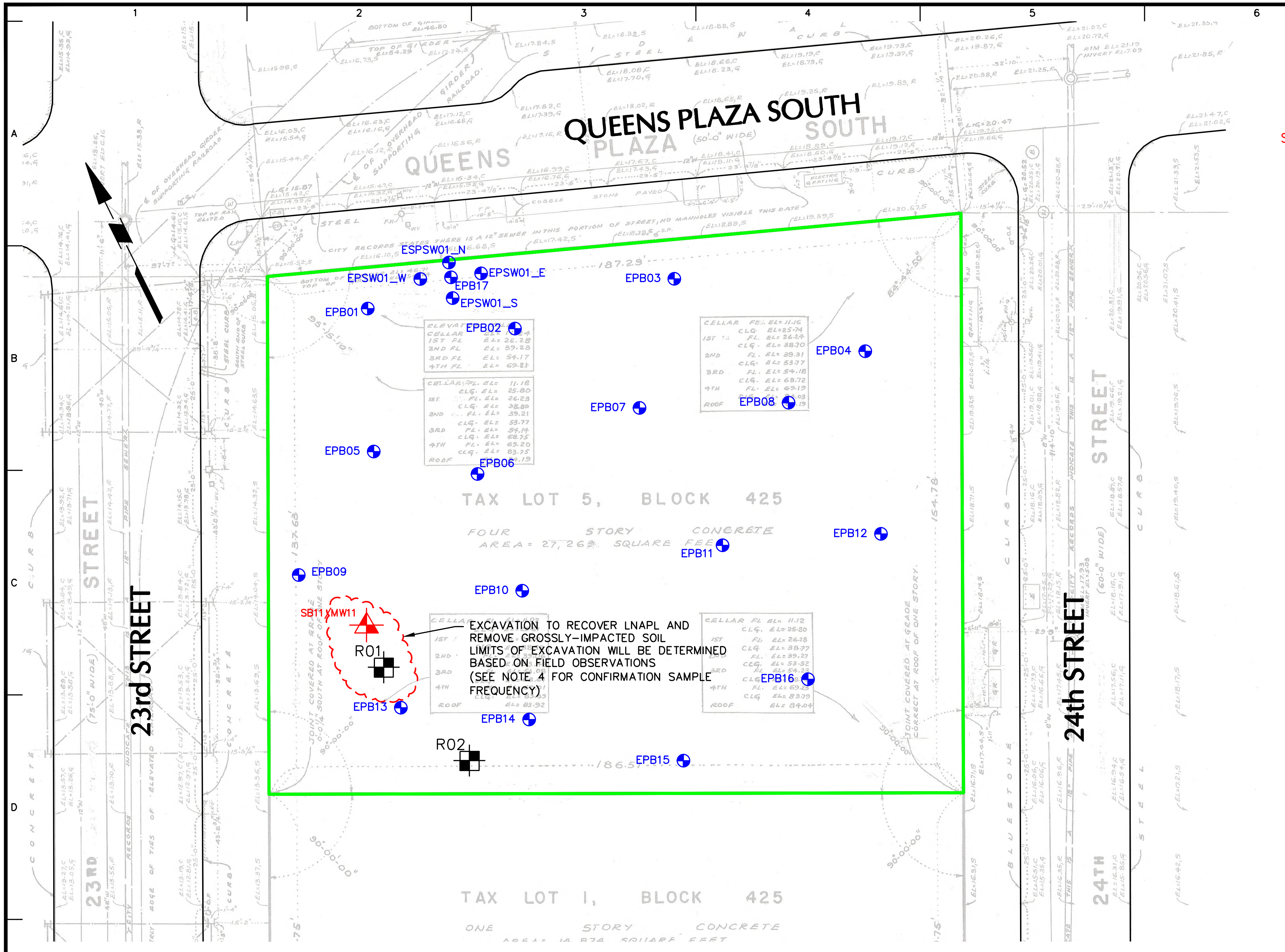
Drawn By
PMM

Submission Date
–

Figure No.
2

Sheet 2 of 6

Filename: \\langan.com\data\NY\data6\170244601\Cadd Data - 170244601\2D-DesignFiles\Environmental\IRM WP\23-10 QPS\Figure 2 -Site Plan.dwg Date: 7/1/2015 Time: 16:58 User: pmcmahon Style Table: Langan.stb Layout: ANSIB-BL



EXCAVATION TO RECOVER LNAPL AND REMOVE GROSSLY-IMPACTED SOIL LIMITS OF EXCAVATION WILL BE DETERMINED BASED ON FIELD OBSERVATIONS (SEE NOTE 4 FOR CONFIRMATION SAMPLE FREQUENCY)

LEGEND:

🟩	SITE BOUNDARY LINE
SB11/MW11 ▲	MONITORING WELL WHERE LNAPL WAS OBSERVED
R01 ▚	PROPOSED RECOVERY SUMP/WELL LOCATION
EPB01 ⊕	PROPOSED CONFIRMATION SAMPLE LOCATION
◌	EXCAVATION AREA

NOTES:

1. BACKGROUND PLAN TAKEN FROM A SURVEY DRAWING BY EARL B. LOVELL – S. P. BELCHER, INC. DATED FEBRUARY 26, 2013.
2. IF RECOVERABLE LNAPL REMAINS IN A RECOVERY SUMP WHEN THE NEW CELLAR SLAB WILL BE PLACED, THE SUMP WILL BE CONVERTED TO A RECOVERY WELL.
3. ADDITIONAL CONFIRMATION SAMPLES WILL BE COLLECTED AS NEEDED FOR DISCOVERED UNDERGROUND STORAGE TANKS IN ACCORDANCE WITH DER-10 SECTION 5.5 UNDERGROUND STORAGE TANK CLOSURE.
4. IF DEEPER EXCAVATIONS ARE CONDUCTED TO REMOVE GROSSLY-IMPACTED SOIL, ADDITIONAL BASE OF EXCAVATION SAMPLES AND SIDEWALL SAMPLES WILL BE COLLECTED AT RATES OF 1 PER 900 SQUARE FEET AND 1 PER 30 FEET, RESPECTIVELY.
5. LNAPL = LIGHT NON-AQUEOUS PHASE LIQUID

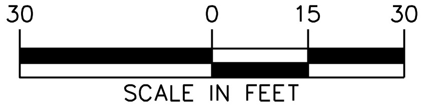


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Figure Title

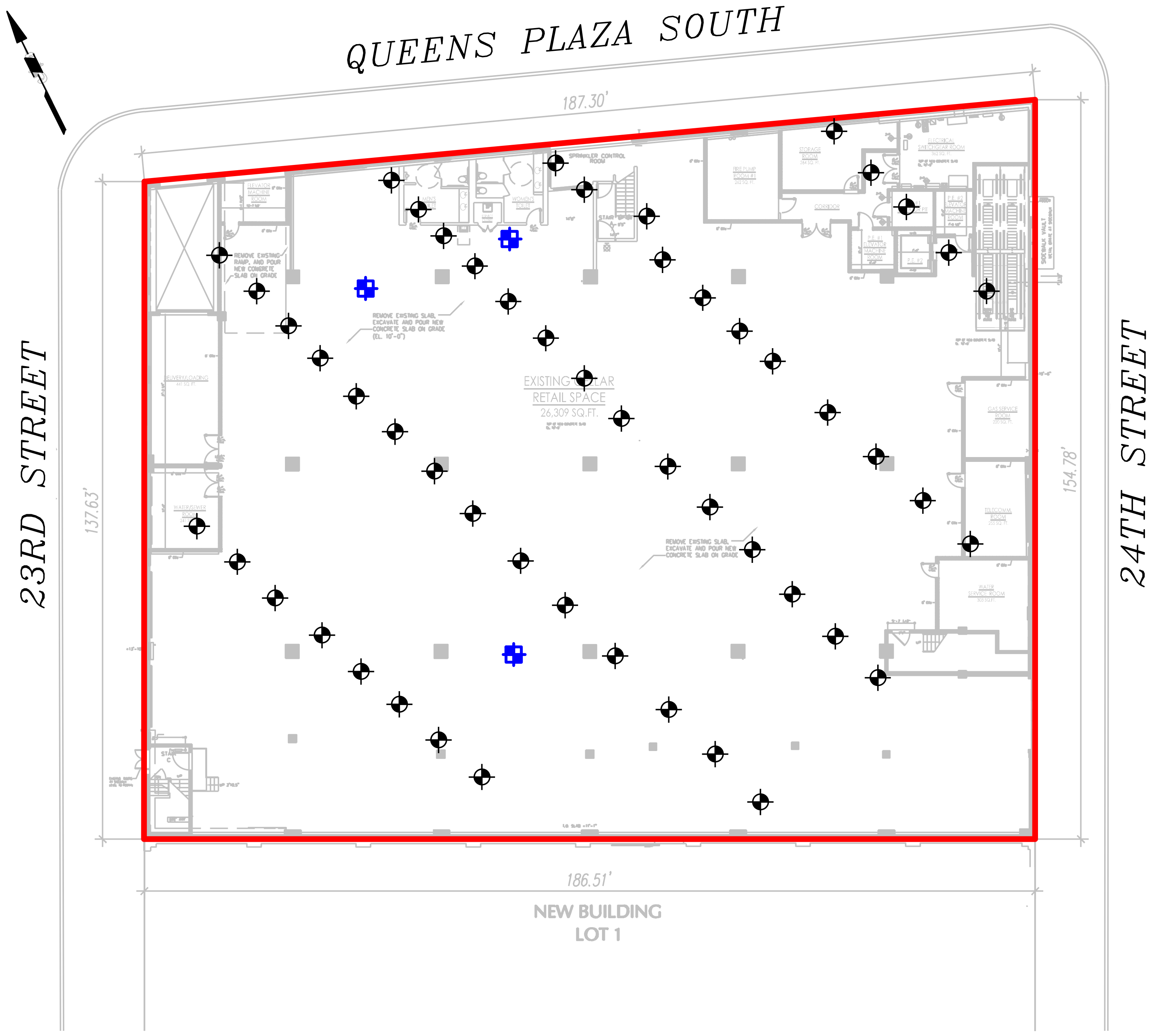
RECOVERY SUMP AND CONFIRMATION SAMPLE LOCATION PLAN

Project No. 170244603
Date 06/11/2015
Scale 1" = 30'
Drawn By PMM
Submission Date –

Figure No. 3

Sheet 3 of 6

Filename: \\Langan.com\data\NY\data6\170244601\Cadd Data - 170244601\2D-DesignFiles\Environmental\IRM WP\23-10 QPS\Figure 3 - Recovery Sump and Documentation Sample Location Plan.dwg Date: 8/13/2015 Time: 17:20 User: pmcmahon Style Table: Langan.stb Layout: ANSIB-BL



LEGEND:

🟥 SITE BOUNDARY

⊕ PROPOSED INJECTION POINT LOCATION

🟦 DESIGN VERIFICATION BORING

NOTES:

1. BASE MAP TAKEN FROM DeSIMONE STRUCTURAL ENGINEERS, "FOUNDATION PLAN, FO-101", DATED AUGUST 15, 2013.
2. INJECTIONS WILL BE CONDUCTED USING A DIRECT-PUSH DRILL RIG.
3. THE INJECTION DEPTH INTERVAL IS ABOUT 5 TO 18 FEET BELOW SLAB GRADE (ABOUT ELEVATION 6 FEET QHD TO -7 FEET QHD).
4. DESIGN VERIFICATION BORINGS WILL BE ADVANCED TO BEDROCK REFUSAL WITH A DIRECT-PUSH DRILL RIG.
5. SLAB GRADE IS ABOUT ELEVATION 11 FEET QHD.
6. QHD = QUEENS HIGHWAY DATUM

30 0 15 30
SCALE IN FEET

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QUEENS NEW YORK

Figure Title

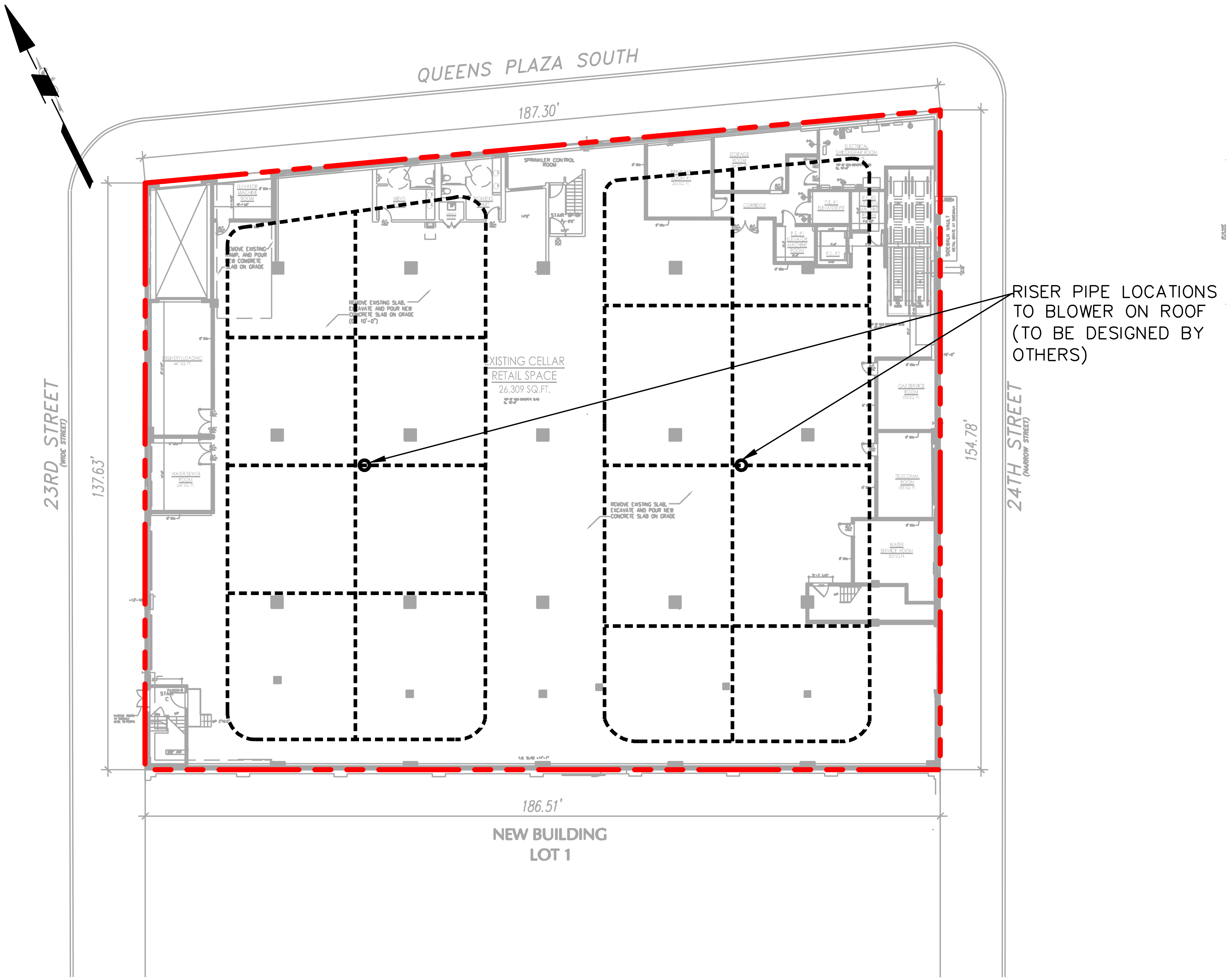
PROPOSED INJECTION POINT LOCATION PLAN

Project No. 170244603
Date 06/30/2015
Scale 1" = 30'
Drawn By PTF
Submission Date

Figure No.
4

Sheet 4 of 6

Filename: \\langan.com\data\NY\data6\170244601\Cadd Data - 170244601\2D-DesignFiles\Environmental\IRM WP\23-10 QPS\Figure 4 - Proposed Injection Point Location Plan.dwg Date: 7/2/2015 Time: 16:29 User: pfarnham Style Table: Langan.stb Layout: ANSIB-BL



LEGEND:

▬	SITE BOUNDARY AND VAPOR BARRIER EXTENT
- - - -	4-INCH DIAMETER VAPOR COLLECTION PIPE
○	APPROXIMATE RISER PIPE LOCATIONS (LOCATIONS TO BE COORDINATED WITH PROJECT TEAM [e.g., ARCHITECT, MEP])

GENERAL NOTES:

1. BASE MAP TAKEN FROM DeSIMONE STRUCTURAL ENGINEERS, "FOUNDATION PLAN, FO-101", DATED AUGUST 15, 2013.
2. VAPOR COLLECTION PIPE RUNS ARE APPROXIMATE. PIPE LOCATIONS ARE SUBJECT TO CHANGE PER EVALUATION OF FOUNDATION AND SUBSURFACE UTILITY DRAWINGS (WHEN PROVIDED TO LANGAN) AND PER FIELD CONDITIONS.
3. RISER PIPE STUB LOCATIONS ARE APPROXIMATE. RISER PIPE RUNS AND ROOF-TOP BLOWER AND EXHAUST POINTS TO BE DESIGNED BY OTHERS.
4. SUBMEMBRANE DEPRESSURIZATION SYSTEM (SMD) DETAILS FOR THE SUBMEMBRANE COMPONENTS AND RISER STICK-UP ARE INCLUDED IN APPENDIX E.

DRAFT

30 0 15 30
SCALE IN FEET

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QUEENS NEW YORK

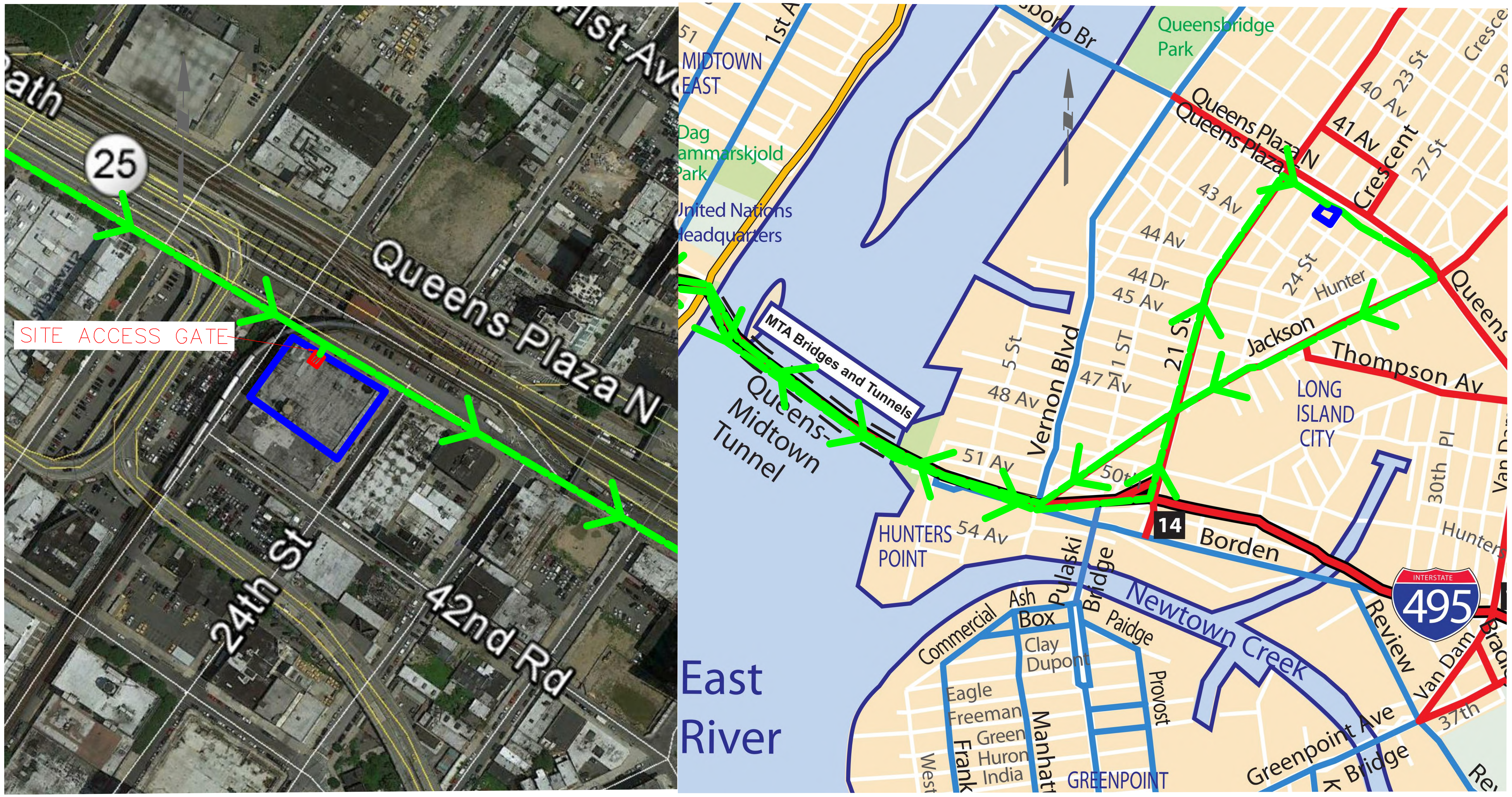
Figure Title
SUBMEMBRANE DEPRESSURIZATION SYSTEM LAYOUT PLAN

Project No. 170244603
Date 6/23/2015
Scale 1" = 30'
Drawn By PMM
Submission Date

Figure No. 5

Sheet 5 of 6

Filename: \\langan.com\data\NY\data6\170244601\Cadd Data - 170244601\2D-DesignFiles\Environmental\IRM WP\23-10 QPS\Figure 8 - Submembrane Depressurization System Layout - rev.dwg Date: 7/31/2015 Time: 17:12 User: pmcmahon Style Table: Langan.stb Layout: ANSIB-BL



LEGEND:

🟦	APPROXIMATE SITE BOUNDARY
🟥	THROUGH TRUCK ROUTE
🟩	TRUCK ROUTE

NOTES:

1. TRUCK ROUTE MAP ADAPTED FROM THE NEW YORK CITY DEPARTMENT OF TRANSPORTATION (NYCDOT) 2011-2012 NEW YORK CITY TRUCK ROUTE MAP ON JULY 9, 2014.
2. AERIAL MAP FROM GOOGLE EARTH IMAGE DATED JUNE 2, 2011.
3. SITE ACCESS GATE LOCATION MAY CHANGE BASED ON CONSTRUCTION LOGISTICS.

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LONG ISLAND CITY
QUEENS NEW YORK

Figure Title
TRUCK ROUTE MAP

Project No. 170244603
Date 5/26/2015
Scale N.T.S
Drawn By PMM
Submission Date

Figure No.
6

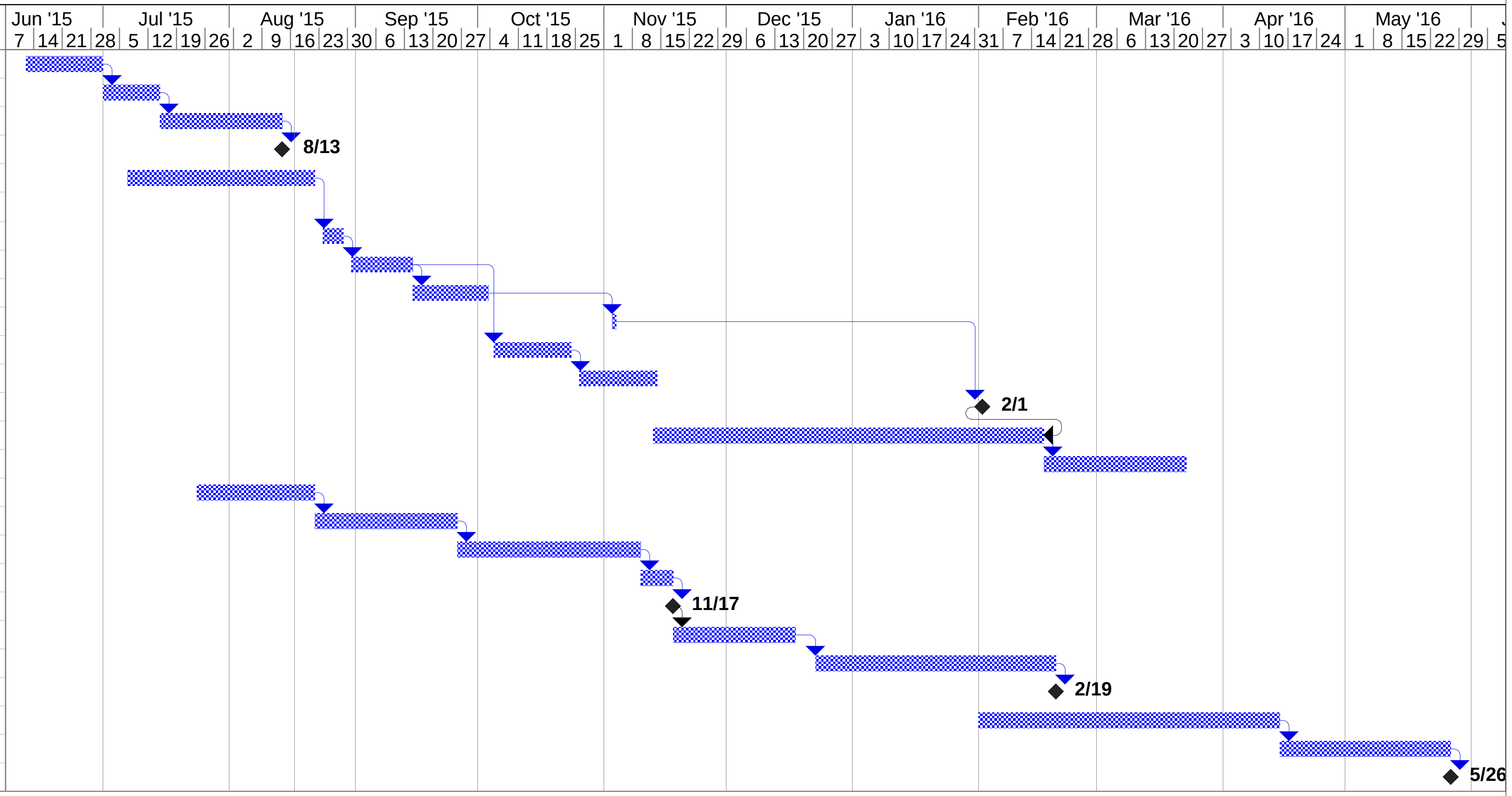
Sheet 6 of 6

Filename: \\langan.com\data\NY\data6\170244601\Cadd Data - 170244601\2D-DesignFiles\Environmental\IRM WP\23-10 QPS\Figure 6.Truck Route Map.dwg Date: 7/1/2015 Time: 16:00 User: pmcmahon Style Table: Langan.stb Layout: ANSIB-BL

APPENDIX A
REMEDIATION SCHEDULE

Appendix A
23-10 Queens Plaza South
Estimated Remediation Schedule

ID	Task Name	Duration	Start	Finish
1	NYSDEC and NYSDOH Review of IRMWP	19 days	Fri 6/12/15	Tue 6/30/15
2	Revise and Resubmit IRMWP	14 days	Wed 7/1/15	Tue 7/14/15
3	30-Day Public Comment Period	30 days	Wed 7/15/15	Thu 8/13/15
4	NYSDEC Approves IRMWP	0 days	Thu 8/13/15	Thu 8/13/15
5	Bid Support and Constuction Documents	46 days	Tue 7/7/15	Fri 8/21/15
6	**IRM Implementation**	212 days	Mon 8/24/15	Tue 3/22/16
7	Site Preparation and AST Removal	5 days	Mon 8/24/15	Fri 8/28/15
8	Cellar Slab Demolition (Start in MW11 vicinity)	15 days	Mon 8/31/15	Mon 9/14/15
9	Design Verification Sampling and Remedial Injections	19 days	Tue 9/15/15	Sat 10/3/15
10	30-day Remediation Performance Monitoring Event	1 day	Tue 11/3/15	Tue 11/3/15
11	UST Removal, Excavations, and Documentation Sampling	19 days	Mon 10/5/15	Fri 10/23/15
12	Backfill and Install SMD System Piping and Gravel Layer	19 days	Mon 10/26/15	Fri 11/13/15
13	90-Day Remediation Performance Monitoring Event	0 days	Mon 2/1/16	Mon 2/1/16
14	Construction Completion Report (CCR) Preparation	96 days	Fri 11/13/15	Tue 2/16/16
15	NYSDEC Review and Approval of CCR	35 days	Wed 2/17/16	Tue 3/22/16
16	RAWP	29 days	Fri 7/24/15	Fri 8/21/15
17	NYSDEC Review of RAWP	35 days	Sat 8/22/15	Fri 9/25/15
18	45-day RAWP Public Comment Period	45 days	Sat 9/26/15	Mon 11/9/15
19	NYSDEC Approves RAWP and Issues Decision Document	8 days	Tue 11/10/15	Tue 11/17/15
20	Construction Notice Fact Sheet	0 days	Tue 11/17/15	Tue 11/17/15
21	Bid Support and Construction Documents	30 days	Wed 11/18/15	Thu 12/17/15
22	RAWP Implementation	59 days	Wed 12/23/15	Fri 2/19/16
23	Construction and RAWP Implementation Completed	0 days	Fri 2/19/16	Fri 2/19/16
24	Final Engineering Report and Site Management Plan	74 days	Mon 2/1/16	Thu 4/14/16
25	NYSDEC Review and Approval of FER and SMP	42 days	Fri 4/15/16	Thu 5/26/16
26	Certificate of Completion	0 days	Thu 5/26/16	Thu 5/26/16



Project: 23-10 Queens Plaza South Remediation | Task ▨ | Milestone ◆ | Summary ▬

APPENDIX B
CONSTRUCTION HEALTH AND SAFETY PLAN

CONSTRUCTION HEALTH AND SAFETY PLAN
23-10 QUEENS PLAZA SOUTH

23-10 QUEENS PLAZA SOUTH
NYC Tax Block 425, Lot 5
New York, NY 11101

Prepared for:

QPS 23-10 Developer LLC
Property Markets Group
111 Fifth Avenue, 6th Floor
New York, NY 10003

Prepared by:

LANGAN
21 Penn Plaza
360 West 31st Street, 8th Floor
New York, New York 10001

June 10, 2015
170244603

LANGAN

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***** Items to be posted prominently on site, or made readily available to personnel.

1.0 INTRODUCTION

1.1 General

This Construction Health and Safety Plan (CHASP) has been developed by Langan to comply with Occupational Safety and Health Administration (OSHA) Standard 29 CFR 1910.120(b)(4), *Hazardous Waste Operations and Emergency Response*. This CHASP addresses all of the foreseeable activities to be conducted at 23-10 Queens Plaza South, Long Island City, New York. This CHASP will be implemented by Langan personnel while on site. Compliance with this CHASP is required of all Langan personnel.

The management of the day-to-day site activities and implementation of this CHASP in the field is the responsibility of the site Health and Safety Officer (HSO). Assistance in the implementation of this CHASP can also be obtained from the Langan Health and Safety Manager (HSM). The content of this CHASP may change or undergo revision based upon additional information made available to health and safety personnel, monitoring results, or changes in the scope of work.

1.2 Site Location and Background

The project site (Block 425, Lot 5) is located at 23-10 Queens Plaza South in the County of Queens, Long Island City, New York and consists of a rectangular lot. In a survey prepared by Earl B. Lovell – S.P. Belchar Inc. dated February 26, 2013, the site area was reported to be 27,269 square feet. A site location map is included as Figure 1. The site is on the city block bordered by Queens Plaza South to the north, 24th Street to the east, 42nd Road to the south, and 23rd Street to the west. The site is improved with a four-story building with a basement and partial sub-basement that is currently partially vacant and partically used as a field office for the construction on the adjacent Lot 1.

Ground surface elevations were obtained from a survey drawing by Earl B. Lovell – S. P. Belcher, Inc. dated February 26, 2013. Elevations presented herein are measured in feet and relative to the Queens Highway Datum (QHD), which is 1.625 feet below the North American Vertical Datum of 1988 (NAVD88).

The top of the basement slab in the Site building is at about el 11.0. Depths in this report are given in feet below slab grade (bsg), which refers to the depth below the top of the basement slab. Sidewalk grades generally increase from the southwest corner to the northeast corner. Sidewalk grades along 23rd Street range from about el 13.4 at the southwest corner to about el 15.5 at the northwest corner. Sidewalk grades along Queens Plaza South range from about el 15.5 at the northwest corner to about el 20.6 at the northeast corner. Sidewalk grades along 24th street range from about el 20.6 at the northeast corner to about el 16.7 at the southeast corner.

The redevelopment of the site includes the renovation of the existing structure and conversion into a commercial parking lot and office space. The cellar will be used for commercial space, the first and second floors will be used for parking and an office lobby, and the third and fourth floors will be office space. The site is in an area primarily characterized by mixed commercial and industrial use with light residential use.

1.3 Summary of Work Tasks

All work will be performed inside the cellar of the site building. Access to work areas will be limited to authorized personnel only. The general categories of work tasks being performed by Langan include:

1.3.1 Provide oversight of handling, loading and off-site transport of historical fill and petroleum-impacted soil

Task includes documentation of Part 364 permit compliance for transport vehicles and permit/registrations for disposal facilities pursuant to soil excavation to up to 23 feet below grade (fbg). Task may also include signing non-hazardous waste manifesting on behalf of the owner is such request is stated in writing.

1.3.2 Conduct air monitoring during earthwork activities in accordance with the Community Air Monitoring Plan (CAMP)

CAMP will include perimeter monitoring for dust, odor and volatile organic compounds. Langan will identify and provide suggestions for mitigation measures to address exceedances of particulate or organic vapor concentration thresholds. Two dust and organic vapor monitoring stations will be installed to continuously collect data and the field engineer will be equipped with a handheld dust and organic vapor meters.

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The CAMP is included in Appendix F of the Interim Remedial Measures Work plan. CAMP will include perimeter monitoring for dust, odor and volatile organic compounds. Langan will identify and provide suggestions for mitigation measures to address exceedances of particulate or organic vapor concentration thresholds. Two dust and organic vapor monitoring stations will be installed to continuously collect data and the field engineer will be equipped with a handheld dust and organic vapor meters.

1.3.3 Monitoring of fill import procedures (as required)

Task will also include review of Contractor submittals to document that only clean backfill material is brought to the site. The task may involve periodic surveying of clean fill material with a photoionization detector (PID).

1.3.4 Documentation of contingency measures should free petroleum product or unknown USTs be encountered

Task includes the overseeing the removal of any tanks (and piping or other associated equipment) encountered (although none are anticipated). USTs will be cleaned, removed and disposed of in accordance with accepted industry standards and applicable federal, state, and local regulatory agency requirements. Petroleum impacted soil will be segregating for subsequent off-site disposal in accordance with applicable federal, state, and local regulatory agency requirements.

1.3.5 Collection of post-excavation endpoint documention soil samples

Task involves the collection of endpoint soil samples for laboratory analysis as specified in the Interim Remedial Measures Work Plan.

1.3.6 Oversee well installation

Task involves overseeing the Contractor’s installation of the monitoring and injection wells, pumps, and related piping.

1.3.7 Oversee the placement of fill to foundation construction grade

Task involves overseeing the placement of fill to foundation construction grade and the Contractor’s installation of the monitoring and injection wells, pumps, and related piping that will be located in the footprint of the proposed building.

1.3.8 Oversee the Contractor’s installation of the access vault for monitoring and injection wells

Task involves overseeing the Contractor’s installation of the access vault for the monitoring and injection wells.

2.0 IDENTIFICATION OF KEY PERSONNEL/HEALTH AND SAFETY PERSONNEL

The following briefly describes the health and safety (H&S) designations and general responsibilities that may be employed for this site. The titles have been established to accommodate the project needs and requirements and insure the safe conduct of site activities. The H&S personnel requirements for a given work location are based upon the proposed site activities.

2.1 Langan Project Manager (PM)

The Langan Project Manager (PM) is Gerald Nicholls. His responsibilities include:

- Ensuring that this CHASP 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 CHASP.

2.2 Langan Corporate Health and Safety Manager (HSM)

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

- Updating the *Health and Safety Program for Hazardous Waste Operations*.
- Assisting the site Health and Safety Officer (HSO) with development of the CHASP, updating CHASP as dictated by changing conditions, jobsite inspection results, etc. and approving changes to this CHASP.
- Assisting the HSO in the implementation of this CHASP and conducting Jobsite Safety Inspections and assisting with communication of results and correction of shortcomings found.
- Maintaining records on personnel (medical evaluation results, training and certifications, accident investigation results, etc.).

2.3 Langan Site Health & Safety Officer (HSO)

The Langan site Health and Safety Officer (HSO) is Paul McMahon. The Site HSO responsibilities include:

- Participating in the development and implementation of this CHASP.

- The management of the day-to-day site activities and implementation of this CHASP in the field
- Conducting Tailgate Safety Meetings and Jobsite Safety Inspections and correcting any shortcomings in a timely manner.
- Ensuring that proper PPE is available, worn by employees and properly stored and maintained.
- Controlling entry into and exit from the site contaminated areas or zones.
- Monitoring employees 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.
- Resolving conflicts that may arise concerning safety requirements and working conditions.
- Reporting all incidents, injuries and near misses to the Langan Incident/Injury Hotline immediately and the client representative.

2.4 Subcontractor Responsibilities

- No Langan Subcontractors are being used on this site.

3.0 TASK/OPERATION SAFETY AND HEALTH RISK ANALYSES

This section provides an assessment of the general hazards that may be encountered during field work activities at the site through a task-by-task risk analysis. Potential hazards, generally categorized as chemical exposure and physical hazards are addressed below.

3.1 Chemical Exposure Hazards

Known and suspected chemical contaminant hazards that could be encountered during site operations are detailed in Table 1, Part A. A complete inventory of material safety data sheets (MSDS) for chemical products used on site can be found in Appendix E.

3.2 Physical Hazards

Physical hazards, which may be encountered during site operations for this project, are detailed in Table 1, Part B.

3.3 Task-By-Task Risk Analysis

Through information gathering, inspection, and monitoring, hazards that are potentially present have been determined for each specific task described in Table 1. This table provides a summary of chemical exposure and physical hazards that could potentially be encountered by personnel during each task effort.

3.4 Job Safety Analysis

A Job Safety Analysis (JSA) is a process to identify existing and potential hazards associated with each job or task so these hazards can be eliminated, controlled or minimized. A JSA will be performed at the beginning of each work day, and additionally whenever an employee begins a new task or moves to a new location. All JSA must be developed and reviewed by all parties involved. A blank JSA form and documentation of completed JSAs are in Appendix G.

4.0 PERSONNEL TRAINING

4.1 Basic Training

Completion of an initial 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training program as detailed in OSHA's 29 CFR 1910.120(e) is required for all Langan and Langan-subcontractor employees who will perform work in areas where the potential for a toxic exposure exists. Annual eight-hour refresher training is also required to maintain competencies to ensure a safe work environment. In addition to these training requirements, supervisory personnel must also receive eight additional hours of specialized management training. Training records are maintained by the HSM.

4.2 Initial Site-Specific Training

Training will be provided to specifically address the activities, procedures, monitoring, and equipment for site operations at the beginning of each field mobilization and the beginning of each discrete phase of work. The training will include the site and facility layout, hazards, and emergency services at the site, and will detail all the provisions contained within this CHASP. Specific issues that will be addressed include the hazards described in Section 3.0.

4.3 Tailgate Safety Briefings

Before starting work each day or as needed, the Langan HSO will conduct a brief tailgate safety briefing meeting to assist site personnel in conducting their activities safely. Tailgate meetings will be documented using the Tailgate Safety Briefing template in Appendix H. Briefings will include the following:

- Scope of work for the day,
- Review of safety information relevant to planned tasks and environmental conditions
- New activities/task being conducted;
- Results of Jobsite Safety Inspection Checklist;
- Changes in work practices;
- Safe work practices; and
- Discussion and remedies for noted or observed deficiencies.

5.0 MEDICAL SURVEILLANCE

5.1 Fitness for Duty

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 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.

Additionally, personnel who may be required to perform work while wearing a respirator must receive medical clearance as required under CFR 1910.134(e), *Respiratory Protection*. Again, 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 the HSM.

6.0 AIR MONITORING

6.1 General

In many instances, it will be necessary to monitor the atmospheric conditions during on-site work activities to identify and quantify airborne contaminants; to assist in defining work zones; and, to determine the level of work protection needed. Air monitoring will be performed wherever the possibility of worker exposure to hazardous substances exists. Air monitoring will be performed at the worker's breathing zone. Upgrades/downgrades to personal protective equipment (PPE) will be made based on air monitoring results in the breathing zone. The Air monitoring device will be calibrated daily and readings will be recorded in the field log or in Appendix D.

6.2 Action Levels

Photoionization detectors (PIDs) and particulate (dust) monitors will be used to evaluate action levels during investigation activities. Table 2 provides a summary explanation of available monitoring equipment.

Breathing zone readings should be taken at the start of work in all areas each day, as well as during the excavation, and frequently whenever strong odors are detected. Before any field activities commence, the background levels of the site will be monitored and recorded away from the areas of potential contamination to representative conditions. Action levels for monitored gases based on PID readings are provided in Table 3.

Work will be stopped immediately and crews will remove themselves to fresh air if workers are experiencing potential acute physical symptoms of exposure such as irritation, nausea, drowsiness or headache. Work will not recommence in the area until reasoning for irritation is determined and appropriate control measures have been taken.

7.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

7.1 Levels of Protection

Langan will provide PPE to workers to protect them 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 the level of protection will be based on continuous air monitoring results as described in Section 6.0. The decision to modify standard PPE will be made by the site HSO after conferring with the PM. The levels of protection are described below.

Level D Protection (as needed)

- Safety glasses with side shields or chemical splash goggles.
- Safety boots/shoes
- Coveralls (Tyvek® or equivalent)
- Hard hat
- Long sleeve work shirt and work pants
- Nitrile gloves
- Hearing protection
- Reflective safety vest

Level C Protection (as needed)

- Full or Half face, air-purifying respirator, with NIOSH approved HEPA filter
- Inner (latex) and outer (nitrile) chemical-resistant gloves.
- Safety glasses with side shields or chemical splash goggles.
- Chemical-resistant safety boots/shoes
- Hard hat
- Long sleeve work shirt and work pants
- Coveralls (Tyvek® or equivalent)
- Hearing protection (as needed)
- Reflective safety vest

The action levels used in determining the necessary levels of respiratory protection and upgrading to Level C are summarized in Table 3. The written Respiratory Protection Program is maintained by the HSM and is available if needed. The monitoring procedures and equipment are outlined in Section 6.0.

7.2 Respirator Fit-Test

All Langan employees who may be exposed to hazardous substances at the work site are in possession of a full or half face-piece, air-purifying respirator and have been successfully fit-tested within the past year. Fit-test records are maintained by the HSM.

8.0 SITE CONTROL

8.1 Site Communications Plan

Verbal communications will be the primary method of communication used at the site during the remedial action/remedial investigation and routine groundwater monitoring work. Cell phones shall be used to the extent practical. In the instances where verbal communication cannot be used, such as when working in respiratory protective equipment, hand signals will be used. Hand signals will be covered during site-specific training. Hand signals and their messages:

Hand Signal	Meaning
Hand gripping throat	Out of air; cannot breathe
Grip partners wrists or place both hands around waist	Leave immediately without debate
Hands on top of head	Need assistance
Thumbs up	OK; I'm alright; I understand
Thumbs down	No; negative
Simulated "stick" break with fists	Take a break; stop work

8.2 Work Zones

The need to formally establish specific work zones (Support, Contamination Reduction, and Exclusion Zones) during site activities will be determined by the HSO. A general description of these work zones is provided in Figure 2. It is important for the safety of all concerned that appropriate barriers (cones, wooden horses, plastic fencing etc.) are in place to keep vehicles and pedestrians away from the Work Zone.

8.3 The Buddy System

When working in teams of two or more, workers will use the "buddy system" for all work activities to ensure that rapid assistance can be provided in the event of an emergency. This requires work groups to be organized such that workers can remain close together and maintain visual contact with one another. Workers using the "buddy system" have the following responsibilities:

- Provide his/her partner with assistance.
- Observe his/her partner for signs of chemical or heat exposure.
- Periodically check the integrity of his/her partner's PPE.
- Notify the HSO or other site personnel if emergency service is needed.

8.4 Nearest Medical Assistance

The address and telephone number of the nearest hospital:

New York Presbyterian/Weill Cornell Medical Center
525 East 68th Street
New York, NY
Information Line: (212) 746-5454

Map with directions to the hospital are shown in Figure 3. This information will either be posted prominently at the site or will be available to all personnel all of the time. Further, all field personnel, including the HSO, will know the directions to the hospital.

8.5 Standing Orders/Safe Work Practices

The standing orders, which consist of a description of safe work practices that must always be followed while on-site by Langan employees and subcontractors, are shown in Appendix A. The site HSO has the responsibility for enforcing these practices. The standing orders will be posted prominently at the site, or are made available to all personnel at all times. Those who do not abide by these safe work practices will be removed from the site.

8.6 Site Security

No unauthorized personnel shall be permitted access to the work areas,

8.7 Underground Utilities

As provided in Langan's Underground Utility Clearance Guidelines, the following safe work practices should be followed by Langan personnel before and during subsurface work:

- Obtain available utility drawings from the property owner/client or operator.
- Provide utility drawings to the subcontractors.
- In the field, mark the proposed area of subsurface disturbance (when possible).
- Ensure that the one-call (811) system has been notified.
- Ensure that utilities are marked before beginning subsurface work.
- Discuss subsurface work locations with the owner/client and subcontractor.
- Obtain approval from the owner/client and operators for proposed subsurface work locations.
- Use safe digging procedures when applicable.
- Stay at least 10 feet from all equipment performing subsurface work.

8.8 Site Safety Inspection

The Langan HSO or alternate will check the work area daily, at the beginning and end of each work shift or more frequently to ensure safe work conditions. The HSO or alternate must complete the Jobsite Safety Inspection Checklist, found in Appendix F, at least weekly or before completion of work, whichever is shorter. Any deficiencies shall be shared with the HSM and PM and will be discussed at the daily tailgate meeting.

8.9 Hand and Power Tools

All hand- and electric-power tools and similar equipment shall be maintained in a safe operating condition. All electric-power tools must be inspected before initial use. Damaged tools shall be removed immediately from service or repaired. Tools shall be used only for the purpose for which they were designed. All users must be properly trained in their safe operation

9.0 DECONTAMINATION PLAN

9.1 General

All personnel, equipment, and samples leaving the contaminated area of the site must be decontaminated. Decontamination for this operation is achieved through physical removal and chemical detoxification/disinfection/sterilization. The first step in decontamination, however, is prevention and standard operating procedures have been established meant to minimize contact with wastes:

- Work habits that minimize contact with wastes are stressed.
- Disposable equipment, where appropriate, will be used.

9.2 Decontamination Procedures

Standard decontamination procedures will be used as described in Appendix B.

9.3 Disposal of Decontamination Wastes

Waste solutions generated during decontamination procedures shall be contained, collected, and stored in drums or other appropriate containers and labeled for proper off-site disposal.

10.0 EMERGENCY RESPONSE

10.1 General

Because of the hazards that may be present at the site and the conditions under which operations are conducted, it is possible that an emergency situation may develop. Emergency situations can be characterized as injury or acute chemical exposure to personnel, fire or explosion, environmental release, or hazardous weather conditions.

10.2 Responsibilities

Site Emergency Coordinator - The HSO, or his/her alternate, will serve as the Site Emergency Coordinator and shall implement emergency procedures whenever conditions warrant such action. The Site Emergency Coordinator will be responsible for assuring the evacuation, emergency treatment, emergency transport of site personnel, and notification of emergency units and the appropriate management staff. Emergency response instructions will be provided by the HSO as part of every employee's training prior to the start of work.

Employees - All employees at the site will be familiar with emergency response procedures for this work location.

10.3 Evacuation

In the event of an emergency situation, an air horn or vehicle horn will be sounded three times indicating the initiation of evacuation procedures. Loud voice command, if appropriate, can be used. All personnel will evacuate and assemble at the site entrance. No one, except the emergency responders, will be allowed to proceed into the area once the emergency signal has been given. The Site Emergency Coordinator will ensure that access for emergency equipment is provided and that all sources of combustion (e.g., operating machinery, etc.) have been shut down once the alarm has been sounded. Wind direction will be taken into consideration for evacuation plans. Evacuation plans will be discussed at the initial Site-Specific Training and as needed at the regular safety briefings.

In all situations, when an on-site emergency results in an evacuation, personnel shall not re-enter until:

- The conditions resulting in the emergency have been corrected.
- The hazards have been reassessed.
- This CHASP has been reviewed.
- Site personnel have been briefed on any changes to this CHASP.

10.4 Emergency Contacts/Notification System

The fire department and other emergency response groups will be notified by telephone of the emergency as soon as possible. An emergency telephone numbers list is presented as Table 4 in this CHASP. This list will either be posted prominently at the site or will be made readily available to all personnel all of the time.

10.5 Emergency Medical Treatment

Personnel Injury - In case of injury to personnel, the HSO will immediately administer emergency first aid. The ambulance/rescue squad will also be contacted as necessary. Some situations may require transport of the injured parties by automobile. Therefore, maps/directions to the nearest hospital are provided as Figure 3. Figure 3 will either be posted at the site, or will be made readily available to all personnel all of the time.

Personnel Exposure – Emergency first aid procedures to be followed are:

Skin Contact:	Use copious amounts of soap and water. Wash/rinse affected areas thoroughly, and then provide appropriate medical attention. Rinse eyes with water for at least 15 minutes.
Inhalation:	Move to fresh air and/or, if necessary decontaminate and transport to emergency medical facility.
Ingestion:	Decontaminate and transport to emergency medical facility.
Puncture/Laceration:	Decontaminate, if possible, and transport to emergency medical facility.

10.6 Fire or Explosion

Appropriate fire extinguishers will be made available at the site for trained personnel to use on insipient stage fires without endangering the safety and health of those nearby. If the use of fire extinguishers will not extinguish the fire, immediately notify the fire department, sound the evacuation signal, and then evacuate the area, assembling at the site entrance to be accounted for and to receive further instruction.

10.7 Spills/Leaks

Control or stop the spread of minor chemical spills or contamination by utilizing the appropriate materials (absorbents, etc.), if possible. If the release is significant, or highly hazardous, immediately notify the appropriate response groups, sound the evacuation signal, evacuate the area, and assemble at the site entrance to be accounted for and to receive further instruction.

10.8 Adverse Weather Conditions

In the event of severe weather (rain, snow, sleet, heat, etc.), conditions will be assessed on site to determine if the work can proceed safely. If it is determined that the weather poses a significant hazard, site operations will be stopped and rescheduled. Some of the items to be considered prior to determining if work should continue include:

- Potential for heat stress and heat-related injuries.
- Potential for cold stress and cold-related injuries.
- Treacherous weather-related working conditions.
- Limited visibility.

10.9 Underground Utilities

In the event a utility is encountered or disturbed during subsurface work, follow these procedures:

- Immediately stop work;
- Leave the work area and retreat to a safe area;
- Call 911, if necessary;
- Contact the client representative and owner and operator of the property; and
- Immediately notify the Langan PM, HSO and Langan Incident/Injury Hotline.

10.10 Documentation

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 201-398-4699 and the client representative to report the incident or near miss. For emergencies involving personnel injury and/or exposure, the HSO and affected employee will complete and submit an Employee Exposure/Injury Incident Report (Appendix C) to the Langan Corporate Health and Safety Manager as soon as possible following the incident.

11.0 CONFINED SPACE ENTRY

Confined spaces **will not** be entered by Langan personnel.

12.0 CHASP ACKNOWLEDGEMENT FORM

All Langan field personnel and subcontractors will sign this CHASP Compliance Agreement indicating that they have become familiar with this CHASP and that they understand it and agree to abide by it.

Printed Name	Signature	Company	Date

TABLES

TABLE 1

TASK RISK ANALYSES

A. CONTAMINANT HAZARDS OF CONCERN

Task	Contaminant	Monitoring Device	PEL/IDLH	Source of Concentration on Site	Route(s) of Exposure	Symptoms	First Aid
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Iron	Dust Monitor	5 ppm/NA	Soil	Inh, Abs, Ing, Con	Irrit eyes, nose; throat, lungs	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Do not induce vomiting, get medical attention.
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Nickel (Ni)	Dust Monitor	1 ppm/10 ppm	Soil	Inh, Ing, Con	Irrit eyes, nose; throat, lungs	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Do not induce vomiting, get medical attention.
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Zinc (Zn)	Dust Monitor	5 ppm/50 ppm	Soil	Inh, Ing, Con	Irrit eyes, skin	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Do not induce vomiting, get medical attention.
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Copper (Cu)	Dust Monitor	1 mg/m3 TWA/ 100mg/m3	Groundwater	Inh, Ing, Con	Eye, resp tract irrit; derm; lung/pulmonary fibrosis; nau, vomit, diarrh; liver damage	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Chromium (Cr)	Dust Monitor	1 mg/m^3/ 250 mg/m^3	Soil	Inh, Ing, Con	Irrit skin	Skin: Soap wash promptly. Breath: Resp. support Swallow: Do not induce vomiting, get medical attention.
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Lead (Pb)	Dust Monitor	0.006 ppm/82 ppm	Soil	Inh, Ing, Con	Irrit eye	Eyes: irrigate, Skin: soap flush promptly, Breathing: Respiratory support, Swallow: Medical attention immediately
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Manganese	Dust Monitor	5 ppm/10 ppm	Soil Groundwater	Inh, Ing	Irrit: throat breathing, Ing: vomiting, lassitude	Breathing – respiratory support, swallow: medical attention immediately
1.3.1, 1.3.2,	Benzene	PID	1 ppm/500	Groundwater,	Inh, Abs,	Irrit eyes, skin, nose;	Eyes: Irrigate immediately

Task	Contaminant	Monitoring Device	PEL/IDLH	Source of Concentration on Site	Route(s) of Exposure	Symptoms	First Aid
1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,			ppm Ca	Soil	Ing, Con	resp. sys.; gidd; head, nau, staggered gait; ftg, anor, lass; derm; bone marrow depres; [carc]	Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Ethylbenzene	PID	100 ppm/800 ppm [10% LEL]	Groundwater Soil	Inh,, Ing, Con	Irrit eyes, skin, muc memb; head; derm; narco, coma	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately.
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Toluene	PID	200 ppm/500 ppm	Groundwater Soil	Inh, Abs, Ing, Con	Irrit eyes, nose; lass; conf; euphoria; dizz; head.; dilated pupils; lacrimation; anxiety; muscle fatigue; insomnia; pares; derm.; liver, kidney damage	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Xylenes	PID	100 ppm/900 ppm	Groundwater Soil	Inh, Abs, Ing, Con	Irrit eyes, skin. nose, throat; dizz, excitement, drow, inco, staggering gait; com vacuolization; anor, nau, vomit, abdom pain; derm	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Arsenic	Dust Monitor	0.01 ppm/5 ppm	Soil	Inh, Ing, Con	Irrit eyes and skin;	Eyes: Irrigate immediately Skin: Soap wash promptly. Swallow: Medical attention immediately.
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	PCBs	Dust Monitor	1 ppm/5 ppm	Soil	Inh, Ing, Con	Irrit eyes	Eyes: Irrigate immediately Skin: Soap wash promptly. Swallow: Medical attention immediately
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Benzo(a)anthracene	Dust Monitor	NA/NA	Soil	Inh, Ing, Con	Irrit eyes, skin; CNS; depress; naus; vom; liver inj; kidney inj; drow; dizz; inco; [carc]	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Induce vomiting, medical attention immediately
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Benzo(a)pyrene	Dust Monitor	0.2 ppm/700 ppm	Soil	Inh, Ing, Con, Abs	Irrit eyes, skin, digestive track, respiratory track	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately. Do not induce

Task	Contaminant	Monitoring Device	PEL/IDLH	Source of Concentration on Site	Route(s) of Exposure	Symptoms	First Aid
							vomiting
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Benzo(b)fluoranthene	Dust Monitor	NA/NA	Soil	Inh, Abs, Ing, Con	Irrit eyes, skin,	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Benzo(k)fluoranthene	Dust Monitor	NA/NA	Groundwater Soil	Inh, Abs, Ing, Con	Irrit eyes, skin; irritation to gastrointestinal (nausea, vomiting, diarrhea)	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately. Do not induce vomiting
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Dibenzo(a,h)anthracene	Dust Monitor	NA/NA	Soil	Inh, Ing, Con	Irrit eyes, skin, digestive track, respiratory track	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately. Do not induce vomiting
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Naphthalene	PID/Dust Monitor	10 ppm/500 ppm	Groundwater Soil	Inh, Ing, Con	Irrit eyes, skin, digestive track, respiratory track	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately. Do not induce vomiting.

Task	Contaminant	Monitoring Device	PEL/IDLH	Source of Concentration on Site	Route(s) of Exposure	Symptoms	First Aid
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8	Toluene	PID	200 ppm/500 ppm	Groundwater	Inh, Abs, Ing, Con	Irrit eyes, nose; lass; conf; euphoria; dizz; head.; dilated pupils; lacrim; anxiety; muscle fatigue; insomnia; pares; derm.; liver, kidney damage	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8	1,1-Dichloroethane	PID	100 ppm/ 3,000 ppm	Groundwater	Inh, Abs, Ing, Con	Irrit eyes, skin; head, vis dist, lass, dizz, tremor, drow, nau, vomit; card arrhy, pares; liver inj; carc	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8	1,1,1-trichloroethane	PID	350 ppm/ 700 ppm	Groundwater	Inh,Ing, Con	Irrit eyes, skin; head, vis dist, lass, dizz, tremor, drow, nau, vomit; card arrhy, pares; liver inj; carc	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8	Tetrachloroethylene	PID	100 ppm/ 150 ppm	Groundwater	Inh, Abs, Ing, Con	Irrit eyes, skin; head, vis dist, lass, dizz, tremor, drow, nau, vomit; card arrhy, pares; liver inj; carc	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8	Trichloroethylene	PID	TWA 100 ppm/ 1000 ppm Ca	Groundwater	Inh, Abs, Ing, Con	Irrit eyes, skin; head, vis dist, lass, dizz, tremor, drow, nau, vomit; card arrhy, pares; liver inj; carc	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8	Cis-1,2-dichloroethylene	PID	200 ppm/1000 ppm	Groundwater	Inh, Ing, Con, Abs	Irrit eye, resp sys; depress, head, euphorie, nau, vomit, weak, tremor, epigastric cramps, derm	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8	Vinyl chloride	PID	1 ppm/ NA (Ca)	Groundwater	Inh, Con (liquid)	Lass; abdom pain, GI bleeding; enlarged liver; pallor or cyan of extremities; liquid: frostbite; carc	Eye: frostbite Skin: frostbite Breath: Resp. support
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6,	1,3,5-Trimethylbenzene	PID	NA/NA	Groundwater Soil	Inh, Ing, Con	Irrit eyes, skin, nose, throat, respiratory system; headache,	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support

Task	Contaminant	Monitoring Device	PEL/IDLH	Source of Concentration on Site	Route(s) of Exposure	Symptoms	First Aid
1.3.7, 1.3.8						drowsiness, lassitude (weakness, exhaustion), dizziness, nausea, incoordination; vomiting, confusion;	Swallow: Medical attention immediately
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	1,2,4-Trimethylbenzene	PID	NA/NA	Groundwater Soil	Inh, Ing, Con	Irrit eyes, skin, nose, throat, respiratory system; headache, drowsiness, lassitude (weakness, exhaustion), dizziness, nausea, incoordination; vomiting, confusion;	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Resp. support Swallow: Medical attention immediately

EXPLANATION OF ABBREVIATIONS

PID = Photoionization Detector
Inh = Inhalation
Abs = Skin absorption
Ing = Ingestion
Con = Skin and/or eye contact
PEL = Permissible Exposure Limit (8-hour Time Weighted Average)
IDLH = Immediately Dangerous to Life and Health
LEL = Lower Explosive Limit
ppm = part per million
TLV = Threshold Limit Value
abdom = abdominal
anor = anorexia
arrhy = arrhythmia
card = cardiac
Ca = Considered by NIOSH to be potential occupational carcinogen
[carc] = potential occupational carcinogen
CNS = central nervous system
depres = depressant/depression
derm= dermatitis
dizz = dizziness
drow = drowsiness
ftg = fatigue
gidd = giddiness
inco = incoordination
inj = injury
lass = lassitude (weakness, exhaustion)
muc memb = mucous membrane
nau = nausea
pares = paresthesia
som = somnolence (sleepiness, unnatural drowsiness)
verti = vertigo
vis dist = visual disturbance

B. PHYSICAL HAZARDS OF CONCERN

Task	Hazard	Description	Control Measures	First Aid
1.3.1, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Skin contact	Development water spills on skin; splashes in eyes. Contact with contaminated soil during subsurface investigations /activities.	Wear proper PPE; follow safe practices	See "A" above
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Lacerations, abrasions, punctures	Cutting bailer twine, pump tubing, acetate liners, etc. with knife. Using tools in tight spaces, etc.	Wear proper PPE; follow safe practices	See pages 48-51, NSC "First Aid a CPR Standard" manual
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Inhalation	Opening wells and well development, vapor extrusion of excavated soil, dust	Follow air monitoring plan; have quick access to respirator	See "A" above.
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Lifting	Improper lifting/carrying of equipment and materials causing strains	Follow safe lifting techniques	Follow the RICE procedures (p.99 in NSC manual)
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Slips, trips, and falls	Any number of injuries could occur from slips, trips, and falls in carrying out these tasks	Good housekeeping at site, constant awareness and focus on the task	
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Noise	Excavation equipment, hand tools, drilling equipment.	Wear hearing protection	-
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Falling objects	Soil material, tools, etc. dropping from drill rigs, front-end loaders, etc.	Hard hats to be worn at all times while in work zones	-
1.3.1, 1.3.3, 1.3.4, 1.3.6, 1.3.7, 1.3.8, 1.3.9, 1.3.10	Underground/over head utilities	Excavation equipment, drill rig auger makes contact with underground object; boom touches	"One Call" before dig; follow safe practices; confirm utility locations with subcontractor	-
1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8,	Insects (bees, wasps, hornet, mosquitoes, and spider)	Sings, Bites	Insect Repellent, proper protective clothing (work boots, socks and light colored pants)	Field personnel who may have insect allergies (e.g., bee sting) should provide this information to the HSO or FSO prior to commencing work, and will have allergy medication on Site.

TABLE 2
Summary of Monitoring Equipment

Instrument	Operation Parameters
Photoionization Detector (PID)	**Hazard Monitored:** Many organic and some inorganic gases and vapors. **Application:** Detects total concentration of many organic and some inorganic gases and vapors. Some identification of compounds is possible if more than one probe is measured. **Detection Method:** Ionizes molecules using UV radiation; produces a current that is proportional to the number of ions. **General Care/Maintenance:** Recharge or replace battery. Regularly clean lamp window. Regularly clean and maintain the instrument and accessories. **Typical Operating Time:** 10 hours. 5 hours with strip chart recorder.
Dust Monitor	**Hazard Monitored:** Real-time aerosol mass readings. **Application:** Measures Particulate concentrations in air **Detection Method:** Uses light-scattering laser photometers sensor to measure real-time aerosol mass readings. **General Care/Maintenance:** Daily zero check, insure inlet is clean. **Typical Operating Time:** 8 – 12 hours.
Additional equipment (if needed, based on site conditions)	
Oxygen Meter	**Hazard Monitored:** Oxygen (O_2). **Application:** Measures the percentage of O_2 in the air. **Detection Method:** Uses an electrochemical sensor to measure the partial pressure of O_2 in the air, and converts the reading to O_2 concentration. **General Care/Maintenance:** Replace detector cell according to manufacturer's recommendations. Recharge or replace batteries prior to explanation of the specified interval. If the ambient air is less than 0.5% C O_2, replace the detector cell frequently. **Typical Operating Time:** 8 – 12 hours.
Combustible Gas Indicator (CGI)	**Hazard Monitored:** Combustible gases and vapors. **Application:** Measures the concentration of combustible gas or vapor. **Detection Method:** A filament, usually made of platinum, is heated by burning the combustible gas or vapor. The increase in heat is measured. Gases and vapors are ionized in a flame. A current is produced in proportion to the number of carbon atoms present. **General Care/Maintenance:** Recharge or replace battery. Calibrate immediately before use. **Typical Operating Time:** Can be used for as long as the battery lasts, or for the recommended interval between calibrations, whichever is less.
Flame Ionization Detector (FID) with Gas Chromatography	**Hazard Monitored:** Many organic gases and vapors (approved areas only). **Application:** In survey mode, detects the concentration of many organic gases and vapors. In gas chromatography (GC) mode, identifies and measures specific compounds. In survey mode, all the organic compounds are ionized and detected

Instrument	Operation Parameters
Option *(i.e., Foxboro Organic Vapor Analyzer (OVA))*	at the same time. In GC mode, volatile species are separated. **General Care/Maintenance:** Recharge or replace battery. Monitor fuel and/or combustion air supply gauges. Perform routine maintenance as described in the manual. Check for leaks. **Typical Operating Time:** 8 hours; 3 hours with strip chart recorder.
Potable Infrared (IR) Spectrophotometer	**Hazard Monitored:** Many gases and vapors. **Application:** Measures concentration of many gases and vapors in air. Designed to quantify one or two component mixtures. **Detection Method:** Passes different frequencies of IR through the sample. The frequencies absorbed are specific for each compound. **General Care/Maintenance:** As specified by the manufacturer.
Direct Reading Colorimetric Indicator Tube	**Hazard Monitored:** Specific gas and vapors. **Application:** Measures concentration of specific gases and vapors. **Detection Method:** The compound reacts with the indicator chemical in the tube, producing a stain whose length or color change is proportional to the compound's concentration. **General Care/Maintenance:** Do not use a previously opened tube even if the indicator chemical is not stained. Check pump for leaks before and after use. Refrigerate before use to maintain a shelf life of about 2 years. Check expiration dates of tubes. Calibrate pump volume at least quarterly. Avoid rough handling which may cause channeling.
Aerosol Monitor	**Hazard Monitored:** Airborne particulate (dust, mist, fume) concentrations **Application:** Measures total concentration of semi-volatile organic compounds, PCBs, and metals. **Detection Method:** Based on light-scattering properties of particulate matter. Using an internal pump, air sample is drawn into the sensing volume where near infrared light scattering is used to detect particles. **General Care/Maintenance:** As specified by the mfr. Also, the instrument must be calibrated with particulates of a size and refractive index similar to those to be measured in the ambient air.
Monitox	**Hazard Monitored:** Gases and vapors. **Application:** Measures specific gases and vapors. **Detection Method:** Electrochemical sensor relatively specific for the chemical species in question. **General Care/Maintenance:** Moisten sponge before use; check the function switch; change the battery when needed.
Gamma Radiation Survey Instrument	**Hazard Monitored:** Gamma Radiation. **Application:** Environmental radiation monitor. **Detection Method:** Scintillation detector. **General Care/Maintenance:** Must be calibrated annually at a specialized facility. **Typical Operating Time:** Can be used for as long as the battery lasts, or for the recommended interval between calibrations, whichever is less.

TABLE 3

INSTRUMENTATION ACTION LEVELS

Photoionization Detector Action Levels	**Action Required**
Background to 5 ppm	No respirator; no further action required
> 1 ppm but < 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 1 ppm, temporarily discontinue work and measure benzene concentrations. 3. If benzene concentrations below 1 ppm, continue work, if above 1 ppm, upgrade to Level C protection. 4. If sustained PID readings fall below 1 ppm, downgrading to Level D protection may be permitted.
> 5 ppm but < 150 ppm for > 5 minutes	1. Discontinue all work; all workers shall move to an area upwind of the jobsite. 2. Evaluate potential causes of the excessive readings, test for benzene concentrations, and allow work area to vent until VOC concentrations fall below 5 ppm. 3. Level C protection will continue to be used until benzene concentrations fall below 1 ppm or PID readings fall below 10 ppm.
> 150 ppm	Evacuate the work area.

Notes:
1. Parts per million (ppm)
2. ppm level based on OSHA Permissible Exposure Limit (PEL) for benzene.
3. 5 ppm level based on OSHA Short-Term Exposure Limit (STEL) maximum exposure for benzene for any 15 minute period.
4. 150 ppm level based on NIOSH Immediately Dangerous to Life and Health (IDLH) for tetrachloroethene.

Particulate (Dust) Monitoring	**Action Required**
Background to 5 ppm	No respirator; no further action required
> Between 5 mg/m^3 and 125 mg/m^3	1. Temporarily discontinue all activities and evaluate potential causes of the excessive readings. Apply dust suppression measures. If these levels persist and cannot be mitigated contact HSO to review conditions and determine source and appropriate response action. 2. If readings remain above 5 mg/m^3, temporarily discontinue work and upgrade to Level C protection. 3. If sustained readings fall below 2.5 mg/m^3, downgrading to Level D protection may be permitted.
Above 125 mg/m^3	1. Discontinue all work; all workers shall move to an area upwind of the jobsite. Apply additional dust suppression measures. 2. Evaluate potential causes of the excessive readings and allow work area to vent until concentrations fall below 125 ppm mg/m^3. 3. Level C protection will continue to be used until particulate readings fall below 2.5 mg/m^3.

Notes: 1. Milligram per cubic meter (mg/m^3)

TABLE 4
EMERGENCY NOTIFICATION LIST

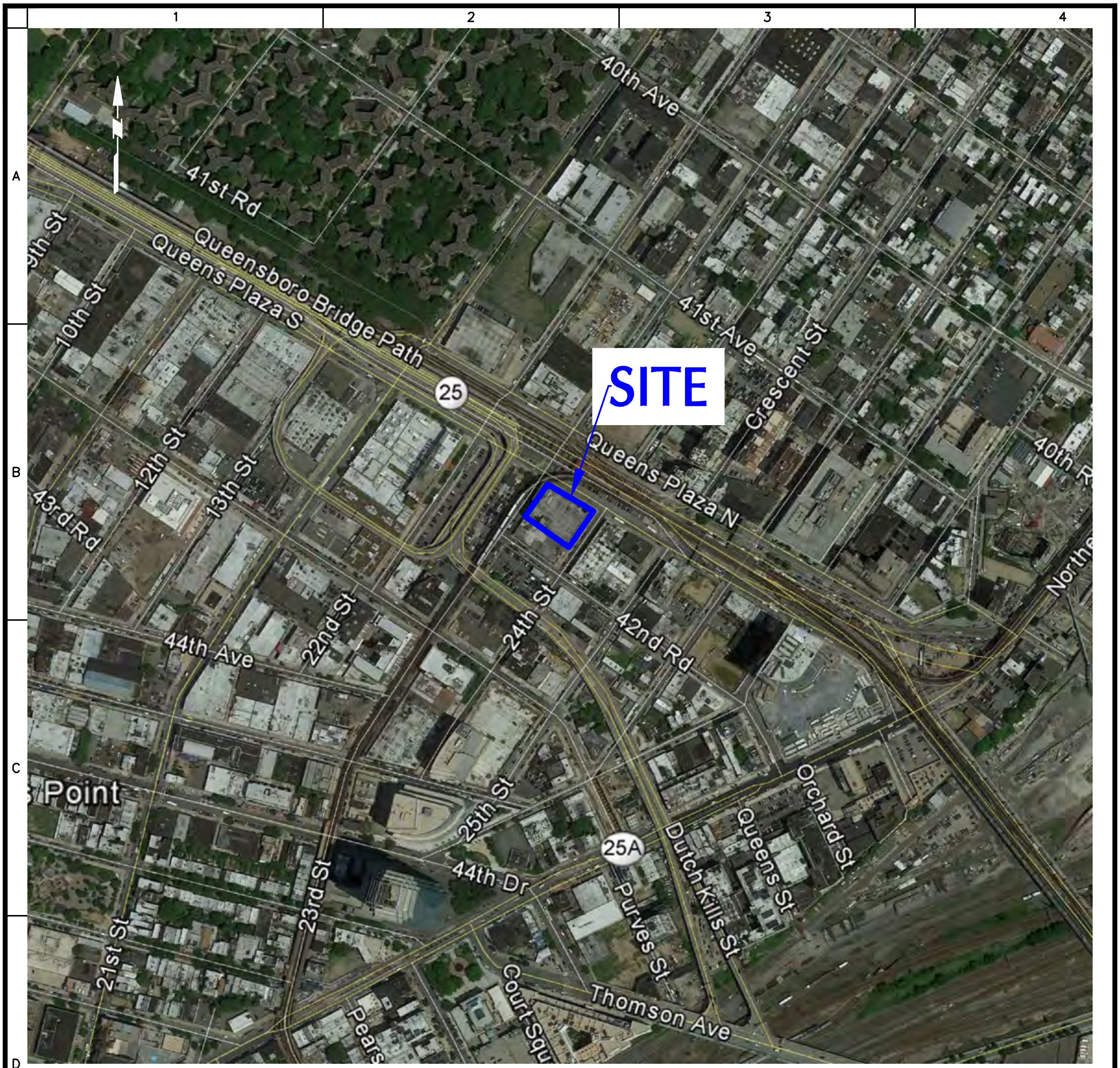
Organization	Contact	Telephone
Local Police Department		911
Local Fire Department		911
Ambulance/Rescue Squad		911
Hospital		911
Langan Incident / Injury Hotline		201-398-4699
Langan Project Manager	Gerald Nicholls	609-933-5330 (cell)
Langan Health and Safety Manager (HSM)	Tony Moffa	215-756-2523 (cell)
Langan Site Health & Safety Officer (HSO)	Paul McMahon	914-433-1157 (cell)
Client	Chris Hunter	201-414-0717 (cell)
National Response Center (NRC)		800-424-8802
Chemical Transportation Emergency Center (Chemtrec)		800-424-9300
Center for Disease Control (CDC)		404-639-3534
EPA (RCRA Superfund Hotline)		800-424-9346
TSCA Hotline		202-554-1404
Poison Control Center		800-222-1222

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 201-398-4699.

FIGURES

FIGURE 1

Site Location Map



LEGEND:

◇ SITE BOUNDARY

NOTES:

1. BASE MAP TAKEN FROM GOOGLE EARTH (IMAGE DATE 6/2/2011)

LANGAN

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Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C.
Langan Engineering and Environmental Services, Inc.
Langan International LLC
Collectively known as Langan

Project	Figure Title	Project No.	Figure No.
23-10 QUEENS PLAZA SOUTH BLOCK No. 425, LOT No. 5 LONG ISLAND CITY QUEENS NEW YORK	**SITE LOCATION MAP**	170244603	**1**
		Date: 5/26/2015	
		Scale: NTS	
		Drawn By: PM	
		Submission Date: -	

Filename: \\Langan.com\data\NY\data6\170244601\Cadd Data - 170244601\2D-DesignFiles\Environmental\IRM WP\23-10 QPS\CHASP\Figure 1 - Site Location Map - revised.dwg Date: 6/12/2015 Time: 11:07 User: pmcmahon Style Table: Langan.stb Layout: ANSIA-BP

FIGURE 2

HOSPITAL LOCATION
SITE LOCATION
Full map view
Memorial Sloan-Kettering...
Roosevelt Island
Queensbridge Park
Coler-Goldwater Specialty Hospital...
Franklin D. Roosevelt Four Freedoms Park
Queensboro Plaza
Queens Plaza
East River
FDR Drive
Vernon Blvd
21st St
E 61st St
E 62nd St
E 63rd St
York Ave
1st Avenue
SUTTON PLACE
A
B
25

HOSPITAL ROUTE PLAN (New York Presbyterian/Weill Cornell Medical Center in New York, NY)

Hospital Location: **525 East 68th Street, New York, NY**
Information Line (212) 746-5454

Route to Hospital

From 23-10 Queens Plaza South, Long Island City to New York Presbyterian Hospital, located at 525 East 68th Street, New York, NY:

1: Take 23rd Street to Queens Plaza N
2: Turn right onto 23rd Street
3: Turn left onto Queens Plaza N
4: Take ramp to Queensboro Bridge Upper Roadway
5: Merge onto Ed Koch Queensboro Bridge
6: Take the ramp to 2nd Avenue S/West Side/1 Ave N/FDR Drive
7: Turn right onto East 62nd Street
8: Take the 1st left onto 1st Avenue
9: Turn right at the 3rd cross street onto East 65th Street
10: Turn left onto York Avenue
11: Take the 1st right onto East 68th Street
12: Turn left to stay on East 68th Street – Destination will be on the right

Total Est. Time: 9 minutes **Total Est. Distance:** 2.6 miles

APPENDIX A

STANDING ORDERS

STANDING ORDERS

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 B

DECONTAMINATION PROCEDURES

PERSONNEL DECONTAMINATION

LEVEL C DECONTAMINATION

Station 1:	Equipment Drop	1. Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, cool down stations may be set up within this area.
Station 2:	Outer Garment, Boots, and Gloves Wash and Rinse	2. Scrub outer boots, outer gloves and chemical-resistant splash suit with decon solution or detergent and water. Rinse off using copious amounts of water.
Station 3:	Outer Boot and Glove Removal	3. Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Canister or Mask Change	4. If worker leaves Exclusion Zone to change canister (or mask), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves and boot covers donned, joints taped, and worker returns to duty.
Station 5:	Boot, Gloves and Outer Garment Removal	5. Boots, chemical-resistant splash suit, inner gloves removed and deposited in separate containers lined with plastic.
Station 6:	Facepiece Removal	6. Facepiece is removed (avoid touching face with fingers). Facepiece deposited on plastic sheets.
Station 7:	Field Wash	7. Hands and face are thoroughly washed. Shower as soon as possible.

LEVEL D DECONTAMINATION

Station 1:	Equipment Drop	1. Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, cool down stations may be set up within this area.
Station 2:	Outer Garment, Boots, and Gloves Wash and Rinse	2. Scrub outer boots, outer gloves and chemical-resistant splash suit with decon solution or detergent and water. Rinse off using copious amounts of water.
Station 3:	Outer Boot and Glove Removal	3. Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Boot, Gloves and Outer Garment Removal	4. Boots, chemical-resistant splash suit, inner gloves removed and deposited in separate containers lined with plastic.
Station 5:	Field Wash	5. Hands and face are thoroughly washed. Shower as soon as possible.

EQUIPMENT DECONTAMINATION

GENERAL:

Equipment to be decontaminated during the project may include tools, monitoring equipment, respirators, sampling containers, laboratory equipment and drilling equipment.

All decontamination will be done by personnel in protective gear, appropriate for the level of decontamination, as determined by the site HSO. The decontamination work tasks will be split or rotated among support and work crews.

Depending on site conditions, backhoe and pumps may be decontaminated over a portable decontamination pad to contain wash water; or, wash water may be allowed to run off into a storm sewer system. Equipment needed may include a steam generator with high-pressure water, empty drums, screens, screen support structures, and shovels. Drums will be used to hold contaminated wash water pumped from the lined pit. These drums will be labeled as such.

Miscellaneous tools and equipment will be dropped into a plastic pail, tub, or other container. They will be brushed off and rinsed with a detergent solution, and finally rinsed with clean water.

MONITORING EQUIPMENT:

Monitoring equipment will be protected as much as possible from contamination by draping, masking, or otherwise covering as much of the instruments as possible with plastic without hindering the operation of the unit. The HNu or OVA meter, for example, can be placed in a clear plastic bag, which allows reading of the scale and operation of knobs. The probes can be partially wrapped keeping the sensor tip and discharge port clear.

The contaminated equipment will be taken from the drop area and the protective coverings removed and disposed in the appropriate containers. Any dirt or obvious contamination will be brushed or wiped with a disposable paper wipe.

RESPIRATORS:

Respirators will be cleaned and disinfected after every use. Taken from the drop area, the masks (with the cartridges removed and disposed of with other used disposable gear) will be immersed in a cleaning solution and scrubbed gently with a soft brush, followed by a rinse in plain warm water, and then allowed to air dry. In the morning, new cartridges will be installed. Personnel will inspect their own masks for serviceability prior to donning them. And, once the mask is on, the wearer will check the respirator for leakage using the negative and positive pressure fit check techniques.

APPENDIX C

EMPLOYEE EXPOSURE/ INJURY INCIDENT REPORT

EMPLOYEE INCIDENT/INJURY REPORT
LANGAN ENGINEERING & ENVIRONMENTAL SERVICES

(Complete and return to Tony Moffa in the Doylestown Office)

Affected Employee Name: ______________________________ Date: ____________________

Incident type: ☐ Injury ☐ Report Only/No Injury

☐ Near Miss ☐ Other: ________________________________

EMPLOYEE INFORMATION (Person completing Form)

Employee Name: ______________________________ Employee No: ______________________

Title: ____ Office Location: ____________________________

Length of time employed or date of hire: ____

Mailing address: ____

____

Sex: M ☐ F ☐ Birth date: ________________

Business phone & extension: ____________________ Residence/cell phone: ______________________

ACCIDENT INFORMATION

Project: ____ Project #: __________________________

Date & time of incident: ______________________ Time work started & ended: __________________________

Site location: ____

Incident Type: Possible Exposure ☐ Exposure ☐ Physical Injury ☐

Names of person(s) who witnessed the incident: ____

____

Exact location incident occurred: ____

____

Describe work being done: ____

____

____

Describe what affected employee was doing prior to the incident occurring: ____________________

____

____

Describe in detail how the incident occurred:____________________

____

____

____

Nature of the incident (List the parts of the body affected):____________________

____

____

____

Person(s) to whom incident was reported (Time and Date): ____________________

____

List the names of other persons affected during this incident: ____________________

____

Possible causes of the incident (equipment, unsafe work practices, lack of PPE, etc): ____________________

____

____

Weather conditions during incident:____________________

MEDICAL CARE INFORMATION

Did affected employee receive medical care? Yes ☐ No ☐

If Yes, when and where was medical care received:____________________

Provide name of facility (hospital, clinic, etc.): ____________________

____

Length of stay at the facility? ____________________

Did the employee miss any work time? Yes ☐ No ☐ Undetermined ☐

Date employee last worked: ____________________ Date employee returned to work:____________________

Has the employee returned to work? Yes ☐ No ☐

Does the employee have any work limitations or restrictions from the injury? : Yes ☐ No ☐

If Yes, please describe: ____

____

Did the exposure/injury result in permanent disability? Yes ☐ No ☐ Unknown ☐

If Yes, please describe: ____

HEALTH & SAFETY INFORMATION

Was the operation being conducted under an established site specific Health and Safety Plan?
Yes ☐ No ☐ Not Applicable: ☐

Describe protective equipment and clothing used by the employee:

____

____

____

Did any limitations in safety equipment or protective clothing contribute to or affect exposure / injury? If so, explain:

____

____

____

______________________________ ______________________
Employee Signature Date

______________________________ ______________________
Langan Representative Date

APPENDIX D

CALIBRATION LOG

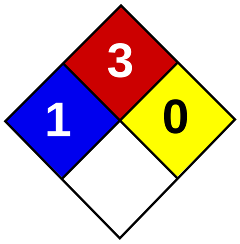
DATE: ______________________________ **PROJECT:** ______________________________

CALIBRATION LOG

Date & Time	Instrument Type	Instrument Number	Media	Initial Reading	Span #	Calibration Reading	Performed By:

APPENDIX E

MATERIAL SAFETY DATA SHEETS (MSDS)



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Acetone MSDS

Section 1: Chemical Product and Company Identification

Product Name: Acetone

Catalog Codes: SLA3502, SLA1645, SLA3151, SLA3808

CAS#: 67-64-1

RTECS: AL3150000

TSCA: TSCA 8(b) inventory: Acetone

CI#: Not applicable.

Synonym: 2-propanone; Dimethyl Ketone; Dimethylformaldehyde; Pyroacetic Acid

Chemical Name: Acetone

Chemical Formula: C3-H6-O

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Acetone	67-64-1	100

Toxicological Data on Ingredients: Acetone: ORAL (LD50): Acute: 5800 mg/kg [Rat]. 3000 mg/kg [Mouse]. 5340 mg/kg [Rabbit]. VAPOR (LC50): Acute: 50100 mg/m 8 hours [Rat]. 44000 mg/m 4 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Reproductive system/toxin/male [SUSPECTED]. The substance is toxic to central nervous system (CNS). The substance may be toxic to kidneys, the reproductive system, liver, skin. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 465°C (869°F)

Flash Points: CLOSED CUP: -20°C (-4°F). OPEN CUP: -9°C (15.8°F) (Cleveland).

Flammable Limits: LOWER: 2.6% UPPER: 12.8%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Slightly explosive in presence of open flames and sparks, of oxidizing materials, of acids.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards: Vapor may travel considerable distance to source of ignition and flash back.

Special Remarks on Explosion Hazards:
Forms explosive mixtures with hydrogen peroxide, acetic acid, nitric acid, nitric acid + sulfuric acid, chromic anydride, chromyl chloride, nitrosyl chloride, hexachloromelamine, nitrosyl perchlorate, nitryl perchlorate, permonosulfuric acid, thiodiglycol + hydrogen peroxide, potassium ter-butoxide, sulfur dichloride, 1-methyl-1,3-butadiene, bromoform, carbon, air, chloroform, thitriazylperchlorate.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, acids, alkalis.

Storage:
Store in a segregated and approved area (flammables area) . Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Keep away from direct sunlight and heat and avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 500 STEL: 750 (ppm) from ACGIH (TLV) [United States] TWA: 750 STEL: 1000 (ppm) from OSHA (PEL) [United States] TWA: 500 STEL: 1000 [Austalia] TWA: 1185 STEL: 2375 (mg/m3) [Australia] TWA: 750 STEL: 1500 (ppm) [United Kingdom (UK)] TWA: 1810 STEL: 3620 (mg/m3) [United Kingdom (UK)] TWA: 1800 STEL: 2400 from OSHA (PEL) [United States]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Fruity. Mint-like. Fragrant. Ethereal

Taste: Pungent, Sweetish

Molecular Weight: 58.08 g/mole

Color: Colorless. Clear

pH (1% soln/water): Not available.

Boiling Point: 56.2°C (133.2°F)

Melting Point: -95.35 (-139.6°F)

Critical Temperature: 235°C (455°F)

Specific Gravity: 0.79 (Water = 1)

Vapor Pressure: 24 kPa (@ 20°C)

Vapor Density: 2 (Air = 1)

Volatility: Not available.

Odor Threshold: 62 ppm

Water/Oil Dist. Coeff.: The product is more soluble in water; log(oil/water) = -0.2

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, ignition sources, exposure to moisture, air, or water, incompatible materials.

Incompatibility with various substances: Reactive with oxidizing agents, reducing agents, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 3000 mg/kg [Mouse]. Acute toxicity of the vapor (LC50): 44000 mg/m3 4 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Reproductive system/toxin/male [SUSPECTED]. Causes damage to the following organs: central nervous system (CNS). May cause damage to the following organs: kidneys, the reproductive system, liver, skin.

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May affect genetic material (mutagenicity) based on studies with yeast (S. cerevisiae), bacteria, and hamster fibroblast cells. May cause reproductive effects (fertility) based upon animal studies. May contain trace amounts of benzene and formaldehyde which may cancer and birth defects. Human: passes the placental barrier.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: May cause skin irritation. May be harmful if absorbed through the skin. Eyes: Causes eye irritation, characterized by a burning sensation, redness, tearing, inflammation, and possible corneal injury. Inhalation: Inhalation at high concentrations affects the sense organs, brain and causes respiratory tract irritation. It also may affect the Central Nervous System (behavior) characterized by dizzness, drowsiness, confusion, headache, muscle weakeness, and possibly motor incoordination, speech abnormalities, narcotic effects and coma. Inhalation may also affect the gastrointestinal tract (nausea, vomiting). Ingestion: May cause irritation of the digestive (gastrointestinal) tract (nausea, vomiting). It may also

affect the Central Nevous System (behavior), characterized by depression, fatigue, excitement, stupor, coma, headache, altered sleep time, ataxia, tremors as well at the blood, liver, and urinary system (kidney, bladder, ureter) and endocrine system. May also have musculoskeletal effects. Chronic Potential Health Effects: Skin: May cause dermatitis. Eyes: Eye irritation.

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 5540 mg/l 96 hours [Trout]. 8300 mg/l 96 hours [Bluegill]. 7500 mg/l 96 hours [Fatthead Minnow]. 0.1 ppm any hours [Water flea].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Acetone UNNA: 1090 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause reproductive harm (male) which would require a warning under the statute: Benzene California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Benzene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Benzene, Formaldehyde Connecticut hazardous material survey.: Acetone Illinois toxic substances disclosure to employee act: Acetone Illinois chemical safety act: Acetone New York release reporting list: Acetone Rhode Island RTK hazardous substances: Acetone Pennsylvania RTK: Acetone Florida: Acetone Minnesota: Acetone Massachusetts RTK: Acetone Massachusetts spill list: Acetone New Jersey: Acetone New Jersey spill list: Acetone Louisiana spill reporting: Acetone California List of Hazardous Substances (8 CCR 339): Acetone TSCA 8(b) inventory: Acetone TSCA 4(a) final test rules: Acetone TSCA 8(a) IUR: Acetone

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R11- Highly flammable. R36- Irritating to eyes. S9- Keep container in a well-ventilated place. S16- Keep away from sources of ignition - No smoking. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References:
-Material safety data sheet issued by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. LOLI, RTECS, HSDB databases. Other MSDSs

Other Special Considerations: Not available.

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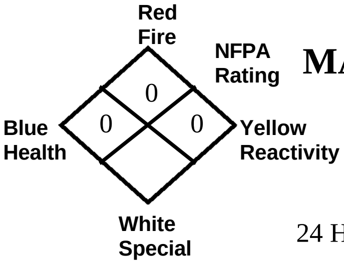
Last Updated: 06/09/2012 12:00 PM

Alconox ®



MATERIAL SAFETY DATA SHEET

Alconox, Inc.
30 Glenn Street
White Plains, NY 10603

24 Hour Emergency Number – Chem-Tel (800) 255-3924

I. IDENTIFICATION

Product Name (as appears on label)	ALCONOX
CAS Registry Number:	Not Applicable
Effective Date:	January 1, 2001
Chemical Family:	Anionic Powdered Detergent
Manufacturer Catalog Numbers for sizes	1104, 1125, 1150, 1101, 1103 and 1112

II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

There are no hazardous ingredients in ALCONOX as defined by the OSHA Standard and Hazardous Substance List 29 CFR 1910 Subpart Z.

III. PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point (F):	Not Applicable
Vapor Pressure (mm Hg):	Not Applicable
Vapor Density (AIR=1):	Not Applicable
Specific Gravity (Water=1):	Not Applicable
Melting Point:	Not Applicable
Evaporation Rate (Butyl Acetate=1):	Not Applicable
Solubility in Water:	Appreciable-Soluble to 10% at ambient conditions
Appearance:	White powder interspersed with cream colored flakes.
pH:	9.5 (1%)

IV. FIRE AND EXPLOSION DATA

Flash Point (Method Used):	None
Flammable Limits:	LEL: No Data UEL: No Data
Extinguishing Media:	Water, dry chemical, CO_2, foam
Special Fire fighting Procedures:	Self-contained positive pressure breathing apparatus and protective clothing should be worn when fighting fires involving chemicals.
Unusual Fire and Explosion Hazards:	None

V. REACTIVITY DATA

Stability:	Stable
Hazardous Polymerization:	Will not occur
Incompatibility (Materials to Avoid):	None
Hazardous Decomposition or Byproducts:	May release CO_2 on burning

VI. HEALTH HAZARD DATA

Route(s) of Entry:	Inhalation? Yes Skin? No Ingestion? Yes
Health Hazards (Acute and Chronic):	Inhalation of powder may prove locally irritating to mucous membranes. Ingestion may cause discomfort and/or diarrhea. Eye contact may prove irritating.
Carcinogenicity:	NTP? No IARC Monographs? No OSHA Regulated? No
Signs and Symptoms of Exposure:	Exposure may irritate mucous membranes. May cause sneezing.
Medical Conditions Generally Aggravated by Exposure:	Not established. Unnecessary exposure to this product or any industrial chemical should be avoided. Respiratory conditions may be aggravated by powder.
Emergency and First Aid Procedures:	Eyes: Immediately flush eyes with water for at least 15 minutes. Call a physician. Skin: Flush with plenty of water. Ingestion: Drink large quantities of water or milk. Do not induce vomiting. If vomiting occurs administer fluids. See a physician for discomfort.

VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken if Material is Released or Spilled:	Material foams profusely. Recover as much as possible and flush remainder to sewer. Material is biodegradable.
Waste Disposal Method:	Small quantities may be disposed of in sewer. Large quantities should be disposed of in accordance with local ordinances for detergent products.
Precautions to be Taken in Storing and Handling:	Material should be stored in a dry area to prevent caking.
Other Precautions:	No special requirements other than the good industrial hygiene and safety practices employed with any industrial chemical.

VIII. CONTROL MEASURES

Respiratory Protection (Specify Type):	Dust mask - Recommended
Ventilation:	Local Exhaust-Normal Special-Not Required Mechanical-Not Required Other-Not Required
Protective Gloves:	Impervious gloves are useful but not required.
Eye Protection:	Goggles are recommended when handling solutions.
Other Protective Clothing or Equipment:	None
Work/Hygienic Practices:	No special practices required

THE INFORMATION HEREIN IS GIVEN IN GOOD FAITH BUT NO WARRANTY IS EXPRESSED OR IMPLIED.

Right to Know
Hazardous Substance Fact Sheet

Common Name: **ARSENIC**

Synonyms: Gray Arsenic; Arsen
Chemical Name: Arsenic
Date: June 1998 Revision: April 2008

CAS Number: 7440-38-2
RTK Substance Number: 0152
DOT Number: UN 1558

Description and Use

Arsenic is a silver-gray or white metallic, odorless, brittle solid. It is used as an alloying agent for heavy metals, and in solders, medicines and herbicides.

Reasons for Citation

- **Arsenic** is on the Right to Know Hazardous Substance List because it is cited by OSHA, ACGIH, DOT, NIOSH, NTP, DEP, IARC, IRIS and EPA.
- This chemical is on the Special Health Hazard Substance List.

SEE GLOSSARY ON PAGE 5.

FIRST AID

Eye Contact

- Immediately flush with large amounts of water for at least 15 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while rinsing. Seek medical attention.

Skin Contact

- Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water.

Inhalation

- Remove the person from exposure.
- Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
- Transfer promptly to a medical facility.

EMERGENCY NUMBERS

Poison Control: 1-800-222-1222
CHEMTREC: 1-800-424-9300
NJDEP Hotline: 1-877-927-6337
National Response Center: 1-800-424-8802

EMERGENCY RESPONDERS >>>> SEE PAGE 6

Hazard Summary

Hazard Rating	NJDHSS	NFPA
HEALTH	4	-
FLAMMABILITY	0	-
REACTIVITY	0	-
CARCINOGEN POISONOUS GASES ARE PRODUCED IN FIRE		

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

- **Arsenic** can affect you when inhaled and may be absorbed through the skin.
- **Arsenic** is a CARCINOGEN and may cause reproductive damage. HANDLE WITH EXTREME CAUTION.
- Skin contact can cause irritation, burns, rash and loss of pigment
- Eye contact can cause irritation and burns.
- Inhaling **Arsenic** can irritate the nose and throat and can cause an ulcer or hole in the "bone" (septum) dividing the inner nose.
- Exposure to **Arsenic** can cause weakness, poor appetite, nausea, vomiting, headache, and even death.
- **Arsenic** may damage the nervous system and the liver.
- **Arsenic** is a noncombustible solid, but when in *dust* or *fine powder* form it can EXPLODE when exposed to heat, flame or hot surfaces.

Workplace Exposure Limits

OSHA: The legal airborne permissible exposure limit (PEL) is **0.01 mg/m^3** averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit (REL) is **0.002 mg/m^3**, which should not be exceeded at any time.

ACGIH: The threshold limit value (TLV) is **0.01 mg/m^3** averaged over an 8-hour workshift.

- **Arsenic** is a CARCINOGEN in humans. There may be <u>no</u> safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.
- The above exposure limits are for air levels only. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.

Determining Your Exposure

- Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- For each individual hazardous ingredient, read the New Jersey Department of Health and Senior Services Hazardous Substance Fact Sheet, available on the RTK Program website (www.nj.gov/health/eoh/rtkweb) or in your facility's RTK Central File or Hazard Communication Standard file.
- You have a right to this information under the New Jersey Worker and Community Right to Know Act, the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and the PEOSH Hazard Communication Standard (N.J.A.C. 12:100-7) require employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects

The following acute (short-term) health effects may occur immediately or shortly after exposure to **Arsenic**:

- Skin contact can cause irritation, burns, rash and loss of pigment.
- Eye contact can cause irritation, burns and red, watery eyes.
- Inhaling **Arsenic** can irritate the nose and throat causing coughing and wheezing.
- Exposure to **Arsenic** can cause weakness, poor appetite, nausea, vomiting, headache, muscle cramps and even death.

Chronic Health Effects

The following chronic (long-term) health effects can occur at some time after exposure to **Arsenic** and can last for months or years:

Cancer Hazard

- **Arsenic** is a CARCINOGEN in humans. It has been shown to cause skin and lung cancer.
- Many scientists believe there is no safe level of exposure to a carcinogen.

Reproductive Hazard

- Chronic **Arsenic** exposure has been associated with spontaneous abortions and still births.
- There is limited evidence that **Arsenic** is a teratogen in animals. Until further testing has been done, it should be treated as a possible teratogen in humans.

Other Effects

- Repeated skin contact can cause thickened skin and/or patchy areas of darkening and loss of pigment. Some persons may develop white lines on the nails.
- Long-term exposure can cause an ulcer or hole in the "bone" (septum) dividing the inner nose, hoarseness and sore eyes.
- **Arsenic** may damage the nervous system causing numbness, "pins and needles," and/or weakness in the hands and feet.
- **Arsenic** may damage the liver.

Medical

Medical Testing

Before first exposure and every 12 months thereafter, OSHA requires your employer to provide (for persons exposed to greater than **0.005 mg/m^3** of *Arsenic*) a work and medical history and exam which shall include:

- Chest x-ray
- Exam of the nose, skin and nails
- Test for urine **Arsenic**. This is most accurate at the end of the workday. Eating shellfish or fish may elevate **Arsenic** levels for up to two days. At NIOSH recommended exposure levels, urine **Arsenic** should not be greater than **100 micrograms per liter** of urine.

After suspected overexposure, repeat these tests and consider exam of the nervous system and liver function tests. Also examine your skin periodically for abnormal growth. Skin cancer from **Arsenic** can be easily cured when detected early.

OSHA requires your employer to provide you and your doctor with a copy of the OSHA *Inorganic Arsenic* Standard (29 CFR 1910.1018).

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Mixed Exposures

- More than light alcohol consumption can cause liver damage. Drinking alcohol may increase the liver damage caused by **Arsenic**.

Conditions Made Worse By Exposure

- May scientists believe that skin changes such as thickening and pigment changes make those skin areas more likely to develop skin cancer.

Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- Specific engineering controls are required for this chemical by OSHA. Refer to the OSHA *Inorganic Arsenic* Standard (29 CFR 1910.1018).
- Use a vacuum or a wet method to reduce dust during clean-up. DO NOT DRY SWEEP.
- Use a high efficiency particulate air (HEPA) filter when vacuuming. Do not use a standard shop vacuum.

Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing

- Avoid skin contact with **Arsenic**. Wear personal protective equipment made from material which can not be permeated or degraded by this substance. Safety equipment suppliers and manufacturers can provide recommendations on the most protective glove and clothing material for your operation.
- Safety equipment manufacturers recommend *Nitrile*, *Natural Rubber* or *Silver Shield*® for gloves and DuPont *Tyvek*®, or the equivalent, as protective materials for clothing.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- Wear impact resistant eye protection with side shields.
- Wear a face shield with goggles when working with corrosive, high irritating or toxic substance.

Respiratory Protection

Improper use of respirators is dangerous. Respirators should only be used if the employer has implemented a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- Where the potential exists for exposure not higher than **0.1 mg/m^3**, use a half-mask air purifying respirator equipped with high efficiency filters.
- Where the potential exists for exposure not higher than **0.5 mg/m^3**, use a full facepiece, air purifying respirator with high efficiency filters.
- Where the potential exists for exposure not higher than **5 mg/m^3**, use any powered-air purifying respirator with high efficiency filters or a half-mask supplied-air respirator operated in a positive pressure mode.
- Leave the area immediately if (1) while wearing a filter or cartridge respirator you can smell, taste, or otherwise detect **Arsenic**, (2) while wearing particulate filters abnormal resistance to breathing is experienced, or (3) eye irritation occurs while wearing a full facepiece respirator. Check to make sure the respirator-to-face seal is still good. If it is, replace the filter or cartridge. If the seal is no longer good, you may need a new respirator.
- Consider all potential sources of exposure in your workplace. You may need a combination of filters, prefilters or cartridges to protect against different forms of a chemical (such as vapor and mist) or against a mixture of chemicals.
- Exposure to **5 mg/m^3** is immediately dangerous to life and health. If the possibility of exposure above **5 mg/m^3** exists, use a NIOSH approved self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode equipped with an emergency escape air cylinder.

Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- **Arsenic** is noncombustible, however, **Arsenic** *dust* or *fine powder* can explode when exposed to heat, flame or hot surfaces.
- Use dry chemical, CO_2, water spray or foam as extinguishing agents.
- POISONOUS GASES ARE PRODUCED IN FIRE, including *Arsenic Oxides*.
- Use water spray to keep fire-exposed containers cool.

Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Arsenic** is spilled, take the following steps:

- ▸ Evacuate personnel and secure and control entrance to the area.
- ▸ Eliminate all ignition sources.
- ▸ Collect powdered material in the most convenient and safe manner, or use a HEPA-filter vacuum for clean-up, and deposit in sealed containers.
- ▸ Ventilate area of spill after clean-up is complete.
- ▸ DO NOT wash into sewer.
- ▸ It may be necessary to contain and dispose of **Arsenic** as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

Handling and Storage

Prior to working with **Arsenic** you should be trained on its proper handling and storage.

- ▸ A regulated, marked area should be established where **Arsenic** is handled, used or stored as required by the OSHA *Inorganic Arsenic* Standard (29 CFR 1910.1018).
- ▸ **Arsenic** reacts with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) to cause fires and explosions.
- ▸ **Arsenic** reacts with ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC) and HYDROGEN GAS to produce toxic *Arsine gas*.
- ▸ **Arsenic** is not compatible with *powdered* METALS (such as ZINC, LITHIUM, RUBIDIUM and PLATINUM); BROMINE AZIDE; LEAD MONOXIDE; and MERCURY OXIDE.
- ▸ Store in tightly closed containers in a cool, well-ventilated area away from COMBUSTIBLES and HEAT.
- ▸ DO NOT store in metal tanks.

Occupational Health Information Resources

The New Jersey Department of Health and Senior Services, Occupational Health Service, offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

For more information, please contact:

New Jersey Department of Health & Senior Services
Right to Know Program
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.state.nj.us
Web address: http://www.nj.gov/health/eoh/rtkweb

The Right to Know Hazardous Substance Fact Sheets are not intended to be copied and sold for commercial purposes.

GLOSSARY

ACGIH is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

Acute Exposure Guideline Levels (AEGLs) are established by the EPA. They describe the risk to humans resulting from once-in-a lifetime, or rare, exposure to airborne chemicals.

Boiling point is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

CFR is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

ERG is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

Emergency Response Planning Guideline (ERPG) values are intended to provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group.

Ionization Potential is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

IRIS is the Integrated Risk Information System database maintained by federal EPA. The database contains information on human health effects that may result from exposure to various chemicals in the environment.

LEL or **Lower Explosive Limit**, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

Permeated is the movement of chemicals through protective materials.

PIH is a DOT designation for chemicals which are Poison Inhalation Hazards.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

UEL or **Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

Vapor Density is the ratio of the weight of a given volume of one gas to the weight of another (usually *Hydrogen*), at the same temperature and pressure.

The **vapor pressure** is a measure of how readily a liquid or a solid mixes with air at its surface. A higher vapor pressure indicates a higher concentration of the substance in air and therefore increases the likelihood of breathing it in.

INFORMATION FOR EMERGENCY RESPONDERS

Common Name: **ARSENIC**

Synonyms: Gray Arsenic; Arsen
CAS No: 7440-38-2
Molecular Formula: As
RTK Substance No: 0152
Description: Silver-gray or white metallic, odorless, brittle solid

HAZARD DATA

Hazard Rating	Firefighting	Reactivity
4 - Health **0 - Fire** **0 - Reactivity** **DOT#:** UN 1558 **ERG Guide #:** 152 **Hazard Class:** 6.1 (Poison)	**Arsenic** is noncombustible, however, *Arsenic dust* or *fine powder* can explode when exposed to heat, flame or hot surfaces. Use dry chemical, CO_2, water spray or foam as extinguishing agents. POISONOUS GASES ARE PRODUCED IN FIRE, including *Arsenic Oxides*. Use water spray to keep fire-exposed containers cool.	**Arsenic** reacts with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) to cause fires and explosions. **Arsenic** reacts with ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC) and HYDROGEN GAS to produce toxic *Arsine gas*. **Arsenic** is not compatible with *powdered* METALS (such as ZINC, LITHIUM, RUBIDIUM and PLATINUM); BROMINE AZIDE; LEAD MONOXIDE; and MERCURY OXIDE.

SPILL/LEAKS

Isolation Distance:

Spills: 25 to 50 meters (75 to 150 feet)

Fire: 800 meters (1/2 mile)

Moisten spilled material first or use a HEPA-filter vacuum for clean-up.

DO NOT wash into sewer.

Toxic to aquatic organisms.

PHYSICAL PROPERTIES

Odor Threshold:	Odorless
Flash Point:	Noncombustible solid
Vapor Pressure:	1 mm Hg at 701°F (372°C)
Specific Gravity:	5.7 (water = 1)
Water Solubility:	Insoluble
Boiling Point:	1,350°F (613°C)
Ionization Potential:	9.87 eV
Molecular Weight:	74.9

EXPOSURE LIMITS

OSHA:	0.01 mg/m^3, 8-hr TWA
NIOSH:	0.002 mg/m^3, 15-min Ceiling
ACGIH:	0.01 mg/m^3, 8-hr TWA
IDLH:	5 mg/m^3

PROTECTIVE EQUIPMENT

Gloves:	Natural Rubber, Nitrile or Silver Shield®
Coveralls:	DuPont Tyvek®
Respirator:	<0.1 mg/m^3 - Full facepiece APR with High efficiency filter <0.5 mg/m^3 -Supplied air

HEALTH EFFECTS

Eyes:	Irritation, burns, red and watery eyes
Skin:	Irritation, burns, itching, rash and loss of pigment
Inhalation:	Nose and throat irritation with coughing, wheezing and hoarseness
	Weakness, headache, nausea, vomiting, and muscle cramps
Chronic:	Cancer (skin and lung) in humans

FIRST AID AND DECONTAMINATION

Remove the person from exposure.

Flush eyes with large amounts of water for at least 15 minutes. Remove contact lenses if worn. Seek medical attention.

Quickly remove contaminated clothing and wash contaminated skin with large amounts of soap and water.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer to a medical facility.

New Jersey Department of Health and Senior Services

HAZARDOUS SUBSTANCE FACT SHEET

Common Name: **ASBESTOS**

CAS Number: See last page
DOT Number: NA 2212

RTK Substance number: 0164
Date: September 1994 Revision: January 2001

HAZARD SUMMARY

- **Asbestos** can affect you when breathed in.
- **Asbestos** is a CARCINOGEN--HANDLE WITH EXTREME CAUTION.
- Repeated exposure to **Asbestos** can cause the disease called *Asbestosis*, a scarring of the lungs that results in changes on chest x-rays. *Asbestosis* develops some years (from seven to thirty) after the period of exposure. Symptoms include cough, shortness of breath and chest pain. It can progress to disability and death. The earlier exposure is stopped, the better the chance of stopping serious disease later.

IDENTIFICATION

Asbestos is the common name for a group of mineral fibers that range in color from white, green, brown, to blue. It is used as a fireproofing and insulating agent, and in brake linings.

REASON FOR CITATION

- **Asbestos** is on the Hazardous Substance List because it is regulated by OSHA and cited by ACGIH, DOT, NIOSH, NTP, DEP, IARC, HHAG and EPA.
- This chemical is on the Special Health Hazard Substance List because it is a **CARCINOGEN**.
- Definitions are provided on page 5.

HOW TO DETERMINE IF YOU ARE BEING EXPOSED

The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information and training concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard, 1910.1200, requires private employers to provide similar training and information to their employees.

- Exposure to hazardous substances should be routinely evaluated. This may include collecting personal and area air samples. You can obtain copies of sampling results from your employer. You have a legal right to this information under OSHA 1910.1020.
- If you think you are experiencing any work-related health problems, see a doctor trained to recognize occupational diseases. Take this Fact Sheet with you.

WORKPLACE EXPOSURE LIMITS

The following exposure limits are for fibers longer than **5 micrometers**:

OSHA:	The legal airborne permissible exposure limit (PEL) is **0.1 fiber/cc** (fiber per cubic centimeter) averaged over an 8-hour workshift <u>and</u> **1 fiber/cc** not to be exceeded during any 15 minute work period.
NIOSH:	The recommended airborne exposure limit is **0.1 fiber/cc** averaged over a 10-hour workshift.
ACGIH:	The recommended airborne exposure limit is **0.1 fiber/cc** averaged over an 8-hour workshift.

- **Asbestos** is a CARCINOGEN in humans. There may be <u>no</u> safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.

WAYS OF REDUCING EXPOSURE

- Enclose operations and use local exhaust ventilation at the site of chemical release. If local exhaust ventilation or enclosure is not used, respirators should be worn.
- A regulated, marked area should be established where **Asbestos** is handled, used, or stored as required by the OSHA Standard 29 CFR 1910.1001.
- Wear protective work clothing.
- Wash thoroughly when leaving a regulated area and at the end of the workshift.
- Post hazard and warning information in the work area. In addition, as part of an ongoing education and training effort, communicate all information on the health and safety hazards of **Asbestos** to potentially exposed workers.

This Fact Sheet is a summary source of information of all potential and most severe health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

HEALTH HAZARD INFORMATION

Acute Health Effects

The following acute (short-term) health effects may occur immediately or shortly after exposure to **Asbestos**:

* There are no known acute effects. People who develop serious and fatal disease later in life may feel fine at the time of exposure.

Chronic Health Effects

The following chronic (long-term) health effects can occur at some time after exposure to **Asbestos** and can last for months or years:

Cancer Hazard

* **Asbestos** is a CARCINOGEN in humans. It has been shown to cause lung cancers (including *mesothelioma*), as well as stomach, colon, rectal, vocal cord and kidney cancers.
* Many scientists believe there is no safe level of exposure to a carcinogen.

Reproductive Hazard

* According to the information presently available to the New Jersey Department of Health and Senior Services, **Asbestos** has been tested and has not been shown to affect reproduction.

Other Long-Term Effects

* Repeated exposure to **Asbestos** can cause the disease called *Asbestosis*, a scarring of the lungs that results in changes on chest x-rays. *Asbestosis* develops some years (from seven to thirty) after the period of exposure. Symptoms include cough, shortness of breath and chest pain. It can progress to disability and death. The earlier exposure is stopped, the better the chance of stopping serious disease later.

MEDICAL

Medical Testing

Before beginning employment and at least annually after that, the following are recommended:

* A medical and work history.
* Completion of a standardized questionnaire.
* A physical exam focusing on the pulmonary and gastrointestinal systems.
* Any other exams or tests suggested by the examining physician.

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under OSHA 1910.1020.

Mixed Exposures

* Because smoking can cause heart disease, as well as lung cancer, emphysema, and other respiratory problems, it may worsen respiratory conditions caused by **Asbestos** exposure. Even if you have smoked for a long time, stopping now will reduce your risk of developing health problems.

WORKPLACE CONTROLS AND PRACTICES

Unless a less toxic chemical can be substituted for a hazardous substance, **ENGINEERING CONTROLS** are the most effective way of reducing exposure. The best protection is to enclose operations and/or provide local exhaust ventilation at the site of chemical release. Isolating operations can also reduce exposure. Using respirators or protective equipment is less effective than the controls mentioned above, but is sometimes necessary.

In evaluating the controls present in your workplace, consider: (1) how hazardous the substance is, (2) how much of the substance is released into the workplace and (3) whether harmful skin or eye contact could occur. Special controls should be in place for highly toxic chemicals or when significant skin, eye, or breathing exposures are possible.

In addition, the following controls are recommended:

* Specific engineering controls are required for this chemical by OSHA. Refer to the OSHA Standard for General Industry: 1910.1001, and the OSHA Standard for Construction: 1926.1101.
* Substitute the less toxic *mineral wool* and *fiberglass* for **Asbestos** where possible. There are substitutes for almost every use of **Asbestos**.
* There are extensive recommended and required engineering and procedural regulations for construction and repair projects involving **Asbestos** material. Before disturbing any **Asbestos** containing materials, contact the NJDHSS for more information.

Good **WORK PRACTICES** can help to reduce hazardous exposures. The following work practices are recommended:

* Workers whose clothing has been contaminated by **Asbestos** should change into clean clothing promptly.
* Do not take contaminated work clothes home. Family members could be exposed.

- Contaminated work clothes should be laundered by individuals who have been informed of the hazards of exposure to **Asbestos**.
- Wash any areas of the body that may have contacted **Asbestos**.
- Do not eat, smoke, or drink where **Asbestos** is handled, processed, or stored, since the chemical can be swallowed. Wash hands carefully before eating, drinking, smoking, or using the toilet.
- Ongoing **Asbestos** abatement projects in sealed areas become very hot and humid. There is a risk of heat stress. You should be trained by your employer to recognize the warning signs and the proper actions to take to avoid seriously dangerous working conditions.
- Use a vacuum or a wet method to reduce dust during clean-up. DO NOT DRY SWEEP.
- When vacuuming, a high efficiency particulate air (HEPA) filter should be used, not a standard shop vacuum.

PERSONAL PROTECTIVE EQUIPMENT

WORKPLACE CONTROLS ARE BETTER THAN PERSONAL PROTECTIVE EQUIPMENT. However, for some jobs (such as outside work, confined space entry, jobs done only once in a while, or jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

OSHA 1910.132 requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Clothing

- Avoid skin contact with **Asbestos**. Wear protective gloves and clothing. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation.
- Contaminated, disposable, work clothes must be disposed of with **Asbestos** waste.
- Non-disposable clothing must be placed in properly labeled plastic bags for laundering or decontamination by the employer.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- Eye protection is included in the recommended respiratory protection.

Respiratory Protection

IMPROPER USE OF RESPIRATORS IS DANGEROUS. Such equipment should only be used if the employer has a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing and medical exams, as described in OSHA 1910.134.

The OSHA Standard 29 CFR 1910.1001 requires the following respiratory protection:

- Where the potential exists for exposure over **0.1 fiber/cc**, use a half-mask air purifying respirator equipped with high efficiency filters. Disposable respirators are not permitted.
- Where the potential exists for exposure over **1 fiber/cc**, use a full facepiece air purifying respirator equipped with high efficiency filters.
- For exposures over **5 fibers/cc**, use a powered air-purifying respirator equipped with high efficiency filters or any supplied air respirator operated in the continuous flow mode.
- For exposures over **10 fibers/cc** use a full facepiece supplied air respirator operated in the pressure-demand mode.
- If exposures are greater than **100 fibers/cc** use a full facepiece supplied air respirator operated in the pressure-demand mode equipped with an auxiliary positive-pressure self-contained breathing apparatus.
- The New Jersey Department of Health and Senior Services recommends that during **Asbestos** abatement projects, when it is impossible to use supplied air or self-contained breathing apparatus, a full facepiece powered air purifying respirator with high efficiency particulate filters be used.

HANDLING AND STORAGE

- Prior to working with **Asbestos** you should be trained on its proper handling and storage.
- A regulated, marked area should be established where **Asbestos** is handled, used, or stored.
- Airborne **Asbestos** dust is very difficult to remove. It is essential that any area where **Asbestos** is handled be enclosed and isolated. The material should be kept wet with special surfactants and water.
- Enclose operations and use local exhaust ventilation with negative pressure air filtration and high efficiency particulate filers in area of **Asbestos** removal. If enclosure with containment "glove" bags is not used for minor repairs, respirators must be worn and proper procedures must be followed.
- All **Asbestos** materials must be removed and disposed of according to regulations. The area must be monitored to ensure airborne **Asbestos** levels are below limits prior to reoccupation of the area where **Asbestos** was disturbed.

QUESTIONS AND ANSWERS

Q: If I have acute health effects, will I later get chronic health effects?
A: Not always. Most chronic (long-term) effects result from repeated exposures to a chemical.

Q: Can I get long-term effects without ever having short-term effects?
A: Yes, because long-term effects can occur from repeated exposures to a chemical at levels not high enough to make you immediately sick.

Q: What are my chances of getting sick when I have been exposed to chemicals?
A: The likelihood of becoming sick from chemicals is increased as the amount of exposure increases. This is determined by the length of time and the amount of material to which someone is exposed.

Q: When are higher exposures more likely?
A: Conditions which increase risk of exposure include dust releasing operations (grinding, mixing, blasting, dumping, etc.), other physical and mechanical processes (heating, pouring, spraying, spills and evaporation from large surface areas such as open containers), and "confined space" exposures (working inside vats, reactors, boilers, small rooms, etc.).

Q: Is the risk of getting sick higher for workers than for community residents?
A: Yes. Exposures in the community, except possibly in cases of fires or spills, are usually much lower than those found in the workplace. However, people in the community may be exposed to contaminated water as well as to chemicals in the air over long periods. This may be a problem for children or people who are already ill.

Q: Don't all chemicals cause cancer?
A: No. Most chemicals tested by scientists are not cancer-causing.

The following information is available from:

New Jersey Department of Health and Senior Services
Occupational Health Service
PO Box 360
Trenton, NJ 08625-0360
(609) 984-1863
(609) 292-5677 (fax)

Web address: http://www.state.nj.us/health/eoh/odisweb/

Industrial Hygiene Information
Industrial hygienists are available to answer your questions regarding the control of chemical exposures using exhaust ventilation, special work practices, good housekeeping, good hygiene practices, and personal protective equipment including respirators. In addition, they can help to interpret the results of industrial hygiene survey data.

Medical Evaluation
If you think you are becoming sick because of exposure to chemicals at your workplace, you may call personnel at the Department of Health and Senior Services, Occupational Health Service, who can help you find the information you need.

Public Presentations
Presentations and educational programs on occupational health or the Right to Know Act can be organized for labor unions, trade associations and other groups.

Right to Know Information Resources
The Right to Know Infoline (609) 984-2202 can answer questions about the identity and potential health effects of chemicals, list of educational materials in occupational health, references used to prepare the Fact Sheets, preparation of the Right to Know survey, education and training programs, labeling requirements, and general information regarding the Right to Know Act. Violations of the law should be reported to (609) 984-2202.

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits (called TLVs) for exposure to workplace chemicals.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is assigned by the Chemical Abstracts Service to identify a specific chemical.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes irreversible damage to human tissue or containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

HHAG is the Human Health Assessment Group of the federal EPA.

IARC is the International Agency for Research on Cancer, a scientific group that classifies chemicals according to their cancer-causing potential.

A **miscible** substance is a liquid or gas that will evenly dissolve in another.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NAERG is the North American Emergency Response Guidebook. It was jointly developed by Transport Canada, the United States Department of Transportation and the Secretariat of Communications and Transportation of Mexico. It is a guide for first responders to quickly identify the specific or generic hazards of material involved in a transportation incident, and to protect themselves and the general public during the initial response phase of the incident.

NCI is the National Cancer Institute, a federal agency that determines the cancer-causing potential of chemicals.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the Public Employees Occupational Safety and Health Act, a state law which sets PELs for New Jersey public employees.

PIH is a DOT designation for chemicals which are Poison Inhalation Hazards.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

TLV is the Threshold Limit Value, the workplace exposure limit recommended by ACGIH.

The **vapor pressure** is a measure of how readily a liquid or a solid mixes with air at its surface. A higher vapor pressure indicates a higher concentration of the substance in air and therefore increases the likelihood of breathing it in.

>>>>>>>>>>>>>>>>>> EMERGENCY INFORMATION <<<<<<<<<<<<<<<<<<

Common Name:	**ASBESTOS**
DOT Number:	**NA 2212**
NAERG Code:	**171**
CAS Number:	**See below**

Hazard rating	NJDHSS	NFPA
FLAMMABILITY	0	-
REACTIVITY	0	-
CARCINOGEN		

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

FIRE HAZARDS

* Extinguish fire using an agent suitable for type of surrounding fire. **Asbestos** itself does not burn.
* Care should be taken to contain **Asbestos** materials disturbed in a fire.
* If employees are expected to fight fires, they must be trained and equipped as stated in OSHA 1910.156.

SPILLS AND EMERGENCIES

If **Asbestos** is spilled, or **Asbestos**-containing materials are damaged, take the following steps:

* Evacuate persons not wearing protective equipment from area of spill until clean-up is complete.
* Repair or removal of **Asbestos** must be conducted by trained personnel.
* **Asbestos** must be wetted, enclosed and/or ventilated prior to removal.
* It may be necessary to contain and dispose of **Asbestos** as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.
* If employees are required to clean-up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

FOR LARGE SPILLS AND FIRES immediately call your fire department. You can request emergency information from the following:

CHEMTREC: (800) 424-9300
NJDEP HOTLINE: 1-877-WARN-DEP

HANDLING AND STORAGE (See page 3)

FIRST AID

In NJ, for POISON INFORMATION call 1-800-764-7661

Eye Contact

* Immediately flush with large amounts of water for at least 15 minutes, occasionally lifting upper and lower lids.

Skin Contact

* Remove contaminated clothing. Wash contaminated skin with soap and water.

Breathing

* Remove the person from exposure.
* Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
* Transfer promptly to a medical facility.

PHYSICAL DATA

Vapor Pressure: 0 mm Hg at 68°F (20°C)

OTHER COMMONLY USED NAMES

Asbestos is the common name for any of the following:

Asbestos (no specification)	CAS # 1332-21-4
Asbestos, Actinolite	CAS # 77536-66-4
Asbestos, Amosite	CAS # 12172-73-5
Asbestos, Anthophyllite	CAS # 77536-67-5
Asbestos, Chrysotile	CAS # 12001-29-5
Asbestos, Crocidolite	CAS # 12001-28-4
Asbestos, Tremolite	CAS # 77536-68-6

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NEW JERSEY DEPARTMENT OF HEALTH AND
SENIOR SERVICES
Right to Know Program
PO Box 368, Trenton, NJ 08625-0368
(609) 984-2202

Right to Know
Hazardous Substance Fact Sheet

Common Name: **POLYCHLORINATED BIPHENYLS**

Synonyms: Aroclor; Chlorodiphenyls; PCBs

Chemical Name: 1,1'-Biphenyl, Chloro Derivs.

Date: April 2002 Revision: November 2008

CAS Number: 1336-36-3

RTK Substance Number: 1554

DOT Number: UN 2315

Description and Use

Polychlorinated Biphenyls are light yellow or colorless, thick, oily liquids. They are used in hydraulic and heat transfer liquids. They were formally used in electrical capacitators and transformers.

Reasons for Citation

- **Polychlorinated Biphenyls** are on the Right to Know Hazardous Substance List because they are cited by OSHA, ACGIH, DOT, NIOSH, NTP, DEP, IARC, IRIS, NFPA and EPA.
- This chemical is on the Special Health Hazard Substance List.

SEE GLOSSARY ON PAGE 5.

FIRST AID

Eye Contact

- Immediately flush with large amounts of water for at least 15 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while rinsing.

Skin Contact

- Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water.

Inhalation

- Remove the person from exposure
- Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
- Transfer promptly to a medical facility.

EMERGENCY NUMBERS

Poison Control: 1-800-222-1222

CHEMTREC: 1-800-424-9300

NJDEP Hotline: 1-877-927-6337

National Response Center: 1-800-424-8802

EMERGENCY RESPONDERS >>>> SEE PAGE 6

Hazard Summary

Hazard Rating	NJDHSS	NFPA
HEALTH	3	2
FLAMMABILITY	-	1
REACTIVITY	-	0
CARCINOGEN TERATOGEN POISONOUS GASES ARE PRODUCED IN FIRE		

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

- **Polychlorinated Biphenyls** can affect you when inhaled and by passing through the skin.
- **Polychlorinated Biphenyls** should be handled as CARCINOGENS and may be TERATOGENS. HANDLE WITH EXTREME CAUTION.
- Contact can irritate the skin and eyes.
- **Polychlorinated Biphenyls** may cause brownish pigmentation of the skin, eyes and fingernails.
- Skin contact may cause an acne-like rash (chloracne).
- Inhaling the vapors can irritate the nose, throat and lungs.
- Exposure to **Polychlorinated Biphenyls** can cause headache, nausea, vomiting, loss of weight and abdominal pain.
- High exposure can damage the nervous system causing headache, numbness, weakness, and tingling ("pins and needles) in the arms and legs.
- **Polychlorinated Biphenyls** may damage the liver.

Workplace Exposure Limits

OSHA: The legal airborne permissible exposure limit (PEL) is **1 mg/m^3** (42% *Chlorine*) and **0.5 mg/m^3** (54% *Chlorine*) averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit (REL) is **0.001 mg/m^3** averaged over a 10-hour workshift.

ACGIH: The threshold limit value (TLV) is **1 mg/m^3** (42% *Chlorine*) and **0.5 mg/m^3** (54% *Chlorine*) averaged over an 8-hour workshift.

- **Polychlorinated Biphenyls** are PROBABLE CARCINOGENS and TERATOGENS in humans. There may be no safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.
- The above exposure limits are for air levels only. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.

Determining Your Exposure

- Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- For each individual hazardous ingredient, read the New Jersey Department of Health and Senior Services Hazardous Substance Fact Sheet, available on the RTK Program website (www.nj.gov/health/eoh/rtkweb) or in your facility's RTK Central File or Hazard Communication Standard file.
- You have a right to this information under the New Jersey Worker and Community Right to Know Act, the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and the PEOSH Hazard Communication Standard (N.J.A.C. 12:100-7) require employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects
The following acute (short-term) health effects may occur immediately or shortly after exposure to **Polychlorinated Biphenyls**:

- Contact can irritate the skin and eyes.
- Inhaling the vapors can irritate the nose, throat and lungs causing coughing, wheezing and/or shortness of breath.
- Exposure to **Polychlorinated Biphenyls** can cause headache, nausea, vomiting, loss of weight and abdominal pain.

Chronic Health Effects
The following chronic (long-term) health effects can occur at some time after exposure to **Polychlorinated Biphenyls** and can last for months or years:

Cancer Hazard
- **Polychlorinated Biphenyls** are PROBABLE CARCINOGENS in humans. There is evidence that they cause cancer of the skin, brain, and pancreas in humans and have been shown to cause liver and pituitary cancer, and leukemia, in animals.
- Many scientists believe there is no safe level of exposure to a carcinogen.

Reproductive Hazard
- **Polychlorinated Biphenyls** may be TERATOGENS in humans since they are teratogens in animals.
- There is limited evidence that **Polychlorinated Biphenyls** may affect male and female fertility.

Other Effects
- **Polychlorinated Biphenyls** may cause brownish pigmentation of the skin, eyes and fingernails.
- Skin contact may cause an acne-like rash (chloracne).
- High exposure can damage the nervous system causing headache, numbness, weakness, and tingling ("pins and needles) in the arms and legs.
- **Polychlorinated Biphenyls** may damage the liver.

Medical

Medical Testing
Before beginning employment and at regular times after that, for frequent or potentially high exposures, the following are recommended:

- Liver function tests
- Exam of the skin and fingernails

If symptoms develop or overexposure is suspected, the following are recommended:

- Blood PCB levels
- Exam of the nervous system

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Mixed Exposures
- More than light alcohol consumption can cause liver damage. Drinking alcohol can increase the liver damage caused by **Polychlorinated Biphenyls**.

Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- Where possible, transfer **Polychlorinated Biphenyls** from drums or other containers to process containers in an enclosed system.

Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing

- Avoid skin contact with **Polychlorinated Biphenyls**. Wear personal protective equipment made from material which can not be permeated or degraded by this substance. Safety equipment suppliers and manufacturers can provide recommendations on the most protective glove and clothing material for your operation.
- Safety equipment manufacturers recommend Butyl, Neoprene, Polyvinyl Chloride, Silver Shield®/4H® and Viton for gloves, and Tychem® CPF 2, SL, CPF 4 and Responder®, or the equivalent, as protective materials for clothing.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- Wear indirect-vent, impact and splash resistant goggles when working with liquids.
- Wear a face shield along with goggles when working with corrosive, highly irritating or toxic substances.

Respiratory Protection

Improper use of respirators is dangerous. Respirators should only be used if the employer has implemented a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- Where the potential exists for exposure over **0.001 mg/m^3**, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.
- Exposure to **5 mg/m^3** is immediately dangerous to life and health. If the possibility of exposure above **5 mg/m^3** exists, use a NIOSH approved self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode equipped with an emergency escape air cylinder.

Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- **Polychlorinated Biphenyls** may burn, but do not readily ignite.
- Use dry chemical, CO_2, water spray or alcohol-resistant foam as extinguishing agents.
- POISONOUS GASES ARE PRODUCED IN FIRE, including *Polychlorinated Dibenzofurans* and *Chlorinated Dibenzo-p-dioxins*.
- Use water spray to keep fire-exposed containers cool.

Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Polychlorinated Biphenyls** are spilled or leaked, take the following steps:

- ▸ Evacuate personnel and secure and control entrance to the area.
- ▸ Eliminate all ignition sources.
- ▸ Absorb liquids in vermiculite, dry sand, earth, or a similar material and place into sealed containers for disposal.
- ▸ Ventilate and wash area after clean-up is complete.
- ▸ DO NOT wash into sewer.
- ▸ It may be necessary to contain and dispose of **Polychlorinated Biphenyls** as HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

Handling and Storage

Prior to working with **Polychlorinated Biphenyls** you should be trained on its proper handling and storage.

- ▸ **Polychlorinated Biphenyls** are not compatible with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) and STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC).
- ▸ Store in tightly closed containers in a cool, well-ventilated area away from STRONG ULTRAVIOLET LIGHT and SUNLIGHT.

Occupational Health Information Resources

The New Jersey Department of Health and Senior Services, Occupational Health Service, offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

For more information, please contact:

New Jersey Department of Health & Senior Services
Right to Know Program
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.state.nj.us
Web address: http://www.nj.gov/health/eoh/rtkweb

The Right to Know Hazardous Substance Fact Sheets are not intended to be copied and sold for commercial purposes.

GLOSSARY

ACGIH is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

Acute Exposure Guideline Levels (AEGLs) are established by the EPA. They describe the risk to humans resulting from once-in-a lifetime, or rare, exposure to airborne chemicals.

Boiling point is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

CFR is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

ERG is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

Emergency Response Planning Guideline (ERPG) values provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group.

Ionization Potential is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

IRIS is the Integrated Risk Information System database on human health effects that may result from exposure to various chemicals, maintained by federal EPA.

LEL or **Lower Explosive Limit**, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

Permeated is the movement of chemicals through protective materials.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

Protective Action Criteria (PAC) are values established by the Department of Energy and are based on AEGLs and ERPGs. They are used for emergency planning of chemical release events.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

UEL or **Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

Vapor Density is the ratio of the weight of a given volume of one gas to the weight of another (usually *Hydrogen*), at the same temperature and pressure.

The **vapor pressure** is a force exerted by the vapor in equilibrium with the solid or liquid phase of the same substance. The higher the vapor pressure the higher concentration of the substance in air.

INFORMATION FOR EMERGENCY RESPONDERS

Common Name: **POLYCHLORINATED BIPHENYLS**

Synonyms: Aroclor; Chlorodiphenyls; PCBs
CAS No: 1336-36-3
Molecular Formula: $C_{12}H_{10-n}Cl_n$
RTK Substance No: 1554
Description: Light yellow or colorless, thick, oily liquids

HAZARD DATA

Hazard Rating	Firefighting	Reactivity
3 - Health **1 - Fire** **0 - Reactivity** **DOT#:** UN 2315 **ERG Guide #:** 171 **Hazard Class:** 9 (Miscellaneous Hazardous Materials)	**Polychlorinated Biphenyls** may burn, but do not readily ignite. Use dry chemical, CO_2, water spray or alcohol-resistant foam as extinguishing agents. POISONOUS GASES ARE PRODUCED IN FIRE, including *Polychlorinated Dibenzofurans* and *Chlorinated Dibenzo-p-dioxins*. Use water spray to keep fire-exposed containers cool.	**Polychlorinated Biphenyls** are not compatible with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) and STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC).

SPILL/LEAKS

Isolation Distance:

Spills: 50 meters (150 feet)

Fire: 800 meters (1/2 mile)

Absorb liquids in vermiculite, dry sand, earth, or a similar material and place into sealed containers for disposal.

DO NOT wash into sewer.

Polychlorinated Biphenyls bioaccumulate and are hazardous to the environment.

PHYSICAL PROPERTIES

Flash Point:	286° to 385°F (141° to 196°C)
Auto Ignition Temp:	464°F (240°C)
Vapor Pressure:	0.001 mm Hg at 68°F (20°C)
Specific Gravity:	1.3 (water = 1)
Water Solubility:	Insoluble
Boiling Point:	617° to 734°F (325° to 390°C)
Melting Point:	-2° to 50°F (-19° to 10°C)
Molecular Weight:	258 to 326

EXPOSURE LIMITS

OSHA:	1 mg/m^3, 8-hr TWA (42% *Chlorine*) and 0.5 mg/m^3, 8-hr TWA (54% *Chlorine*)
NIOSH:	0.001 mg/m^3, 10-hr TWA
ACGIH:	1 mg/m^3, 8-hr TWA (42% *Chlorine*) and 0.5 mg/m^3, 8-hr TWA (54% *Chlorine*)
IDLH:	5 mg/m^3

PROTECTIVE EQUIPMENT

Gloves:	Butyl, Neoprene, Polyvinyl Chloride, Silver Shield®/4H® and Viton (>4-hr breakthrough)
Coveralls:	Tychem® CPF 2, SL, CPF 4 and Responder® (>8-hr breakthrough)
Respirator:	>0.001 mg/m^3 - Supplied air or SCBA

HEALTH EFFECTS

Eyes:	Irritation
Skin:	Irritation
Inhalation:	Nose, throat and lung irritation with coughing, wheezing and shortness of breath Headache, nausea, vomiting, and abdominal pain
Chronic:	Cancer (skin, brain, pancreas) in humans

FIRST AID AND DECONTAMINATION

Remove the person from exposure.

Flush eyes with large amounts of water for at least 15 minutes. Remove contact lenses if worn.

Quickly remove contaminated clothing and wash contaminated skin with large amounts of soap and water.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer promptly to a medical facility

New Jersey Department of Health and Senior Services

HAZARDOUS SUBSTANCE FACT SHEET

Common Name: **TETRACHLOROETHYLENE**

CAS Number: 127-18-4
DOT Number: UN 1897

RTK Substance number: 1810
Date: April 1996 Revision: March 2002

HAZARD SUMMARY

- **Tetrachloroethylene** can affect you when breathed in and by passing through your skin.
- **Tetrachloroethylene** should be handled as a CARCINOGEN--WITH EXTREME CAUTION.
- **Tetrachloroethylene** can cause reproductive damage. Handle with extreme caution.
- Contact can cause skin irritation, burns and drying and cracking of the skin.
- Exposure to **Tetrachloroethylene** can irritate the eyes, nose, mouth and throat.
- High exposure can cause headache, dizziness, lightheadedness, nausea, vomiting and even passing out.
- Breathing **Tetrachloroethylene** can irritate the lungs causing coughing and/or shortness of breath. Higher exposures can cause a build-up of fluid in the lungs (pulmonary edema), a medical emergency, with severe shortness of breath.
- **Tetrachloroethylene** may damage the liver and kidneys and affect the nervous system.

IDENTIFICATION

Tetrachloroethylene is a clear liquid with a sweet *Chloroform*-like odor. It is used in dry cleaning and metal degreasing.

REASON FOR CITATION

- **Tetrachloroethylene** is on the Hazardous Substance List because it is regulated by OSHA and cited by ACGIH, DOT, NIOSH, NTP, DEP, IARC, HHAG, NFPA and EPA.
- This chemical is on the Special Health Hazard Substance List because it is a **CARCINOGEN**.
- Definitions are provided on page 5.

HOW TO DETERMINE IF YOU ARE BEING EXPOSED

The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information and training concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard, 1910.1200, requires private employers to provide similar training and information to their employees.

- Exposure to hazardous substances should be routinely evaluated. This may include collecting personal and area air samples. You can obtain copies of sampling results from your employer. You have a legal right to this information under OSHA 1910.1020.
- If you think you are experiencing any work-related health problems, see a doctor trained to recognize occupational diseases. Take this Fact Sheet with you.
- **ODOR THRESHOLD = 47 ppm**.
- The range of accepted odor threshold values is quite broad. Caution should be used in relying on odor alone as a warning of potentially hazardous exposures.

WORKPLACE EXPOSURE LIMITS

OSHA: The legal airborne permissible exposure limit (PEL) is **100 ppm** averaged over an 8-hour workshift, **200 ppm** not to be exceeded during any 15 minute work period, and **300 ppm** for 5 minutes during any 3 hours.

NIOSH: Recommends that exposure to occupational carcinogens be limited to the lowest feasible concentration.

ACGIH: The recommended airborne exposure limit is **25 ppm** averaged over an 8-hour workshift and **100 ppm** as a STEL (short-term exposure limit).

- **Tetrachloroethylene** may be a CARCINOGEN in humans. There may be no safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.
- The above exposure limits are for air levels only. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.

WAYS OF REDUCING EXPOSURE

- Where possible, enclose operations and use local exhaust ventilation at the site of chemical release. If local exhaust ventilation or enclosure is not used, respirators should be worn.
- Wear protective work clothing.
- Wash thoroughly immediately after exposure to **Tetrachloroethylene** and at the end of the workshift.

* Post hazard and warning information in the work area. In addition, as part of an ongoing education and training effort, communicate all information on the health and safety hazards of **Tetrachloroethylene** to potentially exposed workers.

This Fact Sheet is a summary source of information of all potential and most severe health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

HEALTH HAZARD INFORMATION

Acute Health Effects

The following acute (short-term) health effects may occur immediately or shortly after exposure to **Tetrachloroethylene**:

* Contact can cause skin irritation and burns.
* Exposure to **Tetrachloroethylene** can irritate the eyes, nose, mouth and throat.
* High exposure can cause headache, dizziness, lightheadedness, nausea, vomiting and even passing out.
* Breathing **Tetrachloroethylene** can irritate the lungs causing coughing and/or shortness of breath. Higher exposures can cause a build-up of fluid in the lungs (pulmonary edema), a medical emergency, with severe shortness of breath.

Chronic Health Effects

The following chronic (long-term) health effects can occur at some time after exposure to **Tetrachloroethylene** and can last for months or years:

Cancer Hazard

* **Tetrachloroethylene** may be a CARCINOGEN in humans since it has been shown to cause liver cancer in animals.
* Many scientists believe there is no safe level of exposure to a carcinogen.

Reproductive Hazard

* **Tetrachloroethylene** may damage the developing fetus.

Other Long-Term Effects

* **Tetrachloroethylene** may damage the liver and kidneys and affect the nervous system.
* Long-term exposure can cause drying and cracking of the skin.

MEDICAL

Medical Testing

For those with frequent or potentially high exposure (half the PEL or greater, or significant skin contact), the following are recommended before beginning work and at regular times after that:

* Liver and kidney function tests.
* Exam of the nervous system.

If symptoms develop or overexposure is suspected, the following is recommended:

* Consider chest x-ray after acute overexposure.

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under OSHA 1910.1020.

Mixed Exposures

* Because more than light alcohol consumption can cause liver damage, drinking alcohol can increase the liver damage caused by **Tetrachloroethylene**.
* Because smoking can cause heart disease, as well as lung cancer, emphysema, and other respiratory problems, it may worsen respiratory conditions caused by chemical exposure. Even if you have smoked for a long time, stopping now will reduce your risk of developing health problems.

WORKPLACE CONTROLS AND PRACTICES

Unless a less toxic chemical can be substituted for a hazardous substance, **ENGINEERING CONTROLS** are the most effective way of reducing exposure. The best protection is to enclose operations and/or provide local exhaust ventilation at the site of chemical release. Isolating operations can also reduce exposure. Using respirators or protective equipment is less effective than the controls mentioned above, but is sometimes necessary.

In evaluating the controls present in your workplace, consider: (1) how hazardous the substance is, (2) how much of the substance is released into the workplace and (3) whether harmful skin or eye contact could occur. Special controls should be in place for highly toxic chemicals or when significant skin, eye, or breathing exposures are possible.

In addition, the following control is recommended:

* Where possible, automatically pump liquid **Tetrachloroethylene** from drums or other storage containers to process containers.

Good **WORK PRACTICES** can help to reduce hazardous exposures. The following work practices are recommended:

* Workers whose clothing has been contaminated by **Tetrachloroethylene** should change into clean clothing promptly.

- * Contaminated work clothes should be laundered by individuals who have been informed of the hazards of exposure to **Tetrachloroethylene**.
- * Eye wash fountains should be provided in the immediate work area for emergency use.
- * If there is the possibility of skin exposure, emergency shower facilities should be provided.
- * On skin contact with **Tetrachloroethylene**, immediately wash or shower to remove the chemical. At the end of the workshift, wash any areas of the body that may have contacted **Tetrachloroethylene**, whether or not known skin contact has occurred.
- * Do not eat, smoke, or drink where **Tetrachloroethylene** is handled, processed, or stored, since the chemical can be swallowed. Wash hands carefully before eating, drinking, applying cosmetics, smoking, or using the toilet.

PERSONAL PROTECTIVE EQUIPMENT

WORKPLACE CONTROLS ARE BETTER THAN PERSONAL PROTECTIVE EQUIPMENT. However, for some jobs (such as outside work, confined space entry, jobs done only once in a while, or jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

OSHA 1910.132 requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Clothing

- * Avoid skin contact with **Tetrachloroethylene**. Wear protective gloves and clothing. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation.
- * All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.
- * ACGIH recommends *Nitrile Rubber, Polyvinyl Alcohol* and *Viton* as protective materials.

Eye Protection

- * Wear indirect-vent, impact and splash resistant goggles when working with liquids.
- * Wear a face shield along with goggles when working with corrosive, highly irritating or toxic substances.
- * Contact lenses should not be worn when working with this substance.

Respiratory Protection

IMPROPER USE OF RESPIRATORS IS DANGEROUS. Such equipment should only be used if the employer has a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing and medical exams, as described in OSHA 1910.134.

- * Where the potential exists for exposure over **25 ppm**, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.
- * Exposure to **150 ppm** is immediately dangerous to life and health. If the possibility of exposure above **150 ppm** exists, use a NIOSH approved self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode.

QUESTIONS AND ANSWERS

Q: If I have acute health effects, will I later get chronic health effects?
A: Not always. Most chronic (long-term) effects result from repeated exposures to a chemical.

Q: Can I get long-term effects without ever having short-term effects?
A: Yes, because long-term effects can occur from repeated exposures to a chemical at levels not high enough to make you immediately sick.

Q: What are my chances of getting sick when I have been exposed to chemicals?
A: The likelihood of becoming sick from chemicals is increased as the amount of exposure increases. This is determined by the length of time and the amount of material to which someone is exposed.

Q: When are higher exposures more likely?
A: Conditions which increase risk of exposure include <u>physical and mechanical processes</u> (heating, pouring, spraying, spills and evaporation from large surface areas such as open containers), and <u>"confined space" exposures</u> (working inside vats, reactors, boilers, small rooms, etc.).

Q: Is the risk of getting sick higher for workers than for community residents?
A: Yes. Exposures in the community, except possibly in cases of fires or spills, are usually much lower than those found in the workplace. However, people in the community may be exposed to contaminated water as well as to chemicals in the air over long periods. This may be a problem for children or people who are already ill.

Q: Don't all chemicals cause cancer?
A: No. Most chemicals tested by scientists are not cancer-causing.

Q: Should I be concerned if a chemical causes cancer in animals?
A: Yes. Most scientists agree that a chemical that causes cancer in animals should be treated as a suspected human carcinogen unless proven otherwise.

Q: But don't they test animals using much higher levels of a chemical than people usually are exposed to?

A: Yes. That's so effects can be seen more clearly using fewer animals. But high doses alone don't cause cancer unless it's a cancer agent. In fact, a chemical that causes cancer in animals at high doses could cause cancer in humans exposed to low doses.

Q: Can men as well as women be affected by chemicals that cause reproductive system damage?

A: Yes. Some chemicals reduce potency or fertility in both men and women. Some damage sperm and eggs, possibly leading to birth defects.

Q: Who is at the greatest risk from reproductive hazards?

A: Pregnant women are at greatest risk from chemicals that harm the developing fetus. However, chemicals may affect the ability to have children, so both men and women of childbearing age are at high risk.

The following information is available from:

New Jersey Department of Health and Senior Services
Occupational Health Service
PO Box 360
Trenton, NJ 08625-0360
(609) 984-1863
(609) 984-7407 (fax)

Web address: http://www.state.nj.us/health/eoh/odisweb/

Industrial Hygiene Information

Industrial hygienists are available to answer your questions regarding the control of chemical exposures using exhaust ventilation, special work practices, good housekeeping, good hygiene practices, and personal protective equipment including respirators. In addition, they can help to interpret the results of industrial hygiene survey data.

Medical Evaluation

If you think you are becoming sick because of exposure to chemicals at your workplace, you may call personnel at the Department of Health and Senior Services, Occupational Health Service, who can help you find the information you need.

Public Presentations

Presentations and educational programs on occupational health or the Right to Know Act can be organized for labor unions, trade associations and other groups.

Right to Know Information Resources

The Right to Know Infoline (609) 984-2202 can answer questions about the identity and potential health effects of chemicals, list of educational materials in occupational health, references used to prepare the Fact Sheets, preparation of the Right to Know Survey, education and training programs, labeling requirements, and general information regarding the Right to Know Act. Violations of the law should be reported to (609) 984-2202.

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits (called TLVs) for exposure to workplace chemicals.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is assigned by the Chemical Abstracts Service to identify a specific chemical.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes irreversible damage to human tissue or containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

HHAG is the Human Health Assessment Group of the federal EPA.

IARC is the International Agency for Research on Cancer, a scientific group that classifies chemicals according to their cancer-causing potential.

A **miscible** substance is a liquid or gas that will evenly dissolve in another.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NAERG is the North American Emergency Response Guidebook. It was jointly developed by Transport Canada, the United States Department of Transportation and the Secretariat of Communications and Transportation of Mexico. It is a guide for first responders to quickly identify the specific or generic hazards of material involved in a transportation incident, and to protect themselves and the general public during the initial response phase of the incident.

NCI is the National Cancer Institute, a federal agency that determines the cancer-causing potential of chemicals.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEL is the Permissible Exposure Limit which is enforceable by the Occupational Safety and Health Administration.

PIH is a DOT designation for chemicals which are Poison Inhalation Hazards.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

TLV is the Threshold Limit Value, the workplace exposure limit recommended by ACGIH.

The **vapor pressure** is a measure of how readily a liquid or a solid mixes with air at its surface. A higher vapor pressure indicates a higher concentration of the substance in air and therefore increases the likelihood of breathing it in.

>>>>>>>>>>>>>>>>>>> EMERGENCY INFORMATION <<<<<<<<<<<<<<<<<<<

Common Name: **TETRACHLOROETHYLENE**
DOT Number: **UN 1897**
NAERG Code: **160**
CAS Number: **127-18-4**

Hazard rating	NJDHSS	NFPA
FLAMMABILITY	-	0
REACTIVITY	-	0
CARCINOGEN POISONOUS GASES ARE PRODUCED IN FIRE CONTAINERS MAY EXPLODE IN FIRE		

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

FIRE HAZARDS

- Extinguish fire using an agent suitable for type of surrounding fire. **Tetrachloroethylene** itself does not burn.
- POISONOUS GASES ARE PRODUCED IN FIRE, including *Hydrogen Chloride* and *Phosgene*.
- CONTAINERS MAY EXPLODE IN FIRE.
- Use water spray to keep fire-exposed containers cool.
- If employees are expected to fight fires, they must be trained and equipped as stated in OSHA 1910.156.

SPILLS AND EMERGENCIES

If **Tetrachloroethylene** is spilled or leaked, take the following steps:

- Evacuate persons not wearing protective equipment from area of spill or leak until clean-up is complete.
- Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers.
- Ventilate and wash area after clean-up is complete.
- It may be necessary to contain and dispose of **Tetrachloroethylene** as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.
- If employees are required to clean-up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

FOR LARGE SPILLS AND FIRES immediately call your fire department. You can request emergency information from the following:

CHEMTREC: (800) 424-9300
NJDEP HOTLINE: 1-877-WARN-DEP

HANDLING AND STORAGE

- Prior to working with **Tetrachloroethylene** you should be trained on its proper handling and storage.
- **Tetrachloroethylene** is not compatible with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE); CHEMICALLY ACTIVE METALS (such as POTASSIUM, SODIUM, MAGNESIUM and ZINC); STRONG BASES (such as SODIUM HYDROXIDE and POTASSIUM HYDROXIDE); LITHIUM; BERYLLIUM; and BARIUM.
- Store in tightly closed containers in a cool, well-ventilated area away from HEAT.

FIRST AID

For POISON INFORMATION call 1-800-222-1222

Eye Contact

- Immediately flush with large amounts of water for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention.

Skin Contact

- Quickly remove contaminated clothing. Immediately wash area with large amounts of soap and water. Seek medical attention.

Breathing

- Remove the person from exposure.
- Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
- Transfer promptly to a medical facility.
- Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed.

PHYSICAL DATA

Vapor Pressure: 14 mm Hg at 68°F (20°C)

Water Solubility: Insoluble

OTHER COMMONLY USED NAMES

Chemical Name:

Ethene, Tetrachloro-

Other Names:

Perchloroethylene; PERC; Ethylene Tetrachloride

Not intended to be copied and sold for commercial purposes.

NEW JERSEY DEPARTMENT OF HEALTH AND
SENIOR SERVICES
Right to Know Program
PO Box 368, Trenton, NJ 08625-0368
(609) 984-2202 H5027

Right to Know
Hazardous Substance Fact Sheet

Common Name: **LEAD**

Synonym: Metallic Lead

Chemical Name: Lead

Date: September 2001 Revision: September 2007

CAS Number: 7439-92-1

RTK Substance Number: 1096

DOT Number: UN 3077

Description and Use

Lead is a heavy, soft, silvery-gray metal. It is used in the production of storage batteries, ammunition, cable covering, pigments, glass, ceramic glazes, casting metals, and solders.

Reasons for Citation

- **Lead** is on the Right to Know Hazardous Substance List because it is cited by OSHA, ACGIH, DOT, NIOSH, NTP, DEP, IARC, IRIS and EPA.
- This chemical is on the Special Health Hazard Substance List.

SEE GLOSSARY ON PAGE 5.

FIRST AID

Eye Contact

- Immediately flush with large amounts of cool water for at least 15 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while rinsing.

Skin Contact

- Remove contaminated clothing. Wash contaminated skin with soap and water.

Inhalation

- Remove the person from exposure.
- Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
- Transfer promptly to a medical facility.

EMERGENCY NUMBERS

Poison Control: 1-800-222-1222

CHEMTREC: 1-800-424-9300

NJDEP Hotline: 1-877-927-6337

National Response Center: 1-800-424-8802

EMERGENCY RESPONDERS >>>> SEE PAGE 6

Hazard Summary

Hazard Rating	NJDHSS	NFPA
HEALTH	4	-
FLAMMABILITY	0	-
REACTIVITY	0	-
CARCINOGEN TERATOGEN POISONOUS FUMES ARE PRODUCED IN FIRE DOES NOT BURN		

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

- **Lead** can affect you when inhaled or swallowed.
- **Lead** is a CARCINOGEN and may be a TERATOGEN. HANDLE WITH EXTREME CAUTION.
- Contact can irritate the eyes.
- Exposure can cause headache, irritability, and muscle and joint pain.
- Repeated exposure can cause *Lead poisoning* with metallic taste, colic and muscle cramps.
- **Lead** may damage the nervous system.
- Exposure may cause kidney and brain damage, and anemia.

Workplace Exposure Limits

OSHA: The legal airborne permissible exposure limit (PEL) is **0.05 mg/m^3** averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit (REL) is **0.05 mg/m^3** averaged over a 10-hour workshift. Air concentrations should be maintained so that blood **Lead** is less than **0.06 mg per 100 grams** of whole blood.

ACGIH: The threshold limit value (TLV) is **0.05 mg/m^3** averaged over an 8-hour workshift.

- **Lead** is a PROBABLE CARCINOGEN in humans and may be a TERATOGEN in humans. There may be no safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.

Determining Your Exposure

- Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- For each individual hazardous ingredient, read the New Jersey Department of Health and Senior Services Hazardous Substance Fact Sheet, available on the RTK Program website (www.nj.gov/health/eoh/rtkweb) or in your facility's RTK Central File or Hazard Communication Standard file.
- You have a right to this information under the New Jersey Worker and Community Right to Know Act, the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) requires private employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects
The following acute (short-term) health effects may occur immediately or shortly after exposure to **Lead**:

- Contact can irritate the eyes.
- **Lead** can cause headache, irritability, reduced memory, disturbed sleep, and mood and personality changes.
- Exposure can cause upset stomach, poor appetite, weakness and fatigue.

Chronic Health Effects
The following chronic (long-term) health effects can occur at some time after exposure to **Lead** and can last for months or years:

Cancer Hazard
- **Lead** is a PROBABLE CARCINOGEN in humans. There is some evidence that **Lead** and *Lead compounds* cause lung, stomach, brain and kidney cancers in humans and they have been shown to cause kidney cancer in animals.
- Many scientists believe there is no safe level of exposure to a carcinogen.

Reproductive Hazard
- **Lead** may be a TERATOGEN in humans since it is a teratogen in animals.
- It may decrease fertility in males and females, and damage the developing fetus and the testes (male reproductive glands).

Other Effects
- Repeated exposure to **Lead** can cause *Lead poisoning*. Symptoms include metallic taste, poor appetite, weight loss, colic, nausea, vomiting, and muscle cramps.
- Higher levels can cause muscle and joint pain, and weakness.
- High or repeated exposure may damage the nerves causing weakness, "pins and needles," and poor coordination in the arms and legs.
- **Lead** exposure increases the risk of high blood pressure.
- **Lead** may cause kidney and brain damage, and damage to the blood cells causing anemia.
- Repeated exposure causes **Lead** to accumulate in the body. It can take years for the body to get rid of excess **Lead**.

Medical

Medical Testing
Before first exposure, and every six (6) months thereafter, OSHA requires your employer to provide (for persons exposed to **30 micrograms** or more of *Lead* **per cubic meter** of air):

- Blood *Lead* test
- ZPP (a special test for the effects of *Lead* on blood cells)

For employees with blood *Lead* levels above **40 micrograms per 100 grams** of whole blood (**40 micrograms per deciliter**), OSHA requires blood *Lead* level monitoring every two months until two consecutive blood *Lead* levels are below **40 micrograms per 100 grams** of whole blood. These employees must undergo a medical evaluation, which should include:

- Complete work and medical history
- Thorough physical examination, including examination of the central nervous system
- Blood *Lead* test
- ZPP
- Hemoglobin, hematocrit with complete blood count
- Urinalysis with microscopic examination
- Any other tests determined necessary by the examining physician

This evaluation should be performed at least annually.

OSHA requires your employer to provide you and your doctor with a copy of the OSHA Lead Standards (29 CFR 1910.1025 and 1926.62).

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Mixed Exposures

Body exposures to *Lead* from hobbies using *Lead* solder or pigments, target practice, and drinking moonshine made in *Leaded* containers will increase *Lead* levels. Repeated breathing or handling of *Leaded* gasoline may also add to body *Lead* levels.

Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- Specific engineering controls are required for this chemical by OSHA. Refer to the OSHA **Lead** Standards (29 CFR 1910.1025 and 1926.62).
- Use a vacuum or a wet method to reduce dust during clean-up. DO NOT DRY SWEEP.
- Use a high efficiency particulate air (HEPA) filter when vacuuming. Do not use a standard shop vacuum.

Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing

- Avoid skin contact with **Lead**. Wear personal protective equipment made from material which can not be permeated and/or degraded by this substance. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation.
- Safety equipment manufacturers recommend *Nitrile*, *Latex*, or *Rubber* for gloves and DuPont *Tyvek*® as protective material for clothing.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- Wear non-vented, impact resistant goggles when working with fumes, gases, or vapors.
- For impact hazards (such as flying fragments, chips or particles), wear safety glasses with side shields or safety goggles.
- Wear a face shield along with goggles when working with corrosive, highly irritating or toxic substances.

Respiratory Protection

Improper use of respirators is dangerous. Respirators should only be used if the employer has a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- Where the potential exists for exposure not higher than **0.5 mg/m^3**, use a half-mask air purifying respirator equipped with high efficiency filters.
- Where the potential exists for exposure not higher than **2.5 mg/m^3**, use a full facepiece, air purifying respirator with high efficiency filters.
- Where the potential exists for exposure not higher than **50 mg/m^3**, use any powered-air purifying respirator with high efficiency filters or a half-mask supplied-air respirator operated in a positive pressure mode.
- Leave the area immediately if (1) while wearing a filter or cartridge respirator you can smell, taste, or otherwise detect **Lead**, (2) while wearing particulate filters abnormal resistance to breathing is experienced, or (3) eye irritation occurs while wearing a full facepiece respirator. Check to make sure the respirator-to-face seal is still good. If it is, replace the filter or cartridge. If the seal is no longer good, you may need a new respirator.
- Be sure to consider all potential sources of exposure in your workplace. You may need a combination of filters, prefilters or cartridges to protect against different forms of a chemical (such as vapor and mist) or against a mixture of chemicals.
- Where the potential exists for exposure greater than **50 mg/m^3** but less than **100 mg/m^3**, use supplied-air respirators with full facepiece, hood, helmet or suit, operated in a positive pressure mode.
- Where the potential exists for exposure greater than **100 mg/m^3**, use full facepiece, self-contained breathing apparatus operated in a positive pressure mode.

Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- Extinguish fire using an agent suitable for type of surrounding fire. **Lead** itself does not burn.
- POISONOUS FUMES ARE PRODUCED IN FIRE, including *Lead Oxides*.
- Use water spray to keep fire-exposed containers cool.

Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Lead** is spilled, take the following steps:

- Evacuate personnel and secure and control entrance to the area.
- Eliminate all ignition sources.
- Collect spilled material using a HEPA-filter vacuum and deposit into sealed containers.
- Ventilate and wash area after clean-up is complete.
- It may be necessary to contain and dispose of **Lead** as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

Handling and Storage

Prior to working with **Lead** you should be trained on its proper handling and storage.

- A regulated, marked area should be established where **Lead** is handled, used, or stored.
- **Lead** reacts violently with HYDROGEN PEROXIDE; AMMONIUM NITRATE; ZIRCONIUM; SODIUM AZIDE; SODIUM ACETYLIDE; and CHLORINE TRIFLUORIDE.
- **Lead** is not compatible with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) and STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC).
- Store in tightly closed containers in a cool, well-ventilated area.

Occupational Health Services Resources

The New Jersey Department of Health and Senior Services, Occupational Health Service, offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

For more information, please contact:

New Jersey Department of Health & Senior Services
Right to Know Program
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.state.nj.us
Web address: http://www.nj.gov/health/eoh/rtkweb

The Right to Know Hazardous Substance Fact Sheets are not intended to be copied and sold for commercial purposes.

GLOSSARY

ACGIH is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

Boiling point is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

CFR is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group.

Ionization Potential is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

IRIS is the Integrated Risk Information System database by federal EPA. The database contains information on human health effects that may result from exposure to various chemicals in the environment.

LEL or **Lower Explosive Limit**, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NAERG is the North American Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

Permeated is the movement of chemicals through protective materials.

PIH is a DOT designation for chemicals which are Poison Inhalation Hazards.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

UEL or **Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

Vapor Density is the ratio of the weight of a given volume of one gas to the weight of another (usually *Hydrogen*), at the same temperature and pressure.

The **vapor pressure** is a measure of how readily a liquid or a solid mixes with air at its surface. A higher vapor pressure indicates a higher concentration of the substance in air and therefore increases the likelihood of breathing it in.

INFORMATION FOR EMERGENCY RESPONDERS

Common Name: **LEAD**

Synonym: Metallic Lead
CAS No: 7439-92-1
Molecular Formula: Pb_2
RTK Substance No: 1096
Description: Heavy, soft, silvery-gray metal

HAZARD DATA

Hazard Rating	Firefighting	Reactivity
4 - Health **0 - Fire** **0 - Reactivity** **DOT#:** UN 3077 **ERG Guide #:** 171 **Hazard Class:** 9 (Environmentally Hazardous Substance)	Extinguish fire using an agent suitable for type of surrounding fire. **Lead** itself does not burn. POISONOUS FUMES ARE PRODUCED IN FIRE, including *Lead Oxides*. Use water spray to keep fire-exposed containers cool.	**Lead** reacts violently with HYDROGEN PEROXIDE; AMMONIUM NITRATE; ZIRCONIUM; SODIUM AZIDE; SODIUM ACETYLIDE; and CHLORINE TRIFLUORIDE. **Lead** is not compatible with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) and STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC).

SPILL/LEAKS

Isolation Distance: 10 to 25 meters (30 to 80 feet)

Use a HEPA-filter vacuum for clean-up.

Toxic to aquatic organisms.

Hazardous to the environment and persists in the environment.

PHYSICAL PROPERTIES

Odor Threshold:	No odor
Flash Point:	Not combustible
LEL:	N/A
UEL:	N/A
Specific Gravity:	11.35 at 68°F (20°C)
Vapor Pressure:	0 mm Hg at 68°F (20°C)
Water Solubility:	Insoluble
Boiling Point:	3,164°F (1,740°C)
Melting Point:	621.5°F (327.5°C)

EXPOSURE LIMITS

OSHA:	0.05 mg/m^3, 8-hr TWA
NIOSH:	0.05 mg/m^3, 10-hr TWA
ACGIH:	0.05 mg/m^3, 8-hr TWA
IDLH LEVEL:	100 mg/m^3

PROTECTIVE EQUIPMENT

Gloves:	Nitrile, Latex, Rubber
Coveralls:	DuPont *Tyvek*®
Boots:	Latex, Butyl, Neoprene
Respirator:	<0.5 mg/m^3 - N100 >0.5 mg/m^3 - full facepiece APR with High Efficiency filters >50 mg/m^3 but $\leq$100 mg/m^3 Supplied Air

HEALTH EFFECTS

Eyes:	Irritation
Skin:	No Information
Acute:	Headache, irritability, upset stomach, and weakness
Chronic:	*Lead* may cause lung, brain, stomach, and kidney cancer in humans. Metallic taste, colic, muscle cramps Damage to the nervous system

FIRST AID AND DECONTAMINATION

Remove the person from exposure.

Flush eyes with large amounts of water for at least 15 minutes. Remove contact lenses if worn.

Remove contaminated clothing and wash contaminated skin with soap and water.

Transfer to a medical facility.

Barium Metal

MSDS # 84.00

ScholAR Chemistry

Section 1: Product and Company Identification

Barium Metal

Synonyms/General Names: Barium
Product Use: For educational use only
Manufacturer: Columbus Chemical Industries, Inc., Columbus, WI 53925.

24 Hour Emergency Information Telephone Numbers
CHEMTREC (USA): 800-424-9300 **CANUTEC (Canada): 613-424-6666**
ScholAR Chemistry; 5100 W. Henrietta Rd, Rochester, NY 14586; (866) 260-0501; www.Scholarchemistry.com

Section 2: Hazards Identification

Soft, silvery, lustrous metal immersed in heavy mineral oil; no odor.

HMIS (0 to 4)

Health	3
Fire Hazard	3
Reactivity	2

WARNING! Flammable solid, dangerous when wet, highly toxic by ingestion.
Flammable solid, keep away from all ignition sources. Contact with water produces flammable gas.
Target organs: Central nervous system, kidneys.

This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Section 3: Composition / Information on Ingredients

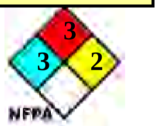
Barium Metal (7440-39-3), 100%

Section 4: First Aid Measures

Always seek professional medical attention after first aid measures are provided.

Eyes:	Immediately flush eyes with excess water for 15 minutes, lifting lower and upper eyelids occasionally.
Skin:	Immediately flush skin with excess water for 15 minutes while removing contaminated clothing.
Ingestion:	Call Poison Control immediately. Rinse mouth with cold water. Give victim 1-2 tbsp of activated charcoal mixed with 8 oz water.
Inhalation:	Remove to fresh air. If not breathing, give artificial respiration.

Section 5: Fire Fighting Measures



Flammable solid. When heated to decomposition, emits acrid fumes and explosive hydrogen gas.
Protective equipment and precautions for firefighters: Do Not Use carbon dioxide, foam, water or halogenated extinguishing agents. Use class D extinguisher or smother with dry sand, dry clay, dry ground limestone or dry graphite. Firefighters should wear full fire fighting turn-out gear and respiratory protection (SCBA). Material is not sensitive to mechanical impact or static discharge.

Section 6: Accidental Release Measures

Use personal protection recommended in Section 8. Isolate the hazard area and deny entry to unnecessary and unprotected personnel. Remove all ignition sources and ventilate area. Sweep up spill and place material in a dry container for disposal. See Section 13 for disposal information.

Section 7: Handling and Storage Red

Handling: Use with adequate ventilation and do not breathe dust or vapor. Avoid contact with skin, eyes, or clothing. Wash hands thoroughly after handling.
Storage: Store in Flammable Area [Red Storage] with other flammable materials and away from any strong oxidizers. Store in a dedicated flammables cabinet. Store in a cool, dry, well-ventilated, locked store room away from incompatible materials.

Section 8: Exposure Controls / Personal Protection

Use ventilation to keep airborne concentrations below exposure limits. Have approved eyewash facility, safety shower, and fire extinguishers readily available. Wear chemical splash goggles and chemical resistant clothing such as gloves and aprons. Wash hands thoroughly after handling material and before eating or drinking. Use NIOSH-approved respirator with a dust cartridge. Exposure guidelines: Barium compounds: OSHA PEL: 0.5 mg/m^3 and ACGIH TLV: 0.5 mg/m^3, STEL: N/A.

Section 9: Physical and Chemical Properties

Molecular formula	Ba.	**Appearance**	Silver metal in heavy mineral oil.
Molecular weight	137.33.	**Odor**	No odor.
Specific Gravity	3.62 g/mL @ 20°C..	**Odor Threshold**	N/A.
Vapor Density (air=1)	N/A.	**Solubility**	Reacts violently with water.
Melting Point	850°C.	**Evaporation rate**	N/A *(Butyl acetate = 1).*
Boiling Point/Range	1695°C.	**Partition Coefficient**	N/A *(log P_{OW}).*
Vapor Pressure (20°C)	N/A.	**pH**	N/A.
Flash Point:	N/A.	**UEL**	N/A.
Autoignition Temp.:	N/A.	**LEL**	N/A.

N/A = Not available or applicable

Section 10: Stability and Reactivity

Avoid heat and ignition sources
Stability: Stable under normal conditions of use.
Incompatibility: Water, acids, chlorine, iodine, bromine and oxidizing agents.
Shelf life: Indefinite if stored properly.

Section 11: Toxicology Information

Acute Symptoms/Signs of exposure: ***Eyes***: Stinging pain, burns, watering of eyes, inflammation of eyelids and conjunctivitis. Avoid looking at burning magnesium. ***Skin***: Irritation, redness, burns. Powdered metal ignites readily on skin causing burns. ***Ingestion***: Nausea, vomiting and headache. ***Inhalation***: Rapid irregular breathing, headache, burns to mucous membranes. Inhalation of dust or fumes causes metal fume fever.
Chronic Effects: Repeated/prolonged skin contact may cause dryness or rashes.
Sensitization: none expected
Barium: LD50 [oral, rat]; Not Available; LC50 [rat]; Not Available; LD50 Dermal [rabbit]; Not Available
Material has not been found to be a carcinogen nor produce genetic, reproductive, or developmental effects.

Section 12: Ecological Information

Ecotoxicity (aquatic and terrestrial): LC50 – 500mg/l – 96h – Cyprinodon variegates.

Section 13: Disposal Considerations

Check with all applicable local, regional, and national laws and regulations. Local regulations may be more stringent than regional or national regulations. Use a licensed chemical waste disposal firm for proper disposal.

Section 14: Transport Information

DOT Shipping Name:	Barium.	**Canada TDG:**	Barium .
DOT Hazard Class:	4.3, pg II.	**Hazard Class:**	4.3, pg II.
Identification Number:	UN1400.	**UN Number:**	UN1400.

Section 15: Regulatory Information

EINECS: Listed (231-149.1) .
TSCA: All components are listed or are exempt.
WHMIS Canada: B6:D2B: Reactive Flammable: Toxic Material.
California Proposition 65: Not listed.
The product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

Section 16: Other Information

Current Issue Date: December 19, 2011

Disclaimer: Scholar Chemistry and Columbus Chemical Industries, Inc., ("S&C") believes that the information herein is factual but is not intended to be all inclusive. The information relates only to the specific material designated and does not relate to its use in combination with other materials or its use as to any particular process. Because safety standards and regulations are subject to change and because S&C has no continuing control over the material, those handling, storing or using the material should satisfy themselves that they have current information regarding the particular way the material is handled, stored or used and that the same is done in accordance with federal, state and local law. ***S&C makes no warranty, expressed or implied, including (without limitation) warranties with respect to the completeness or continuing accuracy of the information contained herein or with respect to fitness for any particular use.***

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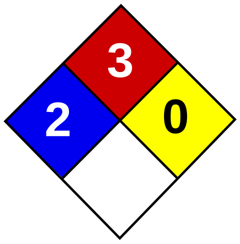


Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Benzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Benzene

Catalog Codes: SLB1564, SLB3055, SLB2881

CAS#: 71-43-2

RTECS: CY1400000

TSCA: TSCA 8(b) inventory: Benzene

CI#: Not available.

Synonym: Benzol; Benzine

Chemical Name: Benzene

Chemical Formula: C6-H6

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Benzene	71-43-2	100

Toxicological Data on Ingredients: Benzene: ORAL (LD50): Acute: 930 mg/kg [Rat]. 4700 mg/kg [Mouse]. DERMAL (LD50): Acute: >9400 mg/kg [Rabbit]. VAPOR (LC50): Acute: 10000 ppm 7 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of eye contact (irritant), of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE]. The substance is toxic to blood, bone marrow, central nervous system (CNS). The substance may be toxic to liver, Urinary System. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 497.78°C (928°F)

Flash Points: CLOSED CUP: -11.1°C (12°F). (Setaflash)

Flammable Limits: LOWER: 1.2% UPPER: 7.8%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Slightly flammable to flammable in presence of oxidizing materials. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Explosive in presence of oxidizing materials, of acids.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Extremely flammable liquid and vapor. Vapor may cause flash fire. Reacts on contact with iodine heptafluoride gas. Dioxygenyl tetrafluoroborate is as very powferful oxidant. The addition of a small particle to small samples of benzene, at ambient temperature, causes ignition. Contact with sodium peroxide with benzene causes ignition. Benzene ignites in contact with powdered chromic anhydride. Virgorous or incandescent reaction with hydrogen + Raney nickel (above 210 C) and bromine trifluoride.

Special Remarks on Explosion Hazards:
Benzene vapors + chlorine and light causes explosion. Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate. Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion. Interaction

of nitryl perchlorate with benzene gave a slight explosion and flash. The solution of permanganic acid (or its explosive anhydride, dimaganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene. Peroxodisulfuric acid is a very powferful oxidant. Uncontrolled contact with benzene may cause explosion. Mixtures of peroxomonsulfuric acid with benzene explodes.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.5 STEL: 2.5 (ppm) from ACGIH (TLV) [United States] TWA: 1.6 STEL: 8 (mg/m3) from ACGIH (TLV) [United States] TWA: 0.1 STEL: 1 from NIOSH TWA: 1 STEL: 5 (ppm) from OSHA (PEL) [United States] TWA: 10 (ppm) from OSHA (PEL) [United States] TWA: 3 (ppm) [United Kingdom (UK)] TWA: 1.6 (mg/m3) [United Kingdom (UK)] TWA: 1 (ppm) [Canada] TWA: 3.2 (mg/m3) [Canada] TWA: 0.5 (ppm) [Canada]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor:
Aromatic. Gasoline-like, rather pleasant. (Strong.)

Taste: Not available.

Molecular Weight: 78.11 g/mole

Color: Clear Colorless. Colorless to light yellow.

pH (1% soln/water): Not available.

Boiling Point: 80.1 (176.2°F)

Melting Point: 5.5°C (41.9°F)

Critical Temperature: 288.9°C (552°F)

Specific Gravity: 0.8787 @ 15 C (Water = 1)

Vapor Pressure: 10 kPa (@ 20°C)

Vapor Density: 2.8 (Air = 1)

Volatility: Not available.

Odor Threshold: 4.68 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:
Miscible in alcohol, chloroform, carbon disulfide oils, carbon tetrachloride, glacial acetic acid, diethyl ether, acetone. Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatibles.

Incompatibility with various substances: Highly reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Benzene vapors + chlorine and light causes explosion. Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate. Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion. Interaction of nitryl perchlorate with benzene gave a slight explosion and flash. The solution of permanganic acid (or its explosive anhydride, dimaganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene. Peroxodisulfuric acid is a very powfferful oxidant. Uncontrolled contact with benzene may cause explosion. Mixtures of peroxomonsulfuric acid with benzene explodes.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 930 mg/kg [Rat]. Acute dermal toxicity (LD50): >9400 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 10000 7 hours [Rat].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE]. Causes damage to the following organs: blood, bone marrow, central nervous system (CNS). May cause damage to the following organs: liver, Urinary System.

Other Toxic Effects on Humans:
Very hazardous in case of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (female fertility, Embryotoxic and/or foetotoxic in animal) and birth defects. May affect genetic material (mutagenic). May cause cancer (tumorigenic, leukemia)) Human: passes the placental barrier, detected in maternal milk.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. It can be absorbed through intact skin and affect the liver, blood, metabolism,and urinary system. Eyes: Causes eye irritation. Inhalation: Causes respiratory tract and mucous membrane irritation. Can be absorbed through the lungs. May affect behavior/Central and Peripheral nervous systems (somnolence, muscle weakness, general anesthetic, and other symptoms similar to ingestion), gastrointestinal tract (nausea), blood metabolism, urinary system. Ingestion: May be harmful if swallowed. May cause gastrointestinal tract irritation including vomiting. May affect behavior/Central and Peripheral nervous systems (convulsions, seizures, tremor, irritability, initial CNS stimulation followed by depression, loss of coordination, dizziness, headache, weakness, pallor, flushing), respiration (breathlessness and chest constriction), cardiovascular system, (shallow/rapid pulse), and blood.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Benzene UNNA: 1114 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Benzene California prop. 65 (no significant risk level): Benzene: 0.007 mg/day (value) California prop. 65: This product contains the following ingredients

for which the State of California has found to cause cancer which would require a warning under the statute: Benzene Connecticut carcinogen reporting list.: Benzene Connecticut hazardous material survey.: Benzene Illinois toxic substances disclosure to employee act: Benzene Illinois chemical safety act: Benzene New York release reporting list: Benzene Rhode Island RTK hazardous substances: Benzene Pennsylvania RTK: Benzene Minnesota: Benzene Michigan critical material: Benzene Massachusetts RTK: Benzene Massachusetts spill list: Benzene New Jersey: Benzene New Jersey spill list: Benzene Louisiana spill reporting: Benzene California Director's list of Hazardous Substances: Benzene TSCA 8(b) inventory: Benzene SARA 313 toxic chemical notification and release reporting: Benzene CERCLA: Hazardous substances.: Benzene: 10 lbs. (4.536 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R11- Highly flammable. R22- Harmful if swallowed. R38- Irritating to skin. R41- Risk of serious damage to eyes. R45- May cause cancer. R62- Possible risk of impaired fertility. S2- Keep out of the reach of children. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S39- Wear eye/face protection. S46- If swallowed, seek medical advice immediately and show this container or label. S53- Avoid exposure - obtain special instructions before use.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

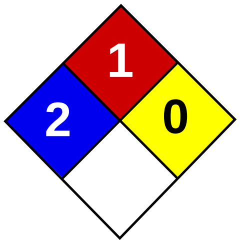
Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:35 PM

Last Updated: 06/09/2012 12:00 PM



Health	2
Fire	1
Reactivity	0
Personal Protection	E

Material Safety Data Sheet

Chromium MSDS

Section 1: Chemical Product and Company Identification

Product Name: Chromium

Catalog Codes: SLC4711, SLC3709

CAS#: 7440-47-3

RTECS: GB4200000

TSCA: TSCA 8(b) inventory: Chromium

CI#: Not applicable.

Synonym: Chromium metal; Chrome; Chromium Metal Chips 2" and finer

Chemical Name: Chromium

Chemical Formula: Cr

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Chromium	7440-47-3	100

Toxicological Data on Ingredients: Chromium LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of inhalation. Slightly hazardous in case of ingestion.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, lungs, liver, upper respiratory tract. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 580°C (1076°F)

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances:
Slightly flammable to flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards:
Moderate fire hazard when it is in the form of a dust (powder) and burns rapidly when heated in flame. Chromium is attacked vigorously by fused potassium chlorate producing vivid incandescence. Pyrophoric chromium unites with nitric oxide with incandescence. Incandescent reaction with nitrogen oxide or sulfur dioxide.

Special Remarks on Explosion Hazards:
Powdered Chromium metal +fused ammonium nitrate may react violently or explosively. Powdered Chromium will explode spontaneously in air.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.5 (mg/m3) from ACGIH (TLV) [United States] TWA: 1 (mg/m3) from OSHA (PEL) [United States] TWA: 0.5 (mg/m3) from NIOSH [United States] TWA: 0.5 (mg/m3) [United Kingdom (UK)] TWA: 0.5 (mg/m3) [Canada]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 52 g/mole

Color: Silver-white to Grey.

pH (1% soln/water): Not applicable.

Boiling Point: 2642°C (4787.6°F)

Melting Point: 1900°C (3452°F) +/- !0 deg. C

Critical Temperature: Not available.

Specific Gravity: 7.14 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Insoluble in cold water, hot water. Soluble in acids (except Nitric), and strong alkalies.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, acids, alkalis.

Corrosivity: Not available.

Special Remarks on Reactivity:
Incompatible with molten Lithium at 180 deg. C, hydrogen peroxide, hydrochloric acid, sulfuric acid, most caustic alkalies and alkali carbonates, potassium chlorate, sulfur dioxide, nitrogen oxide, bromine pentafluoride. It may react violently or ignite with bromine pentafluoride. Chromium is rapidly attacked by fused sodium hydroxide + potassium nitrate. Potentially hazardous incompatibility with strong oxidizers.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: kidneys, lungs, liver, upper respiratory tract.

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause cancer based on animal data. There is no evidence that exposure to trivalent chromium causes cancer in man.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: May cause skin irritation. Eyes: May cause mechanical eye irritation. Inhalation: May cause irritation of the respiratory tract and mucous membranes of the respiratory tract. Ingestion: May cause gastrointestinal tract irritation with nausea, vomiting, diarrhea. Chronic Potential Health Effects: Inhalation: The effects of chronic exposure include irritation , sneezing, reddness of the throat, bronchospasm, asthma, cough, polyps, chronic inflammation, emphysema, chronic bronchitis, pharyngitis, bronchopneumonia, pneumoconoisis. Effects on the nose from chronic chromium exposure include irritation, ulceration, and perforation of the nasal septum. Inflammation and ulceration of the larynx may also occur. Ingestion or Inhalation: Chronic exposure may cause liver and kidney damage.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Chromium Illinois toxic substances disclosure to employee act: Chromium Illinois chemical safety act: Chromium New York release reporting list: Chromium Rhode Island RTK hazardous substances: Chromium Pennsylvania RTK: Chromium Minnesota: Chromium Michigan critical material: Chromium Massachusetts RTK: Chromium Massachusetts spill list: Chromium New Jersey: Chromium New Jersey spill list: Chromium Louisiana spill reporting: Chromium California Director's List of Hazardous Substances: Chromium TSCA 8(b) inventory: Chromium SARA 313 toxic chemical notification and release reporting: Chromium CERCLA: Hazardous substances.: Chromium: 5000 lbs. (2268 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC):
R40- Limited evidence of carcinogenic effect S36/37/39- Wear suitable protective clothing, gloves and eye/face protection. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:16 PM

Last Updated: 06/09/2012 12:00 PM

AIRGAS -- OXYGEN,COMPRESSED GAS (UN1072) -- 6830-00-286-8684

MSDS Safety Information

FSC: 6830
NIIN: 00-286-8684
MSDS Date: 11/29/1995
MSDS Num: CHYYJ
Tech Review: 11/09/1998
Product ID: OXYGEN,COMPRESSED GAS (UN1072)
Responsible Party
Cage: AIRGA
Name: AIRGAS
Address: FIVE RADNOR CORP CNTR,STE 550,100 MATSOF
City: RADNOR PA 19087-4579 US
Info Phone Number: 610-687-5253
Emergency Phone Number: 800-424-9300(CHEMTREC)

Preparer Co. when other than Responsible Party Co.

Cage: AIRGA
Assigned Ind: N
Name: AIRGAS
Address: 100 MATSONFORD ROAD, 5 RADNOR CORP CNTR
City: RADNOR PA 19087

Contractor Summary

Cage: AIRGA
Name: AIRGAS
Address: 100 MATSONFORD ROAD, 5 RADNOR CORP CNTR
City: RADNOR PA 19087 US
Phone: 215-687-5253
Cage: 0MN39
Name: AIRGAS INC
Address: 100 MATSONFORD RD SUITE 550
City: WAYNE PA 19087 US
Phone: 215-687-5253

Item Description Information

Item Name: OXYGEN,AVIATOR'S BREATHING
Specification Number: MIL-O-27210
Type/Grade/Class: NK
Unit of Issue: CF
UI Container Qty: 1
Type of Container: CYLINDER

Ingredients

Cas: 7782-44-7
RTECS #: RS2060000
Name: OXYGEN
% by Wt: >99.0
Other REC Limits: NONE RECOMMENDED
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Ozone Depleting Chemical: N

Name: INERT MATERIALS
% by Wt: <1.0
Other REC Limits: NONE RECOMMENDED
OSHA PEL: NOT ESTABLISHED

ACGIH TLV: NOT ESTABLISHED

Health Hazards Data

LD50 LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
Route Of Entry Inds - Inhalation: YES
Skin: YES
Ingestion: NO
Carcinogenicity Inds - NTP: NO
IARC: NO
OSHA: NO
Effects of Exposure: PURE OXY ESPECIALLY NOT PROPERLY HUMIDIFIED MAY CAUSE MUC MEMB IRRIT,PULM EDEMA AFT 24HR.AIR NORMALLY CONTAINS 20-21%OXY.AS EXPO TO HI CONC &/OR >ATM PRESS CONTD SYMPT OF TOXICITY MAY DEVLP,INCR VITAL CAPACITY,TIGHT CHEST,DISCOMFT,COUGH,CONGEST,TRACHBRONC,PNEU,EDEMA,ATELECTASIS,INCR RESP DEPTH,RAPID PANT/(SIGNS/SYM)
Explanation Of Carcinogenicity: PER MSDS:CARCINOGEN STATUS:NONE.
Signs And Symptions Of Overexposure: HEALTH:ASTHMA-LIKE ATTACKS,APNEA IN INSPIRATORY POSITION,FIBROBLASTIC PROLIFERATION,HYPERPLASIA OF ALVEOLAR CELLS.CVS-BRADYCARDIA,HYPERTHERMIA,PERI VASOCONSTRICT.CNS-MOOD CHANGE,NAU,DIZZ,SLOW MENTAL P ROCE,MALAISE,APPREH,PARESTHESIAS,AUD HALLUC,CONSULV,UNCONSC.CHRONIC:OBSERVED INJURY TO MAN,DECR IN VITAL CAP,SEV IRREVS
Medical Cond Aggravated By Exposure: NONE SPECIFIED BY MANUFACTURER. TARGET ORGANS:POISONING MAY AFFECT PULM,CARDIOVASCULAR & NERVOUS SYSTEMS & EYE.
First Aid: REMOVE TO FRESH AIR IMMED.BREATH STOP DO ART RESP.TREAT SYMPT/SUPP.GET MED ATTN IMMED.SKIN:GAS-NO ADVERSE EFFECTS REPORTED).RAPID LIQ EVAP MAY CAUSE FROSTBITE,RED,TINGL,PAIN,NUMB,HARD,WHITE,BLISTERS.A DVERSE EFFECTS OCCUR GET MED ATTN.TREATFROSTBITE.WARM IN H2O @TEMP NOT >107F/WRAP IN BLANKETS.EXERCISE AFFECT PART.GET MED ATTN IMMED.EYE:IMMED WASH W/H2O,LIFT LIDS.FROSTBITE WARM H2O PREFER(OTH PRE)

Handling and Disposal

Spill Release Procedures: KEEP COMBUST AWAY FRM HAZ AREA.STOP LEAK W/O RISK.ISOLATE AREA TIL GAS DISPERS.KEEP UNNECESSARY PEOPLE AWAY;ISOLATE AREA,DENY ENTRY.VENTI CLSD SPACES BEF ENTERING.PROHIBIT SMOKING,SPARK PROD EPQMT,VEH ICLE OPERATION IN IMMED AREA/DISTANCE DOWNWIND.
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
Waste Disposal Methods: OBSERV ALL FED/STATE/LOC REGS.ASSIST CALL EPA/PROD SUPPLIER.GAS OXY SHOULD BE VENTED IN MANNER THAT DOESNT CREATE OXY RICH ATM IN CONF SPACE.LIQ OXY BE SURE LIQ/VAP DONT COME IN CONTACT W/COMBUST MATL ESPEC HYDROCARBON MATL,OIL,GREASE,ASPHALT.
Handling And Storage Precautions: OBSERVE ALL FED/STATE/LOC REGS WHEN STORING.ASSIST CALL EPA/PROD SUPPLIER.STORE IAW 29CFR1910.101,104.
Other Precautions: 1STAID:GET MED ATTN IMMED.INGEST:SEEK MED ATTN.TREAT SYMPT/SUPPORT.GET MED ATTN.ANTIDOTE:NO SPECIFIC ANTIDOTE.TREAT SYMPTOM/SUPPORT.

Fire and Explosion Hazard Information

Flash Point Text: NP
Autoignition Temp Text: NP
Lower Limits: NP
Upper Limits: NP
Extinguishing Media: DRY CHEMICAL,CARBON DIOXIDE OR HALON.FOR LG FIRES USE WATER SPRAY,FOG,STANDARD FOAM.
Fire Fighting Procedures: MOVE CNTNR FRM FIRE AREA IF POSSIBLE.STAY AWAY FRM STORAGE TANK ENDS.COOL FIRE-EXPO CNTNR W/H2O FRM SIDE TIL WELL AFT FIRE OUT.W/D IMMED IF RISE SOUND FRM(SUPP)

Unusual Fire/Explosion Hazard: NEGLIG FIRE HAZ WHEN EXPO TO HEAT/FLAME.OXIDIZER-DECOMPO ESPECIALLY WHEN HEAT-YIELD OXY/OTHER GAS WHICH WILL INCR BURN RATE OF COMBUST MATTER.CONTACT W/(SUPPLE)

Control Measures

Respiratory Protection: NONE SPECIFIED BY MANUFACTURER.

Ventilation: PROVIDE GENERAL DILUTION VENTILATION.

Protective Gloves: FULL PROTECTIVE COLD INSULATING FOR LIQ

Eye Protection: SPLASH PROOF SAF GOGG,FCSHIELD.

Other Protective Equipment: LIQ-PROTECTIVE INSULATIVE CLOTH,EQPMT-PREVENT SKIN CONTACT,FREEZING.CONTACT LENSES SHOULDNT BE WORN.EYEWASH FOUNT,SHOWER

Work Hygienic Practices: NONE SPECIFIED BY MANUFACTURER.

Supplemental Safety and Health: FIRE/EXPLO:EASILY OXIDIZ,ORG,OTHER COMBUST MATL MAY RESULT IN IGN/VIOL COMBUST/EXPLO.CYL MAY EXPLO IN HEAT/FIRE. FIREFIGHT:VENT SAF DEVICE HEARD/DISCOLORATION OF STORAGE TANKS DUE TO FIRE.MASSIVE FIRE IN STORAGE AREA USE UNMAN HOSE HOLDER/MON NOZ/W/D FRM AREA,LET FIRE BURN.USE EXT SUITABLE FOR TYPE SURROUND FIRE.

Physical/Chemical Properties

HCC: G4

B.P. Text: -297F,-183C

M.P/F.P Text: -361F,-218C

Decomp Text: NP

Vapor Pres: 760 @-183C

Vapor Density: 1.309G/L

Spec Gravity: 1.105

PH: NP

Viscosity: NP

Evaporation Rate & Reference: NP

Solubility in Water: 0.0491 @0C

Appearance and Odor: ODORLESS, COLORLESS,TASTELESS GAS

Percent Volatiles by Volume: NP

Corrosion Rate: NP

Reactivity Data

Stability Indicator: YES

Stability Condition To Avoid: CONTACT W/COMBUST MATL(WOOD,PAPER,FUEL,OILS,ETC);DONT PERMIT DMG/OVERHEAT CNTNR.UNDER PRESSURE,MAY VIO RUP,TRAVEL DISTAN

Materials To Avoid: ETHERS,ACETALDEHYDE,,SECAALCOHOL,ALKALI METALS,ALLYLIC CMPDS,AMMONIA,CARBON,COMBUST MATLS,CYANOGEN,ETHERS,FLAMM MATL

Hazardous Decomposition Products: NONE

Hazardous Polymerization Indicator: NO

Conditions To Avoid Polymerization: NONE SPECIFIED BY MANUFACTURER.

Toxicological Information

Ecological Information

MSDS Transport Information

Regulatory Information

Other Information

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Transportation Information
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Responsible Party Cage: AIRGA
Trans ID NO: 67394
Product ID: OXYGEN,COMPRESSED GAS (UN1072)
MSDS Prepared Date: 11/29/1995
Review Date: 11/09/1998
Article W/O MSDS: N
Net Unit Weight: 300 CUFT
Multiple KIT Number: 0
Unit Of Issue: CF
Container QTY: 1
Type Of Container: CYLINDER
Additional Data: PER MSDS:NON-FLAMM GAS,OXIDIZER & NONFLAMMABLE GAS LABEL,
  LTD QUANT EXCEPTIONS:49CFR173.306.
=======================================================
Detail DOT Information
=======================================================
DOT PSN Code: LEH
DOT Proper Shipping Name: OXYGEN, COMPRESSED
Hazard Class: 2.2
UN ID Num: UN1072
Label: NONFLAMMABLE GAS, OXIDIZER
Special Provision: A52
Packaging Exception: 306
Non Bulk Pack: 302
Bulk Pack: 314,315
Max Qty Pass: 75 KG
Max Qty Cargo: 150 KG
Vessel Stow Req: A
=======================================================
Detail IMO Information
=======================================================
IMO PSN Code: LBP
IMO Proper Shipping Name: OXYGEN, COMPRESSED
IMDG Page Number: 2169
UN Number: 1072
UN Hazard Class: 2(2.2)
IMO Packaging Group: -
Subsidiary Risk Label: OXIDIZING AGENT
EMS Number: 2-04
MED First Aid Guide NUM: NON
=======================================================
Detail IATA Information
=======================================================
IATA PSN Code: SWO
IATA UN ID Num: 1072
IATA Proper Shipping Name: OXYGEN, COMPRESSED
IATA UN Class: 2.2
Subsidiary Risk Class: 5.1
IATA Label: NON-FLAMMABLE GAS & OXIDIZER
Packing Note Passenger: 200
Max Quant Pass: 75KG
Max Quant Cargo: 150KG
Packaging Note Cargo: 200
=======================================================
Detail AFI Information
=======================================================
AFI PSN Code: SWO
AFI Proper Shipping Name: OXYGEN, COMPRESSED
AFI Hazard Class: 2.2
AFI UN ID NUM: UN1072
```

AFI Label: 5.1
Special Provisions: P5
Back Pack Reference: A6.3, A6.6

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HAZCOM Label

===

Product ID: OXYGEN,COMPRESSED GAS (UN1072)
Cage: AIRGA
Company Name: AIRGAS
Street: 100 MATSONFORD ROAD, 5 RADNOR CORP CNTR
City: RADNOR PA
Zipcode: 19087 US
Health Emergency Phone: 800-424-9300(CHEMTREC)
Date Of Label Review: 11/09/1998
Label Date: 11/09/1998
Chronic Hazard IND: Y
Eye Protection IND: YES
Skin Protection IND: YES
Signal Word: DANGER
Health Hazard: Moderate
Contact Hazard: None
Fire Hazard: None
Reactivity Hazard: Severe
Hazard And Precautions: SKIN:MAY CAUSE FROSTBITE W/REDNESS,TINGLING,PAIN/NUMBNESS,HARD,WHITE,DVLP BLISTERS.EYE:FROSTBITE,REDNESS,PAIN,BLUR VISION.INGEST:FROSTBITE DMG OF LIPS/MOUTH/MUC MEMB.INHAL:MUC MEMB IRRIT,PULM EDEMA,CV S/CNS EFFECTS,UNCONSC,CONVULS.1STAID:REMOVE TO FRESH AIR IMMED.BREATH STOP DO ART RESP.TREAT SYMPT/SUPP.SKIN:GAS-NO ADVERSE EFFECTS REPORTED.RAPID LIQ EVAP MAY CAUSE FROSTBITE,RED,TINGLE,PAIN,NUMB,HAR D,WHITE,BLISTERS.TREAT FROSTBITE.WARM IN H2O @TEMP NOT >107F/WRAP IN BLANKETS.EXERCISE AFFECT PART.GET MED ATTN IMMED.EYE:IMMED WASH W/H2O,LIFT LIDS.FROSTBITE WARM H2O PREFER.INGEST:TREAT SYMPT/SUPP.I N ALL CASES GET MED ATTN.

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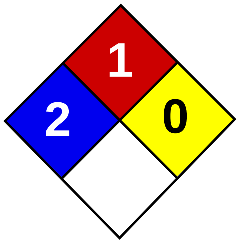


Health	2
Fire	1
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Copper MSDS

Section 1: Chemical Product and Company Identification

Product Name: Copper

Catalog Codes: SLC4939, SLC2152, SLC3943, SLC1150, SLC2941, SLC4729, SLC1936, SLC3727, SLC5515

CAS#: 7440-50-8

RTECS: GL5325000

TSCA: TSCA 8(b) inventory: Copper

CI#: Not available.

Synonym:

Chemical Name: Not available.

Chemical Formula: Cu

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Copper	7440-50-8	100

Toxicological Data on Ingredients: Copper LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of ingestion. Hazardous in case of eye contact (irritant), of inhalation. Slightly hazardous in case of skin contact (irritant).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to lungs, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not breathe dust. Avoid contact with eyes Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If you feel unwell, seek medical attention and show the label when possible.

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Keep container tightly closed. Keep in a cool, well-ventilated place. Combustible materials should be stored away from extreme heat and away from strong oxidizing agents.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 1 (mg/m3) from ACGIH [1990] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 63.54 g/mole

Color: Not available.

pH (1% soln/water): Not applicable.

Boiling Point: 2595°C (4703°F)

Melting Point: 1083°C (1981.4°F)

Critical Temperature: Not available.

Specific Gravity: 8.94 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans: The substance is toxic to lungs, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of ingestion. Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Human: passes through the placenta, excreted in maternal milk.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Copper Massachusetts RTK: Copper TSCA 8(b) inventory: Copper CERCLA: Hazardous substances.: Copper

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC): R36- Irritating to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 04:58 PM

Last Updated: 06/09/2012 12:00 PM

MATERIAL SAFETY DATA SHEET

Diesel Fuel (All Types) **MSDS No. 9909**

EMERGENCY OVERVIEW
CAUTION!
OSHA/NFPA COMBUSTIBLE LIQUID - SLIGHT TO MODERATE IRRITANT
EFFECTS CENTRAL NERVOUS SYSTEM
HARMFUL OR FATAL IF SWALLOWED

Moderate fire hazard. Avoid breathing vapors or mists. May cause dizziness and drowsiness. May cause moderate eye irritation and skin irritation (rash). Long-term, repeated exposure may cause skin cancer.
If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs).

NFPA 704 (Section 16)

1. CHEMICAL PRODUCT AND COMPANY INFORMATION

Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs):	**CHEMTREC (800) 424-9300**
COMPANY CONTACT (business hours):	Corporate Safety (732) 750-6000
MSDS INTERNET WEBSITE:	www.hess.com (See Environment, Health, Safety & Social Responsibility)

SYNONYMS: Ultra Low Sulfur Diesel (ULSD); Low Sulfur Diesel; Motor Vehicle Diesel Fuel; Diesel Fuel #2; Dyed Diesel Fuel; Non-Road, Locomotive and Marine Diesel Fuel; Tax-exempt Diesel Fuel

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and CHEMICAL INFORMATION ON INGREDIENTS

INGREDIENT NAME (CAS No.)	CONCENTRATION PERCENT BY WEIGHT
Diesel Fuel (68476-34-6)	100
Naphthalene (91-20-3)	Typically < 0.01

A complex mixture of hydrocarbons with carbon numbers in the range C9 and higher. Diesel fuel may be dyed (red) for tax purposes. May contain a multifunctional additive.

3. HAZARDS IDENTIFICATION

EYES

Contact with liquid or vapor may cause mild irritation.

SKIN

May cause skin irritation with prolonged or repeated contact. Practically non-toxic if absorbed following acute (single) exposure. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are repeatedly exposed.

INGESTION

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

INHALATION

Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

CHRONIC EFFECTS and CARCINOGENICITY

Similar products produced skin cancer and systemic toxicity in laboratory animals following repeated applications. The significance of these results to human exposures has not been determined - see Section 11 Toxicological Information.

IARC classifies whole diesel fuel exhaust particulates as probably carcinogenic to humans (Group 2A). NIOSH regards whole diesel fuel exhaust particulates as a potential cause of occupational lung cancer based on animal studies and limited evidence in humans.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash).

4. FIRST AID MEASURES

EYES

In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN

Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION

DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION

Remove person to fresh air. If person is not breathing provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES:

FLASH POINT: > 125 ^{o}F (> 52 ^{o}C) minimum PMCC
AUTOIGNITION POINT: 494 ^{o}F (257 ^{o}C)
OSHA/NFPA FLAMMABILITY CLASS: 2 (COMBUSTIBLE)
LOWER EXPLOSIVE LIMIT (%): 0.6
UPPER EXPLOSIVE LIMIT (%): 7.5

FIRE AND EXPLOSION HAZARDS

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

EXTINGUISHING MEDIA

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES

ACTIVATE FACILITY’S SPILL CONTINGENCY OR EMERGENCY RESPONSE PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE

HANDLING PRECAUTIONS

Handle as a combustible liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Diesel fuel, and in particular low and ultra low sulfur diesel fuel, has the capability of accumulating a static electrical charge of sufficient energy to cause a fire/explosion in the presence of lower flashpoint products such as gasoline. The accumulation of such a static charge occurs as the diesel flows through pipelines, filters, nozzles and various work tasks such as tank/container filling, splash loading, tank cleaning; product sampling; tank gauging; cleaning, mixing, vacuum truck operations, switch loading, and product agitation. There is a greater potential for static charge accumulation in cold temperature, low humidity conditions.

Documents such as 29 CFR OSHA 1910.106 "Flammable and Combustible Liquids, NFPA 77 Recommended Practice on Static Electricity, API 2003 "Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents and ASTM D4865 "Standard Guide for Generation and Dissipation of Static

Electricity in Petroleum Fuel Systems" address special precautions and design requirements involving loading rates, grounding, bonding, filter installation, conductivity additives and especially the hazards associated with "switch loading." ["Switch Loading" is when a higher flash point product (such as diesel) is loaded into tanks previously containing a low flash point product (such as gasoline) and the electrical charge generated during loading of the diesel results in a static ignition of the vapor from the previous cargo (gasoline).]

Note: When conductivity additives are used or are necessary the product should achieve 25 picosiemens/meter or greater at the handling temperature.

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION

EXPOSURE LIMITS

		Exposure Limits	
Components (CAS No.)	**Source**	**TWA/STEL**	**Note**
Diesel Fuel: (68476-34-6)	OSHA	5 mg/m, as mineral oil mist	
	ACGIH	100 mg/m^3 (as totally hydrocarbon vapor) TWA	A3, skin
Naphthalene (91-20-3)	OSHA	10 ppm TWA	
	ACGIH	10 ppm TWA / 15 ppm STEL	A4, Skin

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION

Gloves constructed of nitrile, neoprene, or PVC are recommended. Chemical protective clothing such as of E.I. DuPont TyChem®, Saranex® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

RESPIRATORY PROTECTION

A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

9. PHYSICAL and CHEMICAL PROPERTIES

APPEARANCE

Clear, straw-yellow liquid. Dyed fuel oil will be red or reddish-colored.

ODOR

Mild, petroleum distillate odor

BASIC PHYSICAL PROPERTIES

BOILING RANGE: 320 to 690 oF (160 to 366 ^{o}C)
VAPOR PRESSURE: 0.009 psia @ 70 ^{o}F (21 ^{o}C)
VAPOR DENSITY (air = 1): > 1.0
SPECIFIC GRAVITY (H_2O = 1): 0.83 to 0.88 @ 60 ^{o}F (16 ^{o}C)
PERCENT VOLATILES: 100 %
EVAPORATION RATE: Slow; varies with conditions
SOLUBILITY (H_2O): Negligible

10. STABILITY and REACTIVITY

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID and INCOMPATIBLE MATERIALS

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources. Keep away from strong oxidizers; Viton ®; Fluorel ®

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

11. TOXICOLOGICAL PROPERTIES

ACUTE TOXICITY

Acute dermal LD50 (rabbits): > 5 ml/kg
Primary dermal irritation: extremely irritating (rabbits)
Guinea pig sensitization: negative
Acute oral LD50 (rats): 9 ml/kg
Draize eye irritation: non-irritating (rabbits)

CHRONIC EFFECTS AND CARCINOGENICITY

Carcinogenic: OSHA: NO IARC: NO NTP: NO ACGIH: A3

Studies have shown that similar products produce skin tumors in laboratory animals following repeated applications without washing or removal. The significance of this finding to human exposure has not been determined. Other studies with active skin carcinogens have shown that washing the animal's skin with soap and water between applications reduced tumor formation.

MUTAGENICITY (genetic effects)

This material has been positive in a mutagenicity study.

12. ECOLOGICAL INFORMATION

Keep out of sewers, drainage areas, and waterways. Report spills and releases, as applicable, under Federal and State regulations.

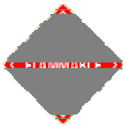
13. DISPOSAL CONSIDERATIONS

Consult federal, state and local waste regulations to determine appropriate disposal options.

14. TRANSPORTATION INFORMATION

PROPER SHIPPING NAME:	Diesel Fuel
HAZARD CLASS and PACKING GROUP:	3, PG III
DOT IDENTIFICATION NUMBER:	NA 1993 (Domestic) UN 1202 (International)
DOT SHIPPING LABEL:	None

Placard (International Only):



Use Combustible Placard if shipping in bulk domestically

15. REGULATORY INFORMATION

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other regulations at the state and/or local level. Consult those regulations applicable to your facility/operation.

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

The CERCLA definition of hazardous substances contains a “petroleum exclusion” clause which exempts crude oil, refined, and unrefined petroleum products and any indigenous components of such. However, other federal reporting requirements (e.g., SARA Section 304 as well as the Clean Water Act if the spill occurs on navigable waters) may still apply.

SARA SECTION 311/312 - HAZARD CLASSES

ACUTE HEALTH	CHRONIC HEALTH	FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVE
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product may contain listed chemicals below the *de minimis* levels which therefore are not subject to the supplier notification requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372. If you may be required to report releases of chemicals listed in 40 CFR 372.28, you may contact Hess Corporate Safety if you require additional information regarding this product.

CALIFORNIA PROPOSITON 65 LIST OF CHEMICALS

This product contains the following chemicals that are included on the Proposition 65 "List of Chemicals" required by the California Safe Drinking Water and Toxic Enforcement Act of 1986:

INGREDIENT NAME (CAS NUMBER)	**Date Listed**
Diesel Engine Exhaust (no CAS Number listed)	10/01/1990

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 3 (Combustible Liquid) and Class D, Division 2, Subdivision B (Toxic by other means)

16. OTHER INFORMATION

NFPA® HAZARD RATING		
	HEALTH:	0
	FIRE:	2
	REACTIVITY:	0

Refer to NFPA 704 “Identification of the Fire Hazards of Materials” for further information

HMIS® HAZARD RATING			
	HEALTH:	1 *	* Chronic
	FIRE:	2	
	PHYSICAL:	0	

SUPERSEDES MSDS DATED: 02/28/2001

ABBREVIATIONS:

AP = Approximately
< = Less than
> = Greater than
N/A = Not Applicable
N/D = Not Determined
ppm = parts per million

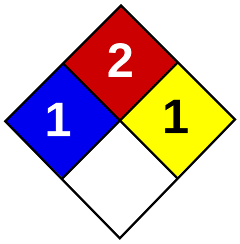
ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute (212) 642-4900
API	American Petroleum Institute (202) 682-8000
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation [General info: (800) 467-4922]
EPA	U.S. Environmental Protection Agency
HMIS	Hazardous Materials Information System
IARC	International Agency For Research On Cancer
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association (617)770-3000
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U.S. Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit (NIOSH)
SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
SCBA	Self-Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short-Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr.)
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Canadian Workplace Hazardous Materials Information System

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.



Health	1
Fire	2
Reactivity	1
Personal Protection	E

Material Safety Data Sheet

Iron Metal MSDS

Section 1: Chemical Product and Company Identification

Product Name: Iron Metal

Catalog Codes: SLI2047, SLI1996

CAS#: 7439-89-6

RTECS: NO4565500

TSCA: TSCA 8(b) inventory: Iron Metal

CI#: Not applicable.

Synonym:

Chemical Name: Iron

Chemical Formula: Fe

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Iron Metal, powder	7439-89-6	100

Toxicological Data on Ingredients: Not applicable.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to liver, cardiovascular system, upper respiratory tract, pancreas. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Flammable in presence of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Explosive in presence of open flames and sparks, of heat.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards:
Chlorine Trifluoride reacts with iron with incandescence. Powdered iron reacts with fluorine below redness with incandescence. Reduced iron decomposes with nitrogen dioxide @ ordinary temperature with incandescence. Reacting mass formed by mixture of phosphorus and iron can become incandescent when heated. This material is flammable in powder form only.

Special Remarks on Explosion Hazards: Material in powdered form can explode when exposed to heat or flame

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions:
Do not ingest. Do not breathe dust. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, acids.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Moisture sensitive.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Solid metallic powder.)

Odor: Odorless.

Taste: Tasteless.

Molecular Weight: 55.85 g/mole

Color: Black to Grey.

pH (1% soln/water): Not applicable.

Boiling Point: 3000°C (5432°F)

Melting Point: 1535°C (2795°F)

Critical Temperature: Not available.

Specific Gravity: Density: 7.86 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water, diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, ignition sources, incompatible materials, water/moisture, air, dust generation.

Incompatibility with various substances:
Reactive with oxidizing agents, acids. Slightly reactive to reactive with moisture.

Corrosivity: Not considered to be corrosive for metals and glass.

Special Remarks on Reactivity:
Hot iron(wire) burns in Chlorine gas. Violent decompositon of hydrogen peroxide (53% by weight or greater) may be caused by contact with iron. Readily oxidizes in moist air forming rust. Reactive with halogens. Incompatible with acetaldehyde, ammonium peroxodisulfate, chloroformamidinum, chloric acid, ammonium nitrate, dinitorgen tetroxide, nitryl fluoride, polystyrene, sodium acetylide, potassium dichromate, peroxyformic acid, sulfuric acid, sodium carbide. Readily attacked by dilute mineral acids and or attacked or dissolved by organic acids. Not appreciably attacked by cold sulfuric acid, or nitric acid, but is attacked by hot acids.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 30000 mg/kg [Rat].

Chronic Effects on Humans: May cause damage to the following organs: liver, cardiovascular system, upper respiratory tract, pancreas.

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Iron metal filings or dust: May cause skin irritation by mechanical action. Iron metal wire: Not likely to cause skin irritation Eyes: Iron metal filings or dust: Can irritate eyes by mechanical action. Iron metal wire: No hazard. Will not cause eye irritation. Inhalation: Iron dust: Can irritate the respiratory tract by mechanical action. Iron metal wire or filings: Not an inhalation hazard unless metal is heated. If metal is heated, fumes will be released. Inhalation of these fumes may cause "fume metal fever", which is characterized by flu-like symptoms. Symptoms may include metallic taste, fever, nausea, vomiting, chills, cough, weakness, chest pain, generalized muscle pain/aches, and increased white blood cell count. Ingestion: Iron metal wire: Not an ingestion hazard: Iron metal filings or dust: The amount of ingested iron which constitutes a toxic dose is not well defined. Proposed toxic doses of elemental iron are 20 mg/kg for gastrointestinal irritation to greater than 60 mg/kg for systemic toxicity. Gastrointestinal effects are the first signs to appear, with hemorrhagic vomiting and diarrhea, hematochezia, abdominal pain, lethargy, metabolic acidosis, coagulaopathy, shock, coma and convulsions developing from 0 to 6 hours after ingestion. Leukocytosis may also occur. An asymptomatic phase may ensue at 6 to 12 hours postingestion, followed by hypoglycemia or hyperglycemia, hepatic and renal failure, severe acidosis, cyanosis, fever, CNS depression (lethargy, restlessness and/or confusion seizures), hypotension, and cardiovascular collapse/cardiac failure in 12 to 48 hours. Hepatic cirrhosis, gastrointestinal scarring and/or strictures may arise in 2 to 6 weeks. It may also cause an anaphylactoid reaction. Non-cardiogenic pulmonary edema also develop in severe cases of iron intoxication. Chronic Potential Health Effects: Inhalation: Chronic inhalation of iron dust can lead to accumulation in the lungs and a characteristic stippled appearance on X-rays. This condition, called SIDEROSIS, is considered benign in that it does not interfere with lung function and does not predispose to other disease. Chronic inhalation of iron dust may also cause fibrosis in the lungs. Ingestion: Clinical signs of iron overload appear when the total body iron is 5 to 10 times higher than normal. Neurobehavioral defects including depression, decreased activity, habituation, reflex startle, and conditioned avoidance response performance may occur. However, similiar effects were also seen in iron defficiency. It is therefore likely that these behavioral effects are secondary to general toxicity. High serum iron levels may be associated with an increased risk of fatal acute myocardial infarction (MI). Skin: Prolonged or repeated contact may cause hypersensivity.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 4.1: Flammable solid.

Identification: : Metal powder, flammable, n.o.s. (Iron metal powder) UNNA: 3089 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California Director's List of Hazardous Substances: Iron Metal TSCA 8(b) inventory: Iron Metal

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS B-4: Flammable solid.

DSCL (EEC):
R11- Highly flammable. S16- Keep away from sources of ignition - No smoking. S22- Do not breathe dust.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 2

Reactivity: 1

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 2

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 05:52 PM

Last Updated: 06/09/2012 12:00 PM

BOC GASES

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: ISOBUTYLENE

1. Chemical Product and Company Identification

BOC Gases,
Division of
The BOC Group, Inc.
575 Mountain Avenue
Murray Hill, NJ 07974

TELEPHONE NUMBER: (908) 464-8100
24-HOUR EMERGENCY TELEPHONE NUMBER:
CHEMTREC (800) 424-9300

BOC Gases
Division of
BOC Canada Limited
5975 Falbourne Street, Unit 2
Mississauga, Ontario L5R 3W6

TELEPHONE NUMBER: (905) 501-1700
24-HOUR EMERGENCY TELEPHONE NUMBER:
(905) 501-0802
EMERGENCY RESPONSE PLAN NO: 20101

PRODUCT NAME: ISOBUTYLENE
CHEMICAL NAME: Isobutylene
COMMON NAMES/SYNONYMS: 2-Methylpropene, Isobutene
TDG (Canada) CLASSIFICATION: 2.1
WHMIS CLASSIFICATION: A, B1, D2B

PREPARED BY: Loss Control (908)464-8100/(905)501-1700
PREPARATION DATE: 6/1/95
REVIEW DATES: 6/7/96

2. Composition, Information on Ingredients

INGREDIENT	% VOLUME	PEL-OSHA[1]	TLV-ACGIH[2]	LD$_{50}$ or LC$_{50}$ Route/Species
Isobutylene FORMULA: C4H8 CAS: 115-11-7 RTECS #: UD0890000	99.0 to 99.8	Simple Asphyxiant	Simple Asphyxiant	LC$_{50}$ 620 mg/m^3/3H (rat)

[1] As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)

[2] As stated in the ACGIH 1994-95 Threshold Limit Values for Chemical Substances and Physical Agents

3. Hazards Identification

EMERGENCY OVERVIEW

This product does not contain oxygen and may cause asphyxia if released in a confined area. Simple hydrocarbons can cause irritation and central nervous system depression at high concentrations. flammable.

ROUTE OF ENTRY:

Skin Contact	Skin Absorption	Eye Contact	Inhalation	Ingestion
Yes	No	Yes	Yes	No

HEALTH EFFECTS:

Exposure Limits	Irritant	Sensitization
No	Yes	No
Teratogen	Reproductive Hazard	Mutagen
No	No	No
Synergistic Effects		
None Reported		

Carcinogenicity: -- NTP: No   IARC: No   OSHA: No

EYE EFFECTS:
Irritation may occur.

SKIN EFFECTS:
None anticipated as product is a gas at room temperature.

INGESTION EFFECTS:
Ingestion is unlikely.

INHALATION EFFECTS:
Product is relatively nontoxic. Simple hydrocarbons can irritate the eyes, mucous membranes and respiratory system at high concentrations.

Inhalation of high concentrations may cause dizziness, disorientation, incoordination, narcosis, nausea or narcotic effects.

This product may displace oxygen if released in a confined space. Maintain oxygen levels above 19.5% at sea level to prevent asphyxiation.

Effects of oxygen deficiency resulting from simple asphyxiants may include: rapid breathing, diminished mental alertness, impaired muscular coordination, faulty judgement, depression of all sensations, emotional instability, and fatigue. As asphyxiation progresses, nausea, vomiting, prostration, and loss of consciousness may result, eventually leading to convulsions, coma, and death.

Oxygen deficiency during pregnancy has produced developmental abnormalities in humans and experimental animals.

NFPA HAZARD CODES	**HMIS HAZARD CODES**	**RATINGS SYSTEM**
Health: 1	Health: 1	0 = No Hazard
Flammability: 4	Flammability: 4	1 = Slight Hazard
Reactivity: 0	Reactivity: 0	2 = Moderate Hazard
		3 = Serious Hazard
		4 = Severe Hazard

4. First Aid Measures

EYES:
Never introduce oil or ointment into the eyes without medical advice! If pain is present, refer the victim to an ophthalmologist for further treatment and follow up.

SKIN:

Remove contaminated clothing and wash affected area with soap and water. If irritation persists, seek medical attention.

INGESTION:
Not normally required. Seek immediate medical attention.

INHALATION:
PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO PRODUCT. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given assisted (artificial) respiration and supplemental oxygen. Further treatment should be symptomatic and supportive.

5. Fire Fighting Measures

Conditions of Flammability: Flammable liquid and vapor		
Flash point: -105 ^{o}F (-76 ^{o}C)	Method: Closed Cup	Autoignition Temperature: 869 ^{o}F (465 ^{o}C)
LEL(%): 1.8	UEL(%): 9.6	
Hazardous combustion products: Carbon monoxide, Carbon dioxide		
Sensitivity to mechanical shock: None		
Sensitivity to static discharge: Not Available		

FIRE AND EXPLOSION HAZARDS:
Isobutylene is heavier than air and may travel a considerable distance to an ignition source. Isobutylene is a flammable gas! Keep away from open flame and other sources of ignition. Do not allow smoking in storage areas or when handling.

EXTINGUISHING MEDIA:
Water, carbon dioxide, dry chemical.

FIRE FIGHTING INSTRUCTIONS:
If possible, stop the flow of gas with a remote valve. Use water spray to cool fire exposed containers. If fire is extinguished and flow of gas is continued, increase ventilation to prevent a build up of a flammable/ explosive atmosphere. Extinguish sources of ignition.

Be cautious of a Boiling Liquid Evaporating Vapor Explosion, BLEVE, if flame is impinging on surrounding containers. Direct 500 GPM water stream onto containers above the liquid level with remote monitors. Limit the number of personnel in proximity to the fire. Evacuate surrounding areas to at least 3000 feet in all directions.

6. Accidental Release Measures

Evacuate all personnel from affected area. Use appropriate protective equipment. Increase ventilation to prevent build up of a flammable/explosive atmosphere. Extinguish all sources of ignition! If leak is in user's equipment, be certain to purge piping with inert gas prior to attempting repairs. If leak is in container or container valve, contact the appropriate emergency telephone number listed in Section 1 or call your closest BOC location

7. Handling and Storage

Earth bond and ground all lines and equipment associated with the product system. Electrical equipment should be non-sparking and explosion proof.

Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure regulator when connecting cylinder to lower pressure (<250 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder.

Protect cylinders from physical damage. Store in cool, dry, well-ventilated area away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 130^{o}F (54^{o}C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders from being stored for excessive periods of time.

Post "No Smoking" signs in storage or use areas.

For additional recommendations consult Compressed Gas Association Pamphlet P-1.

Never carry a compressed gas cylinder or a container of a gas in cryogenic liquid form in an enclosed space such as a car trunk, van or station wagon. A leak can result in a fire, explosion, asphyxiation or a toxic exposure.

8. Exposure Controls, Personal Protection

EXPOSURE LIMITS[1]:

INGREDIENT	% VOLUME	PEL-OSHA[2]	TLV-ACGIH[3]	LD_{50} or LC_{50} Route/Species
Isobuylene FORMULA: C4H8 CAS: 115-11-7 RTECS #: UD0890000	99.0 to 99.8	Simple Asphyxiant	Simple Asphyxiant	LC_{50} 620 mg/m^3/3H (rat)

[1] Refer to individual state of provincial regulations, as applicable, for limits which may be more stringent than those listed here.
[2] As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)
[3] As stated in the ACGIH 1994-1995 Threshold Limit Values for Chemical Substances and Physical Agents.

ENGINEERING CONTROLS:
Use local exhaust to prevent accumulation. Use general ventilation to prevent build up of flammable concentrations. May use hood with forced ventilation when handling small quantities. If product is handled routinely where the potential for leaks exists, all electrical equipment must be rated for use in potentially flammable atmospheres. Consult the National Electrical Code for details.

EYE/FACE PROTECTION:
Safety goggles or glasses.

SKIN PROTECTION:
Protective gloves made of plastic or rubber.

RESPIRATORY PROTECTION:
Positive pressure air line with full-face mask and escape bottle or self-contained breathing apparatus should be available for emergency use.

OTHER/GENERAL PROTECTION:
Safety shoes, safety shower, eyewash.

9. Physical and Chemical Properties

PARAMETER	VALUE	UNITS
Physical state (gas, liquid, solid)	: Gas	
Vapor pressure at 70^{o}F	: 39	psia
Vapor density at STP (Air = 1)	: 1.98	
Evaporation point	: Not Available	
Boiling point	: 19.5	^{o}F
	: -6.9	^{o}C
Freezing point	: -220.6	^{o}F
	: -140.3	^{o}C
pH	: Not Available	
Specific gravity	: Not Available	
Oil/water partition coefficient	: Not Available	
Solubility (H20)	: Insoluble	
Odor threshold	: Not Available	
Odor and appearance	: A colorless gas with an unpleasant odor similar to that of burning coal.	

10. Stability and Reactivity

STABILITY:
Stable

CONDITIONS TO AVOID (STABILITY):
None

INCOMPATIBLE MATERIALS:
Oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS:
Carbon monoxide

11. Toxicological Information

Oxygen deficiency during pregnancy has produced developmental abnormalities in humans and experimental animals.

No chronic effects data given in the Registry of Toxic Effects of Chemical Substances (RTECS) or Sax, Dangerous Properties of Industrial Materials, 7th ed.

12. Ecological Information

No data given.

13. Disposal Considerations

Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED, WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to BOC Gases or authorized distributor for proper disposal.

14. Transport Information

PARAMETER	United States DOT	Canada TDG
PROPER SHIPPING NAME:	Isobutylene	Isobutylene
HAZARD CLASS:	2.1	2.1
IDENTIFICATION NUMBER:	UN 1055	UN 1055
SHIPPING LABEL:	FLAMMABLE GAS	FLAMMABLE GAS

15. Regulatory Information

Isoutylene is listed under the accident prevention provisions of section 112(r) of the Clean Air Act (CAA) with a threshold quantity (TQ) of 10,000 pounds.

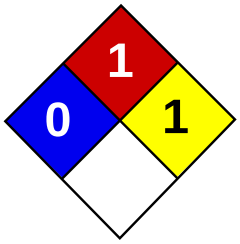
SARA TITLE III NOTIFICATIONS AND INFORMATION

SARA TITLE III - HAZARD CLASSES:
Acute Health Hazard
Fire Hazard
Sudden Release of Pressure Hazard

16. Other Information

Compressed gas cylinders shall not be refilled without the express written permission of the owner. Shipment of a compressed gas cylinder which has not been filled by the owner or with his/her (written) consent is a violation of transportation regulations.

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES:



Health	1
Fire	3
Reactivity	2
Personal Protection	E

Material Safety Data Sheet
Magnesium MSDS

Section 1: Chemical Product and Company Identification

Product Name: Magnesium

Catalog Codes: SLM4408, SLM2263, SLM3637

CAS#: 7439-95-4

RTECS: OM2100000

TSCA: TSCA 8(b) inventory: Magnesium

CI#: Not applicable.

Synonym: Magnesium ribbons, turnings or sticks

Chemical Name: Magnesium

Chemical Formula: Mg

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Magnesium	7439-95-4	100

Toxicological Data on Ingredients: Magnesium LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Flammable in presence of acids, of moisture. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Explosive in presence of acids, of moisture.

Fire Fighting Media and Instructions:
Flammable solid. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Magnesium turnings, chips or granules, ribbons, are flammable. They can be easily ignited. They may reignite after fire is extinguished. Produces flammable gases on contact with water and acid. May ignite on contact with water or moist air. Magnesium fires do not flare up violently unless moisture is present.

Special Remarks on Explosion Hazards: Reacts with acids and water to form hydrogen gas with is highly flammable and eplosive

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Flammable solid. Stop leak if without risk. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal.

Section 7: Handling and Storage

Precautions:

Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not breathe dust. Keep away from incompatibles such as oxidizing agents, acids, moisture.

Storage:
Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Moisture sensitive. Dangerous when wet.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 24.31 g/mole

Color: Silver-white

pH (1% soln/water): Not applicable.

Boiling Point: 1100°C (2012°F)

Melting Point: 651°C (1203.8°F)

Critical Temperature: Not available.

Specific Gravity: 1.74 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Very slightly soluble in hot water. Insoluble in cold water. Insoluble in chromium trioxides, and mineral acids, alkalies. Slightly soluble with decomposition in hot water. Soluble in concentrated hydrogen fluoride, and ammonium salts.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, incompatible materials, water or moisture, moist air.

Incompatibility with various substances: Reactive with oxidizing agents, acids, moisture.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Violent chemical reaction with oxidizing agents. Reacts with water to create hydrogen gas and heat. Must be kept dry. Reacts with acids to form hydrogen gas which is highly flammable and explosive. Magnesium forms hazardous or explosive mixtures with aluminum and potassium perchlorate; ammonium nitrate; barium nitrate, barium dioxide and zinc; beryllium oxide; boron phosphodiiodide; bromobenzyl trifluoride; cadmium cyanide; cadmium oxide; calcium carbide; carbonates; carbon tetrachloride; chlorine; chlorine trifluoride; chloroform; cobalt cyanide; copper cyanide; copper sulfate(anhydrous), ammonium nitrate, potassium chlorate and water; cupric oxide; cupric sulfate; fluorine; gold cyanide; hydrogen and calcium carbonate; hydrogen iodide; hydrogen peroxide; iodine; lead cyanide; mercuric oxide; mercury cyanide; methyl chloride; molybdenum trioxide; nickel cyanide; nitric acid; nitrogen dioxide; oxygen (liquid); performic acid; phosphates; potassium chlorate; potassium perchlorate; silver nitrate; silver oxide; sodium perchlorate; sodium peroxide; sodium peroxide and carbon dioxide; stannic oxide; sulfates; trichloroethylene; zinc cyanide; zinc oxide.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: May cause skin irritation by mechanical action. May get mechanical injury or embedding of chips/particles in skin. The particles that are embedded in the wounds may retard healing. Eyes: May cause eye irritation by mechanical action. Mechanical injury may occur. Particles or chips may embed in eye and retard healing. Inhalation: Low hazard for ususal industrial handling. It may cause respiratory tract irritation. However, it is unlikely due to physical form. When Magnesium metal is heated during welding or smelting process, Metal Fume Fever may result from inhalation of magnesium fumes. Metal Fume Fever is a flu-like condition consisting of fever, chills, sweating, aches, pains, cough, weakness, headache, nausea, vomiting, and breathing difficulty. Other symptoms may include metallic taste, increased white blood cell count. There is no permanent ill-effect. Ingestion: Low hazard for usual industrial handling. There are no known reports of serious industrial poisonings with Magnesium. Ingeston of large amounts of chips, turnings or ribbons may cause gastrointestinal tract irritation with nausea, vomiting, and diarrhea. Acute ingestion may also result in Hypermagnesia. Hypermagnesia may cause hypotension, bradycardia, CNS depression, respiratory depression, and impairment of neuromuscular transmission (hyporeflexia, paralysis).

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 4.1: Flammable solid.

Identification: : Magnesium UNNA: 1869 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Magnesium Rhode Island RTK hazardous substances: Magnesium Pennsylvania RTK: Magnesium Massachusetts RTK: Magnesium Massachusetts spill list: Magnesium New Jersey: Magnesium TSCA 8(b) inventory: Magnesium

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-4: Flammable solid. CLASS B-6: Reactive and very flammable material.

DSCL (EEC):
R11- Highly flammable. R15- Contact with water liberates extremely flammable gases. S7/8- Keep container tightly closed and dry. S43- In case of fire, use dry chemical. Never use water.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 3

Reactivity: 2

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 0

Flammability: 1

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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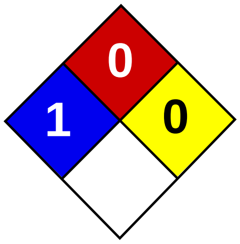

Health	1
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Manganese Metal Powder MSDS

Section 1: Chemical Product and Company Identification

Product Name: Manganese Metal Powder

Catalog Codes: SLM4390

CAS#: 7439-96-5

RTECS: OO9275000

TSCA: TSCA 8(b) inventory: Manganese

CI#: Not available.

Synonym:

Chemical Name: Manganese

Chemical Formula: Mn

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Manganese	7439-96-5	100

Toxicological Data on Ingredients: Manganese: ORAL (LD50): Acute: 9000 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, lungs, brain, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Explosive in presence of open flames and sparks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Moderate fire potential, in the form of dust or powder, when exposed to flame. When manganese if heated in the vapor of phosphorus at a very dull red heat, union occurs with incandescence. Concentrated nitric acid reacts with powdered manganese with incandescence and explosion. Powdered manganese ignites in chlorine.

Special Remarks on Explosion Hazards: Moderate explosion potential, in the form of dust or powder, when exposed to flame.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, reducing agents.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.1 (mg/m3) from ACGIH (TLV) [United States] TWA: 5 (mg/m3) [Canada] TWA: 1 STEL: 3 (mg/m3) from NIOSH [United States] TWA: 5 (mg/m3) from OSHA (PEL) [United States]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Powdered solid.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 54.94 g/mole

Color: Grayish white.

pH (1% soln/water): Not applicable.

Boiling Point: 2095°C (3803°F)

Melting Point: 1244°C (2271.2°F)

Critical Temperature: Not available.

Specific Gravity: 7.44 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, reducing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Superficially oxidized on exposure to air. Reacts with aqueous solutions of sodium or potassium bicarbonate. Reacts with dilute mineral acids with evolution of hydrogen and formation of divalent manganous salts. Reacts with fluorine and chlorine to produce di or tri fluoride, and di and tri chloride, respectively. In the form of powder, it reduces most metallic oxides on heating. On heating, it reacts directly with carbon, phosphorus, antimony, or arsenic. Also incompatible with hydroxides, cyanides, carbonates.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 9000 mg/kg [Rat].

Chronic Effects on Humans: May cause damage to the following organs: blood, lungs, brain, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant), of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
Manganese can cross the placenta. May cause cancer (tumorigenic) based on animal data.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: May cause skin irritaiton Eyes: Dust may cause mechanical irritation. Inhalation: Dust may cause respiratory tract irritation. May cause "Metal Fume Fever" which may include flu-like symptoms (fever, chills, upset stomach, vomiting, weakness, headache, body aches, muscle pains, dry mouth and throat, coughing, tightness of the chest). May affect behavior/Central Nervous system (change in motor activity, torpor, nervousness, tremor, yawning, mood swings, irritability, restlessness, fatigue, headache, apathy, languor, insomnia than somnolence, hallucinations, delusions, uncontrollable laughter followed by crying, compulsions, aggressivness, weakness in legs, memory loss, decreased libido, impotence, salivation, hearing loss, slow gait,), and respiration (dyspnea, shallow respiration, cyanosis, alveolar inflammation). Ingestion: Repeated or prolonged exposure from ingestion may affect brain (degenerative changes), blood and metabolism. Ingestion: May cause digestive tract irritation. There is a low gastrointesitnal absorption of manganese. Chronic Potential Health Effects: Inhalation: Repeated or prolonged exposure from inhalation may affect brain (degeneratiave changes), behavior/Central Nervous system with symptoms to acute exposure. May also affect liver (chronic liver disease, jaundice) Ingestion: Repeated or prolonged exposure from ingestion may affect brain, blood and metabolism

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
Illinois toxic substances disclosure to employee act: Manganese Rhode Island RTK hazardous substances: Manganese Pennsylvania RTK: Manganese Minnesota: Manganese Massachusetts RTK: Manganese New Jersey: Manganese New Jersey spill list: Manganese Louisiana spill reporting: Manganese California Director's List of Hazardous Substances: Manganese TSCA 8(b) inventory: Manganese SARA 313 toxic chemical notification and release reporting: Manganese

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC): Not applicable.

HMIS (U.S.A.):

- **Health Hazard:** 1
- **Fire Hazard:** 0
- **Reactivity:** 0
- **Personal Protection:** E

National Fire Protection Association (U.S.A.):

- **Health:** 1
- **Flammability:** 0
- **Reactivity:** 0
- **Specific hazard:**

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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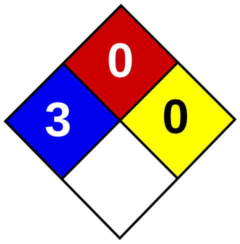

Health	**3**
Fire	**0**
Reactivity	**0**
Personal Protection	

Material Safety Data Sheet
Mercury MSDS

Section 1: Chemical Product and Company Identification

Product Name: Mercury

Catalog Codes: SLM3505, SLM1363

CAS#: 7439-97-6

RTECS: OV4550000

TSCA: TSCA 8(b) inventory: Mercury

CI#: Not applicable.

Synonym: Quick Silver; Colloidal Mercury; Metallic Mercury; Liquid Silver; Hydragyrum

Chemical Name: Mercury

Chemical Formula: Hg

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Mercury	7439-97-6	100

Toxicological Data on Ingredients: Mercury LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (corrosive, permeator). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Hazardous in case of skin contact (permeator). CARCINOGENIC EFFECTS: Classified A5 (Not suspected for human.) by ACGIH. 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, liver, brain, peripheral nervous system, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation.

Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
When thrown into mercury vapor, boron phosphodiiodide ignites at once. Flame forms with chlorine jet over mercury surface at 200 deg to 300 deg C. Mercury undergoes hazardous reactions in the presence of heat and sparks or ignition.

Special Remarks on Explosion Hazards:
A violent exothermic reaction or possible explosion occurs when mercury comes in contact with lithium and rubidium. CHLORINE DIOXIDE & LIQUID HG, WHEN MIXED, EXPLODE VIOLENTLY. Mercury and Ammonia can produce an

explosive compound. A mixture of the dry carbonyl and oxygen will explode on vigorous shaking with mercury. Methyl azide in the presence of mercury was shown to be potentially explosive.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, metals.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 25°C (77°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.025 from ACGIH (TLV) [United States] SKIN TWA: 0.05 CEIL: 0.1 (mg/m3) from OSHA (PEL) [United States] Inhalation TWA: 0.025 (mg/m3) [United Kingdom (UK)] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Heavy liquid)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 200.59 g/mole

Color: Silver-white

pH (1% soln/water): Not available.

Boiling Point: 356.73°C (674.1°F)

Melting Point: -38.87°C (-38°F)

Critical Temperature: 1462°C (2663.6°F)

Specific Gravity: 13.55 (Water = 1)

Vapor Pressure: Not available.

Vapor Density: 6.93 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, metals.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Ground mixtures of sodium carbide and mercury, aluminum, lead, or iron can react vigorously. A violent exothermic reaction or possible explosion occurs when mercury comes in contact with lithium and rubidium. Incompatible with boron diiodophosphide; ethylene oxide; metal oxides, metals(aluminum, potassium, lithium, sodium, rubidium); methyl azide; methylsilane, oxygen; oxidants(bromine, peroxyformic acid, chlorine dioxide, nitric acid, tetracarbonynickel, nitromethane, silver perchlorate, chlorates, sulfuric acid, nitrates,); tetracarbonylnickel, oxygen, acetylinic compounds, ammonia, ethylene oxide, methylsiliane, calcium,

Special Remarks on Corrosivity:
The high mobility and tendency to dispersion exhibited by mercury, and the ease with which it forms alloys (amalga) with many laboratory and electrical contact metals, can cause severe corrosion problems in laboratories. Special precautions: Mercury can attack copper and copper alloy materials.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A5 (Not suspected for human.) by ACGIH. 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: blood, kidneys, liver, brain, peripheral nervous system, central nervous system (CNS).

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (corrosive, permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:

May affect genetic material. May cause cancer based on animal data. Passes through the placental barrier in animal. May cause adverse reproductive effects(paternal effects- spermatogenesis; effects on fertility - fetotoxicity, post-implantation mortality), and birth defects.

Special Remarks on other Toxic Effects on Humans:

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Mercury UNNA: 2809 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Mercury California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Mercury Connecticut hazardous material survey.: Mercury Illinois toxic substances disclosure to employee act: Mercury Illinois chemical safety act: Mercury New York acutely hazardous substances: Mercury Rhode Island RTK hazardous substances: Mercury Pennsylvania RTK: Mercury Minnesota: Mercury Massachusetts RTK: Mercury New Jersey: Mercury New Jersey spill list: Mercury Louisiana spill reporting: Mercury California Director's List of Hazardous Substances.: Mercury TSCA 8(b) inventory: Mercury SARA 313 toxic chemical notification and release reporting: Mercury CERCLA: Hazardous substances.: Mercury: 1 lbs. (0.4536 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):
R23- Toxic by inhalation. R33- Danger of cumulative effects. R38- Irritating to skin. R41- Risk of serious damage to eyes. R50/53- Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. S2- Keep out of the

reach of children. S7- Keep container tightly closed. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S39- Wear eye/face protection. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). S46- If swallowed, seek medical advice immediately and show this container or label. S60- This material and its container must be disposed of as hazardous waste. S61- Avoid release to the environment. Refer to special instructions/Safety data sheets.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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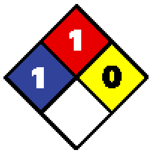


NFPA 704 (Section 16)

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

HESS 10W40 Motor Oil **MSDS No. 14292**

1. CHEMICAL PRODUCT and COMPANY INFORMATION

Amerada Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

Manufactured by:

The Valvoline Company
P.O. Box 14000
Lexington, KY 40512

EMERGENCY TELEPHONE NUMBER: **VALVOLINE: 800-247-5263**
COMPANY CONTACT (business hours): Valvoline Info: 606-357-7847
AHC Corporate Safety 732-750-6000

SYNONYMS: Valvoline Product Code 52670414

This product is manufactured by The Valvoline Company and packaged under the Amerada Hess ("Hess") label. The information in this MSDS has been developed by The Valvoline Company, MSDS No. 505.0164091-016.003I, date 5/11/99.

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and INFORMATION ON INGREDIENTS

INGREDIENT NAME	EXPOSURE LIMITS	CONCENTRATION PERCENT BY WEIGHT
Aliphatic Petroleum Distillates CAS NUMBER: 64742-65-0	OSHA PEL-TWA: 5 mg/m^3 as mineral oil mist ACGIH TLV-TWA: 5 mg/m^3 as mineral oil mist	83.0 – 93.0
Detergent/ Dispersant Engine Oil Package	No exposure limits established	N/A
Zinc Compounds	No exposure limits established	N/A

Petroleum-based lubricating oil with detergent/dispersant engine oil package with zinc compounds.

3. HAZARDS IDENTIFICATION

EYES

May cause mild eye irritation. Symptoms include stinging, tearing, and redness.

SKIN

May cause mild skin irritation. Prolonged or repeated contact may dry the skin. Symptoms include redness, burning, drying and cracking of the skin, and skin burns. Additional symptoms of skin contact include: acne. Passage of this material into the body through the skin is possible, but it is unlikely that this would result in harmful effects during safe handling and use.

INGESTION

Swallowing small amounts of this material during normal handling is not likely to cause harmful effects. Swallowing large amounts may be harmful.

INHALATION

It is possible to breathe this material under certain conditions of handling and use (for example, during heating, spraying, or stirring). Breathing small amounts of this material during normal handling is not likely to cause harmful effects. Breathing large amounts may be harmful. Symptoms usually occur at air concentrations higher than the recommended exposure limits.

SYMPTOMS OF EXPOSURE

Signs and symptoms of exposure to this material through breathing, swallowing, and/or passage of the material through the skin may include: stomach or intestinal upset, (nausea, vomiting, diarrhea), irritation (nose, throat, airways), blood abnormalities (breakage of blood cells), liver damage.

TARGET ORGAN EFFECTS

No data

DEVELOPMENTAL INFORMATION

There are no data available for assessing risk to the fetus from maternal exposure to this material.

CANCER INFORMATION

This material is not listed as a carcinogen by IARC, NTP, or OSHA. Used motor oil has been shown to cause skin cancer in laboratory animal continually exposed by repeated applications. Avoid prolonged or repeated skin contact.

OTHER HEALTH EFFECTS

No data

4. FIRST AID MEASURES

EYES

If symptoms develop, move individual away from exposure and into fresh air. Flush eyes gently with water while holding eyelids apart. If symptoms persist or there is visual difficulty, seek medical attention.

SKIN

Remove contaminated clothing. Wash exposed area with soap and water. If symptoms persist, seek medical attention. Launder clothing before reuse.

INGESTION

Seek medical attention. If individual is drowsy or unconscious, do not give anything by mouth; place individual on the left side with the head down. Contact a physician, medical facility, or poison control center for advice about whether to induce vomiting. If possible, do not leave individual unattended.

INHALATION

If symptoms develop, move individual away from exposure and into fresh air. If symptoms persist, seek medical attention. If breathing is difficult, administer oxygen. Keep person warm and quiet; seek immediate medical attention.

Note to Physicians

Acute aspiration of large amounts of oil-laden material may produce a serious aspiration hazard. Patients who aspirate these oils should be followed for the development of long-term sequelae. Repeated aspiration of mineral oil can produce chronic inflammation of the lungs (i.e. lipoid pneumonia) that may progress to pulmonary fibrosis. Symptoms are often subtle and radiological changes appear worse than clinical abnormalities. Occasionally, persistent cough, irritation of the upper respiratory tract, shortness of breath with exertion, fever, and bloody sputum occur. Inhalation exposure to oil mists below current workplace exposure limits is unlikely to cause pulmonary abnormalities. Preexisting disorders of the following organs (or organ systems) may be aggravated by exposure to this material: skin.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES:

FLASH POINT:	435.0 °F (223.8 °C) COC
AUTOIGNITION POINT:	No data
EXPLOSIVE LIMITS (%):	No data

HAZARDOUS PRODUCTS OF COMBUSTION

May form: carbon dioxide and carbon monoxide, oxides of sulfur, nitrogen and phosphorous, various hydrocarbons.

FIRE AND EXPLOSION HAZARDS

Never use welding or cutting torch on or near drum (even empty) because product (even just residue) can ignite explosively. No special fire hazards are known to be associated with this product. Dense smoke may be generated while burning.

EXTINGUISHING MEDIA

Regular fire fighting foam, carbon dioxide, dry chemical.

FIRE FIGHTING INSTRUCTIONS

Water or foam may cause frothing which can be violent and possibly endanger the life of the firefighter. Water may be used to keep fire-exposed containers cool until fire is out. Wear a self-contained breathing apparatus with full facepiece operated in the pressure-demand mode with appropriate turnout gear and chemical resistant personal protective equipment. Refer to Section 8.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES

SMALL SPILL: Absorb liquid on vermiculite, floor absorbent or other absorbent material. Persons not wearing proper personal protective equipment should be excluded from area of spill.

LARGE SPILL: Prevent run-off to sewers, streams, or other bodies of water. If run-off occurs, notify authorities as required, that a spill has occurred. Persons not wearing proper personal protective equipment should be excluded from area of spill until clean-up has been completed.

7. HANDLING and STORAGE

HANDLING PRECAUTIONS

Containers of this material may be hazardous when emptied. Since emptied containers retain product residues (vapor, liquid, and/or solid), all hazard precautions given in the data sheet must be observed. All five gallon pails and larger metal containers including tank cars and tank trucks should be grounded and/or bonded when material is transferred. Precautions during use: avoid prolonged or frequently repeated skin contact with this material. Skin contact can be minimized by wearing impervious protective gloves. As with all products of this nature, good personal hygiene is essential. Hands and other exposed areas should be washed thoroughly with soap and water after contact, especially before eating and/or smoking. Regular laundering of contaminated clothing is essential to reduce indirect skin contact with this material. Warning. Sudden release of hot organic chemical vapors or mists from process equipment operating at elevated temperature and pressure, or sudden ingress of air into vacuum equipment, may result in ignitions without the presence of obvious ignition sources. Published "autoignition" or "ignition" temperature values cannot be treated as safe operating temperatures in chemical processes without analysis of the actual process conditions. Any use of this product in elevated temperature processes should be thoroughly evaluated to establish and maintain safe operating conditions.

STORAGE PRECAUTIONS

Do not store near extreme heat, open flame, or sources of ignition.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION

ENGINEERING CONTROLS

Provide sufficient mechanical (general and/or local exhaust) ventilation to maintain exposure below TLV(s).

EYE PROTECTION

Not required under normal conditions of use. However, if misting or splashing conditions exist, then safety glasses or chemical splash goggles are advised.

SKIN PROTECTION

Not normally required. However, wear resistant gloves such as nitrile rubber to prevent irritation which may result from prolonged or repeated skin contact with product., To prevent repeated or prolonged skin contact, wear impervious clothing and boots. Wear normal work clothing covering arms and legs..

RESPIRATORY PROTECTION

If workplace exposure limit(s) of product or any component is exceeded (See Exposure Guidelines), a NIOSH/MSHA approved air supplied respirator is advised in absence of proper environmental control. OSHA regulations also permit other NIOSH/MSHA respirators (negative pressure type) under specified conditions (consult your industrial hygienist). Engineering or administrative controls should be implemented to reduce exposure. Not required under normal conditions of use. However, if oil mists are generated above recommended PEL/TLV of 5 mg/m3, then a NIOSH/MSHA approved respirator is advised in absence of proper environmental control. (See your industrial hygienist.)

9. PHYSICAL and CHEMICAL PROPERTIES

APPEARANCE

Dry, clear, and bright liquid

ODOR

No data

BASIC PHYSICAL PROPERTIES

BOILING RANGE:	(for component) > 425.0 F (218.3 C) @ 760.00 mmHg
VAPOR PRESSURE:	No data
VAPOR DENSITY (air = 1):	No data
LIQUID DENSITY:	7.340 lbs/gal @ 60.00 F (.881 kg/l @ 15.60 C)
SPECIFIC GRAVITY (H_2O = 1):	0.881 @ 60F
PERCENT VOLATILES:	No data
EVAPORATION RATE:	Slower than ethyl ether
pH:	No data
VISCOSITY:	<= 3300.0 cps @ -20 C; 13.5 – 14.5 cst @ 100 C

10. STABILITY and REACTIVITY

STABILITY: Stable. Product will not undergo hazardous polymerization.

INCOMPATIBLE MATERIALS

Avoid contact with: acids, halogens, strong oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS

May form: aldehydes, carbon dioxide and carbon monoxide, hydrogen sulfide, oxides of sulfur, nitrogen and phosphorus, toxic fumes, various hydrocarbons.

11. TOXICOLOGICAL PROPERTIES

No data

12. ECOLOGICAL INFORMATION

No data

13. DISPOSAL CONSIDERATIONS

Dispose of in accordance with all applicable local, state and federal regulations.

14. TRANSPORTATION INFORMATION

DOT Information - 49 CFR 172.101
DOT Description: Not Regulated
Container/Mode: CASES/SURFACE - NO EXCEPTIONS
NOS Component: None
RQ (Reportable Quantity) - 49 CFR 172.101: Not applicable

15. REGULATORY INFORMATION

TSCA (Toxic Substances Control Act) Status (UNITED STATES)

The intentional ingredients of this product are listed.

CERCLA RQ - 40 CFR 302.4: None

SARA 302 Components - 40 CFR 355 Appendix A: None

SARA Section 311/312 Hazard Class - 40 CFR 370.2

Immediate (X) Delayed (X) Fire(--) Reactive (--) Sudden Release of Pressure (--)

SARA 313 Components - 40 CFR 372.65 Section 313 Component(s) and CAS Number:
ZINC C1-C14 ALKYLDITHIOPHOSPHATE (CAS No. 68649-42-3)

International Regulations Inventory Status: Not determined

State and Local Regulations: California Proposition 65 None

16. OTHER INFORMATION

NFPA® HAZARD RATING	HEALTH:	1	Slight
	FIRE:	1	Slight
	REACTIVITY:	0	Negligible

HMIS® HAZARD RATING	HEALTH:	1*	Slight
	FIRE:	1	Slight
	REACTIVITY:	0	Negligible
			* Chronic

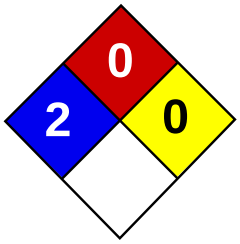
OTHER: The information presented in this MSDS was taken directly from the MSDS for this product prepared by The Valvoline Company, the manufacturer of the product – see Section 2.

ABBREVIATIONS:
AP = Approximately
< = Less than
> = Greater than
N/A = Not Applicable
N/D = Not Determined
ppm = parts per million

ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute (212) 642-4900
API	American Petroleum Institute (202) 682-8000
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation [General info: (800) 467-4922]
EPA	U.S. Environmental Protection Agency
HMIS	Hazardous Materials Information System
IARC	International Agency For Research On Cancer
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association (617) 770-3000
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U.S. Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit (NIOSH)
SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
SCBA	Self-Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short-Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr.)
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Canadian Workplace Hazardous Materials Information System

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES (The Valvoline Company)
The information accumulated herein is believed to be accurate but is not warranted to be whether originating with the company or not. Recipients are advised to confirm in advance of need that the information is current, applicable, and suitable to their circumstances.



Health	2
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet

Nickel metal MSDS

Section 1: Chemical Product and Company Identification

Product Name: Nickel metal

Catalog Codes: SLN2296, SLN1342, SLN1954

CAS#: 7440-02-0

RTECS: QR5950000

TSCA: TSCA 8(b) inventory: Nickel metal

CI#: Not applicable.

Synonym: Nickel Metal shot; Nickel metal foil.

Chemical Name: Nickel

Chemical Formula: Ni

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Nickel metal	7440-02-0	100

Toxicological Data on Ingredients: Nickel metal LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant, sensitizer), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer), of ingestion, of inhalation (lung sensitizer). CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. Classified 2 (Some evidence.) by NTP. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to skin. The substance may be toxic to kidneys, lungs, liver, upper respiratory tract. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Material in powder form, capable of creating a dust explosion. This material is flammable in powder form only.

Special Remarks on Explosion Hazards:
Material in powder form, capable of creating a dust explosion. Mixtures containing Potassium Perchlorate with Nickel & Titanium powders & infusorial earth can explode. Adding 2 or 3 drops of approximately 90% peroxyformic acid to powdered nickel will result in explosion. Powdered nickel reacts explosively upon contact with fused ammonium nitrate at temperatures below 200 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Keep away from incompatibles such as oxidizing agents, combustible materials, metals, acids.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 1 (mg/m3) from ACGIH (TLV) [United States] Inhalation Respirable. TWA: 0.5 (mg/m3) [United Kingdom (UK)] TWA: 1 (mg/m3) from OSHA (PEL) [United States] InhalationConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid. Lustrous solid.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 58.71 g/mole

Color: Silvery.

pH (1% soln/water): Not applicable.

Boiling Point: 2730°C (4946°F)

Melting Point: 1455°C (2651°F)

Critical Temperature: Not available.

Specific Gravity: Density: 8.908 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:

Insoluble in cold water, hot water. Insoluble in Ammonia. Soluble in dilute Nitric Acid. Slightly soluble in Hydrochloric Acid, Sulfuric Acid.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, combustible materials, metals, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with strong acids, selenium, sulfur, wood and other combustibles, nickel nitrate, aluminum, aluminum trichloride, ethylene, p-dioxan, hydrogen, methanol, non-metals, oxidants, sulfur compounds, aniline, hydrogen sulfide, flammable solvents, hydrazine, and metal powders (especially zinc, aluminum, and magnesium), ammonium nitrate, nitryl fluoride, bromine pentafluoride, potassium perchlorate + titanium powder + indusorial earth.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. Classified 2 (Some evidence.) by NTP. Causes damage to the following organs: skin. May cause damage to the following organs: kidneys, lungs, liver, upper respiratory tract.

Other Toxic Effects on Humans:
Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant, sensitizer), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose/Conc: LDL [Rat] **-** Route: Oral; Dose: 5000 mg/kg LDL [Guinea Pig] **-** Route: Oral; Dose: 5000 mg/kg

Special Remarks on Chronic Effects on Humans: May cause cancer based on animal test data

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Nickel dust and fume can irritate skin. Eyes: Nickel dust and fume can irritate eyes. Inhalation: Inhalation of dust or fume may cause respiratory tract irritation with non-productive cough, hoarseness, sore throat, headache, vertigo, weakness, chest pain, followed by delayed effects, including tachypnea, dyspnea, and ARDS. Death due to ARDS has been reported following inhalation of high concentrations of respirable metallic nickel dust. Later effects may include pulmonary edema and fibrosis. Ingestion: Metallic nickel is generally considered not to be acutely toxic if ingested. Ingestion may cause nausea, vomiting, abdominal , and diarrhea. Nickel may damage the kidneys(proteinuria), and may affect liver function. It may also affect behavior (somnolence), and cardiovascular system (increased cornary artery resistance, decreased myocardial contractility, myocardial damage, regional or general arteriolar or venus dilation). Chronic Potential Health Effects: Skin: May cause skin allergy. Nickel and nickel compounds are among the most common sensitizers inducing allergic contact dermatitis. Inhalation: Chronic inhalation nickel dust or fume can cause chronic hypertrophic rhinitis, sinusitis, nasal polyps, perforation of the nasal septum, chronic pulmonary irritation, fibrosis, pulmonary edema, pulmonary eosinophilia, Pneumoconiosis, allergies (asthma-like allergy), and cancer of the nasal sinus cavities, lungs, and possibly other organs. Future exposures can cause asthma attacks with shortness of breath, wheezing, cough, and/or chest tightness. Chronic inhalation of nickel dust or fume may also affect the liver (impaired liver function tests), and blood (changes in red blood cell count). Ingestion: Prolonged or repeated ingestion of nickel can be a source chronic urticaria and other signs of allergy.

Chronic ingestion of NIckel may also affect respiration and cause pneumoconiosis or fibrosis. Note: In the general population, sensitization occurs from exposure to nickel-containing coins, jewelry, watches,

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Nickel metal California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Nickel metal Connecticut hazardous material survey.: Nickel metal Illinois toxic substances disclosure to employee act: Nickel metal Illinois chemical safety act: Nickel metal New York release reporting list: Nickel metal Rhode Island RTK hazardous substances: Nickel metal Pennsylvania RTK: Nickel metal Michigan critical material: Nickel metal Massachusetts RTK: Nickel metal Massachusetts spill list: Nickel metal New Jersey: Nickel metal New Jersey spill list: Nickel metal Louisiana spill reporting: Nickel metal California Director's List of Hazardous Substances: Nickel metal TSCA 8(b) inventory: Nickel metal

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects. R43- May cause sensitization by skin contact. S22- Do not breathe dust. S36- Wear suitable protective clothing.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:42 PM

Last Updated: 06/09/2012 12:00 PM

```
ACCUSTANDARD INC              -- M-525-1-5X PAH MIXTURES 0.5 MG/ML FOR METHOD
=======================================================
MSDS Safety Information
=======================================================
FSC: 6550
MSDS Date: 10/26/1994
MSDS Num: CFCBJ
LIIN: 00F050479
Product ID: M-525-1-5X PAH MIXTURES 0.5 MG/ML FOR METHOD 525
MFN: 01
Responsible Party
Cage: 0U4A8
Name: ACCUSTANDARD INC
Address: 25 SCIENCE PK SUITE 687
City: NEW HAVEN CT 06511-5000
Info Phone Number: 203-786-5290
Emergency Phone Number: 203-786-5290
Review Ind: Y
Published: Y
=======================================================
Preparer Co. when other than Responsible Party Co.
=======================================================
Cage: 0U4A8
Name: ACCUSTANDARD INC
Address: 125 MARKET ST
City: NEW HAVEN CT 06513
=======================================================
Contractor Summary
=======================================================
Cage: 0U4A8
Name: ACCUSTANDARD INC
Address: 125 MARKET ST
City: NEW HAVEN CT 06513
Phone: 800-442-5290
=======================================================
Ingredients
=======================================================
Cas: 208-96-8
RTECS #: AB1254000
Name: ACENAPHTHYLENE
% Wt: 0.05
EPA Rpt Qty: 5000 LBS
DOT Rpt Qty: 5000 LBS
------------------------------
Cas: 120-12-7
RTECS #: CA9350000
Name: ANTHRACENE (IARC CARCINOGEN - GROUP 3) *96-2*
% Wt: 0.05
EPA Rpt Qty: 5000 LBS
DOT Rpt Qty: 5000 LBS
------------------------------
Cas: 56-55-3
RTECS #: CV9275000
Name: BENZO (A) ANTHRACENE, BENZ (A) ANTHRACENE
% Wt: 0.05
EPA Rpt Qty: 10 LBS
DOT Rpt Qty: 10 LBS
------------------------------
Cas: 50-32-8
RTECS #: DJ3675000
Name: BENZO (A) PYRENE (SUSPECTED HUMAN CARCINOGEN BY ACHIGH & NTP, ANIMAL
  SUFFICIENT BY IARC, IARC GROUP 2A)   *96-2*
% Wt: 0.05
ACGIH TLV: A2 CARCINOGEN
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EPA Rpt Qty: 1 LB
DOT Rpt Qty: 1 LB
------------------------------
Cas: 205-99-2
RTECS #: DF6350000
Name: BENZO (B) FLUORANTHENE (SUSPECTED CARCINOGEN BY NTP, IARC GROUP 2B)
  *96-2*
% Wt: 0.05
Other REC Limits: A2 CARCINOGEN
EPA Rpt Qty: 1 LB
DOT Rpt Qty: 1 LB
------------------------------
Cas: 191-24-2
RTECS #: DI6200500
Name: BENZO (GHI) PERYLENE
% Wt: 0.05
EPA Rpt Qty: 5000 LBS
DOT Rpt Qty: 5000 LBS
------------------------------
Cas: 207-08-9
RTECS #: DF6350000
Name: BENZO (K) FLUORANTHENE
% Wt: 0.05
EPA Rpt Qty: 5000 LBS
DOT Rpt Qty: 5000 LBS
------------------------------
Cas: 218-01-9
RTECS #: GC0700000
Name: CHRYSENE (SUSPECTED HUMAN CARCINOGEN BY ACGIH & IARC, IARC GROUP 3)
  *96-2*
% Wt: 0.05
ACGIH TLV: A2 CARCINOGEN
EPA Rpt Qty: 100 LBS
DOT Rpt Qty: 100 LBS
------------------------------
Cas: 53-70-3
RTECS #: HN2625000
Name: DIBENZ (A,H) ANTHRACENE
% Wt: 0.05
EPA Rpt Qty: 1 LB
DOT Rpt Qty: 1 LB
------------------------------
Cas: 86-73-7
RTECS #: LL5670000
Name: FLUORENE
% Wt: 0.05
EPA Rpt Qty: 5000 LBS
DOT Rpt Qty: 5000 LBS
------------------------------
Cas: 193-39-5
RTECS #: NK9300000
Name: INDENO (1,2,3,CD) PYRENE
% Wt: 0.05
EPA Rpt Qty: 100 LBS
DOT Rpt Qty: 100 LBS
------------------------------
Cas: 85-01-8
RTECS #: SE7175000
Name: PHENANTHRENE
% Wt: 0.05
EPA Rpt Qty: 5000 LBS
DOT Rpt Qty: 5000 LBS
------------------------------
Cas: 129-00-0
RTECS #: UR2450000
```

Name: PYRENE
% Wt: 0.05
EPA Rpt Qty: 5000 LBS
DOT Rpt Qty: 5000 LBS

Cas: 67-64-1
RTECS #: AL3150000
Name: ACETONE; DIMETHYL KETONE; 2-PROPANONE
% Wt: 99.35
OSHA PEL: 2400 MG/CUM
ACGIH TLV: 750 PPM
EPA Rpt Qty: 5000 LBS
DOT Rpt Qty: 5000 LBS

Health Hazards Data

Route Of Entry Inds - Inhalation: YES
Skin: NO
Ingestion: YES
Carcinogenicity Inds - NTP: YES
IARC: YES
OSHA: NO
Effects of Exposure: HARMFUL IF INHALED/SWALLOWED. PROLONGED EXPOSURE/HIGH CONCENTRATIONS MAY CAUSE IRRITATION OF EYES & RESPIRATORY TRACT. MAY CAUSE DAMAGE TO CENTRAL NERVOUS SYSTEM, LIVER & KIDNEYS. SKIN/EYES: IRRITATIO N.
Explanation Of Carcinogenicity: SEE INGREDIENTS
Signs And Symptions Of Overexposure: HEADACHE, DIZZINESS, NAUSEA, IRRITATION, NARCOSIS, UNCONSCIOUSNESS.
Medical Cond Aggravated By Exposure: SKIN CONDITIONS.
First Aid: SKIN: WASH THOROUGHLY W/SOAP & WATER. EYES: FLUSH THOROUGHLY W/WATER FOR 15 MINS. INHALATION: REMOVE TO FRESH AIR. GIVE CPR IF NEEDED. INGESTION: IF CONSCIOUS, DRINK WATER & INDUCE VOMITING IMMEDIATEL Y AS DIRECTED BY MEDICAL PERSONNEL. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. OBTAIN MEDICAL ATTENTION IN ALL CASES.

Handling and Disposal

Spill Release Procedures: WEAR PROTECTIVE EQUIPMENT. ELIMINATE IGNITION SOURCES. CONTAIN THE RELEASE & ELIMINATE ITS SOURCE, W/O RISK.
Waste Disposal Methods: DISPOSE AS HAZARDOUS WASTE IAW/FEDERAL, STATE & LOCAL REGULATIONS.
Handling And Storage Precautions: KEEP CONTAINERS CLOSED. STORE IN A COOL AREA AWAY FROM IGNITION SOURCES & OXIDIZERS.
Other Precautions: DON'T BREATHE VAPOR, GET IN EYES. AVOID PROLONGED/REPEATED SKIN CONTACT.

Fire and Explosion Hazard Information

Flash Point Method: CC
Flash Point Text: 0F
Lower Limits: 2.6
Upper Limits: 12.8
Extinguishing Media: DRY CHEMICAL, ALCOHOL FOAM, WATER SPRAY, CO2.
Fire Fighting Procedures: USE WATER SPRAY TO COOL EXPOSED CONTAINERS. WEAR SCBA.
Unusual Fire/Explosion Hazard: DANGEROUS FIRE & EXPLOSIVE HAZARD. VAPORS CAN TRAVEL DISTANCES TO IGNITION SOURCES & FLASH BACK.

Control Measures

Respiratory Protection: IF WORKPLACE EXPOSURE LIMITS ARE EXCEEDED, USE NIOSH/MSHA APPROVED AIR SUPPLIED RESPIRATOR.
Ventilation: HANDLE/TRANSFER IN AN APPROVED FUME HOOD/ADEQUATE VENTILATION.
Protective Gloves: BUTYL RUBBER, POLYURETHANE, POLYETHYLENE

```
Eye Protection: SAFETY GLASSES W/SIDE SHIELDS
Other Protective Equipment: EYE WASH & SAFETY EQUIPMENT SHOULD BE READILY
  AVAILABLE.
Work Hygienic Practices: REMOVE/LAUNDER CONTAMINATED CLOTHING BEFORE REUSE.
  WASH THOROUGHLY AFTER HANDLING.
Supplemental Safety and Health: FOR RESEARCH & DEVELOPMENT USE ONLY. NOT
  FOR MANUFACTURING/COMMERCIAL PURPOSES.
=======================================================
Physical/Chemical Properties
=======================================================
B.P. Text: 132.8F
M.P/F.P Text: -137.2F
Vapor Pres: 184
Vapor Density: 2
Spec Gravity: 0.7905
Evaporation Rate & Reference: (BU AC =1): 14.48
Solubility in Water: MISCIBLE
Appearance and Odor: COLORLESS LIQUID W/PUNGENT ODOR.
Percent Volatiles by Volume: >99.9
=======================================================
Reactivity Data
=======================================================
Stability Indicator: YES
Stability Condition To Avoid: HEAT, IGNITION SOURCES.
Materials To Avoid: ACIDS, BASES, OXIDIZERS, POTASSIUM T-BUTOXIDE, NITRIC &
  SULFURIC ACID MIXTURE, BROMINE, CHLORINE.
Hazardous Decomposition Products: CARBON OXIDES.
Hazardous Polymerization Indicator: NO
=======================================================
Toxicological Information
=======================================================
=======================================================
Ecological Information
=======================================================
=======================================================
MSDS Transport Information
=======================================================
=======================================================
Regulatory Information
=======================================================
=======================================================
Other Information
=======================================================
=======================================================
HAZCOM Label
=======================================================
Product ID: M-525-1-5X PAH MIXTURES 0.5 MG/ML FOR METHOD 525
Cage: 0U4A8
Company Name: ACCUSTANDARD INC
Street: 125 MARKET ST
City: NEW HAVEN CT
Zipcode: 06513
Health Emergency Phone: 203-786-5290
Label Required IND: Y
Date Of Label Review: 10/12/1999
Status Code: A
Origination Code: G
Hazard And Precautions: HARMFUL IF INHALED/SWALLOWED. PROLONGED EXPOSURE/HIGH
  CONCENTRATIONS MAY CAUSE IRRITATION OF EYES & RESPIRATORY TRACT. MAY
  CAUSE DAMAGE TO CENTRAL NERVOUS SYSTEM, LIVER & KIDNEYS. SKIN/EYES:
  IRRITATIO N.
=======================================================
Disclaimer (provided with this information by the compiling agencies): This
  information is formulated for use by elements of the Department of Defense.
  The United States of America in no manner whatsoever expressly or implied
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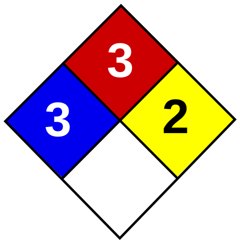

Health	3
Fire	3
Reactivity	2
Personal Protection	E

Material Safety Data Sheet

Sodium MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sodium

Catalog Codes: SLS3505

CAS#: 7440-23-5

RTECS: VY0686000

TSCA: TSCA 8(b) inventory: Sodium

CI#: Not applicable.

Synonym: Natrium

Chemical Name: Sodium

Chemical Formula: Na

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sodium	7440-23-5	100

Toxicological Data on Ingredients: Sodium LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant). Hazardous in case of skin contact (permeator), of ingestion, of inhalation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:

After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 115°C (239°F)

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances:
Extremely flammable in presence of moisture. Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid. Moisture reactive material. SMALL FIRE: Obtain advice on use of water. Use DRY chemical powder. LARGE FIRE: Use water spray or fog. Do not use water jet.

Special Remarks on Fire Hazards: When heated to decomposition it emits toxic fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Flammable solid that, in contact with water, emits flammable gases. Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Cover with dry earth, sand or other non-combustible material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal.

Section 7: Handling and Storage

Precautions:
Keep under inert atmosphere. Keep container dry. Do not breathe dust. Never add water to this product In case of insufficient ventilation, wear suitable respiratory equipment If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes Keep away from incompatibles such as oxidizing agents, acids, moisture.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. Keep container dry. Keep in a cool place.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 22.99 g/mole

Color: Silvery.

pH (1% soln/water): Not applicable.

Boiling Point: 881.4°C (1618.5°F)

Melting Point: 97.8°C (208°F)

Critical Temperature: Not available.

Specific Gravity: 0.97 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances:
Highly reactive with oxidizing agents, acids, moisture. The product reacts violently with water to emit flammable but non toxic gases.

Corrosivity: Not available.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant). Hazardous in case of skin contact (permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Material is destructive to tissue of the mucous membranes and upper respiratory tract.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 4.3: Material that emits flammable gases on contact with water.

Identification: : Sodium : UN1428 PG: I

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Sodium Massachusetts RTK: Sodium TSCA 8(b) inventory: Sodium CERCLA: Hazardous substances.: Sodium

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R17- Spontaneously flammable in air. R38- Irritating to skin. R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 3

Reactivity: 2

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 3

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

Created: 10/09/2005 06:28 PM

Last Updated: 06/09/2012 12:00 PM

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SIGMA-ALDRICH

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Material Safety Data Sheet

Version 4.2
Revision Date 09/21/2012
Print Date 10/11/2012

1. PRODUCT AND COMPANY IDENTIFICATION

Product name : *trans*-1,2-Dichloroethylene

Product Number : D62209
Brand : Aldrich

Supplier : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA
Telephone : +1 800-325-5832
Fax : +1 800-325-5052
Emergency Phone # (For both supplier and manufacturer) : (314) 776-6555
Preparation Information : Sigma-Aldrich Corporation
Product Safety - Americas Region
1-800-521-8956

2. HAZARDS IDENTIFICATION

Emergency Overview

OSHA Hazards
Flammable liquid

Target Organs

Central nervous system, Liver, Kidney

GHS Classification
Flammable liquids (Category 2)
Acute toxicity, Oral (Category 4)
Acute toxicity, Inhalation (Category 4)
Skin irritation (Category 2)
Eye irritation (Category 2A)
Acute aquatic toxicity (Category 3)

GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)

H225	Highly flammable liquid and vapour.
H302 + H332	Harmful if swallowed or if inhaled
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H402	Harmful to aquatic life.

Precautionary statement(s)

P210	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

HMIS Classification

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical hazards:	0

NFPA Rating

Health hazard:	2
Fire:	3
Reactivity Hazard:	0

Potential Health Effects

Inhalation	May be harmful if inhaled. Causes respiratory tract irritation.
Skin	Harmful if absorbed through skin. Causes skin irritation.
Eyes	Causes eye irritation.
Ingestion	Harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms : trans-1,2-Dichloroethene
trans-Acetylene dichloride

Formula : $C_2H_2Cl_2$

Molecular Weight : 96.94 g/mol

Component		Concentration
trans-Dichloroethylene		
CAS-No.	156-60-5	-
EC-No.	205-860-2	
Index-No.	602-026-00-3	

4. FIRST AID MEASURES

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Conditions of flammability
Flammable in the presence of a source of ignition when the temperature is above the flash point. Keep away from heat/sparks/open flame/hot surface. No smoking.

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Special protective equipment for firefighters
Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas

Further information
Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

7. HANDLING AND STORAGE

Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

Conditions for safe storage

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.

Light sensitive. Air and moisture sensitive.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Value	Control parameters	Basis
trans-Dichloroethylene	156-60-5	TWA	200 ppm	USA. ACGIH Threshold Limit Values (TLV)
Remarks	Central Nervous System impairment Eye irritation			

Personal protective equipment

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Eye protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	liquid, clear
Colour	light yellow

Safety data

pH	no data available
Melting point/freezing point	Melting point/range: 50 °C (122 °F) - lit.
Boiling point	48 °C (118 °F) - lit.
Flash point	6.0 °C (42.8 °F) - closed cup
Ignition temperature	no data available
Autoignition temperature	no data available
Lower explosion limit	9.7 %(V)
Upper explosion limit	12.8 %(V)
Vapour pressure	no data available
Density	1.257 g/mL at 25 °C (77 °F)
Water solubility	no data available
Partition coefficient: n-octanol/water	no data available
Relative vapour density	no data available
Odour	no data available
Odour Threshold	no data available
Evaporation rate	no data available

10. STABILITY AND REACTIVITY

Chemical stability
Stable under recommended storage conditions.

Possibility of hazardous reactions

Vapours may form explosive mixture with air.

Conditions to avoid
Heat, flames and sparks. Extremes of temperature and direct sunlight.

Materials to avoid
Oxidizing agents, Bases

Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas
Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral LD50
LD50 Oral - rat - 1,235 mg/kg

LD50 Oral - mouse - 2,122 mg/kg
Remarks: Behavioral:Altered sleep time (including change in righting reflex). Behavioral:Somnolence (general depressed activity). Behavioral:Ataxia.

Inhalation LC50
LC50 Inhalation - rat - 24100 ppm
Remarks: Behavioral:Somnolence (general depressed activity).

Dermal LD50
LD50 Dermal - rabbit - > 5,000 mg/kg
Remarks: Prolonged skin contact may cause skin irritation and/or dermatitis. Nutritional and Gross Metabolic:Weight loss or decreased weight gain.

Other information on acute toxicity
no data available

Skin corrosion/irritation
Skin - rabbit - Skin irritation - 24 h

Serious eye damage/eye irritation
Eyes - rabbit - Eye irritation

Respiratory or skin sensitization
no data available

Germ cell mutagenicity
no data available

Carcinogenicity

IARC:	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
ACGIH:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
NTP:	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity

no data available

Teratogenicity

no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)
no data available

Specific target organ toxicity - repeated exposure (Globally Harmonized System)
no data available

Aspiration hazard
no data available

Potential health effects

Inhalation	May be harmful if inhaled. Causes respiratory tract irritation.
Ingestion	Harmful if swallowed.
Skin	Harmful if absorbed through skin. Causes skin irritation.
Eyes	Causes eye irritation.

Signs and Symptoms of Exposure
prolonged or repeated exposure can cause:, narcosis, To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Synergistic effects
no data available

Additional Information
RTECS: KV9400000

12. ECOLOGICAL INFORMATION

Toxicity

Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 220.00 mg/l - 48 h

Persistence and degradability
no data available

Bioaccumulative potential
no data available

Mobility in soil
no data available

PBT and vPvB assessment
no data available

Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Harmful to aquatic life.

13. DISPOSAL CONSIDERATIONS

Product
Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 1150 Class: 3 Packing group: II
Proper shipping name: 1,2-Dichloroethylene
Reportable Quantity (RQ): 1000 lbs
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG
UN number: 1150 Class: 3 Packing group: II EMS-No: F-E, S-D
Proper shipping name: 1,2-DICHLOROETHYLENE
Marine pollutant: No

IATA
UN number: 1150 Class: 3 Packing group: II
Proper shipping name: 1,2-Dichloroethylene

15. REGULATORY INFORMATION

OSHA Hazards
Flammable liquid

SARA 302 Components
SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
Fire Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
trans-Dichloroethylene	156-60-5	1993-04-24

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
trans-Dichloroethylene	156-60-5	1993-04-24

New Jersey Right To Know Components

	CAS-No.	Revision Date
trans-Dichloroethylene	156-60-5	1993-04-24

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

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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.

MATERIAL SAFETY DATA SHEET

BP UNLEADED GASOLINES

MSDS No. 12632000 ANSI/ENGLISH

1.0 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: BP UNLEADED GASOLINES

MANUFACTURER/SUPPLIER:

BP Oil Company
200 East Randolph Drive
Chicago, Illinois 60601 U.S.A.

EMERGENCY HEALTH INFORMATION:
1 (800) 447-8735

EMERGENCY SPILL INFORMATION:
1 (800) 424-9300 CHEMTREC (USA)

OTHER PRODUCT SAFETY INFORMATION:
(630) 836-5441

2.0 COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS#	Range % by Wt.
Gasoline	8006-61-9	99.9-100
Benzene	71-43-2	0-3
Butane	106-97-8	4-6
Cyclohexane	110-82-7	0-1
Ethylbenzene	100-41-4	0-2
Heptane	142-82-5	6-8
Hexane	110-54-3	8-10
Pentane	109-66-0	9-11
Toluene	108-88-3	10-12
Trimethylbenzene	95-63-6	0-3
Xylene	1330-20-7	8-10

(See Section 8.0, "Exposure Controls/Personal Protection", for exposure guidelines)

3.0 HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Danger! Extremely flammable. Inhalation of vapor/aerosol concentrations above the recommended exposure limits causes headaches, drowsiness, and nausea, and may lead to unconsciousness or death. Harmful if swallowed and/or aspirated into the lungs. Prolonged or repeated contact may cause irritation and/or dermatitis. Use as motor fuel only. Long-term exposure to vapors has caused cancer in laboratory animals.

POTENTIAL HEALTH EFFECTS:

EYE CONTACT: High concentrations of vapor/mist may cause eye discomfort.

SKIN CONTACT: Prolonged or repeated contact can defat the skin and lead to irritation and/or dermatitis.

INHALATION: Inhalation of vapor/aerosol concentrations above the recommended exposure limits causes headaches, drowsiness, and nausea, and may lead to unconsciousness or death. See "Toxicological Information" section (Section 11.0).

INGESTION: Harmful or fatal if liquid is aspirated into lungs. Ingestion causes gastrointestinal irritation and diarrhea. See "Toxicological Information" section (Section 11.0).

HMIS CODE: (Health:1) (Flammability:3) (Reactivity:0) CHRONIC HEALTH HAZARD.

NFPA CODE: (Health:1) (Flammability:3) (Instability:0)

4.0 FIRST AID MEASURES

EYE: Flush eyes with plenty of water. Get medical attention if irritation persists.

SKIN: Wash exposed skin with soap and water. Remove contaminated clothing, including shoes, and thoroughly clean and dry before reuse. Get medical attention if irritation develops.

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get medical attention.

INGESTION: If swallowed, do NOT induce vomiting. Get immediate medical attention.

5.0 FIRE FIGHTING MEASURES

FLASHPOINT: -45°F

UEL: 7.6%

LEL: 1.3%

AUTOIGNITION TEMPERATURE: 495.0°F

FLAMMABILITY CLASSIFICATION: Extremely Flammable Liquid.

EXTINGUISHING MEDIA: Agents approved for Class B hazards (e.g., dry chemical, carbon dioxide, foam, steam) or water fog. Water may be ineffective but should be used to cool-fire exposed containers, structures and to protect personnel.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Extremely flammable vapor/air mixtures form. Extinguishment of fire before source of vapor is shut off can create an explosive mixture in air. Product gives off vapors that are heavier than air which can travel considerable distances to a source of ignition and flashback. Runoff to sewer may cause a fire or explosion hazard.

FIRE-FIGHTING EQUIPMENT: Firefighters should wear full bunker gear, including a positive pressure self-contained breathing apparatus.

PRECAUTIONS: Keep away from sources of ignition (e.g., heat and open flames). Keep container closed. Use with adequate ventilation.

HAZARDOUS COMBUSTION PRODUCTS: Combustion of this product in an area without adequate ventilation may result in hazardous levels of combustion products (e.g., carbon monoxide, carbon dioxide) and inadequate oxygen levels.

6.0 ACCIDENTAL RELEASE MEASURES

Remove or shut off all sources of ignition. Wear respirator and spray with water to disperse vapors. Increase ventilation if possible. Prevent spreading by diking, ditching, or absorbing on inert materials. Keep out of sewers and waterways.

7.0 HANDLING AND STORAGE

HANDLING: Use with adequate ventilation. Keep away from ignition sources (e.g., heat, sparks, or open flames). Ground and bond containers when transferring materials. Wash thoroughly after handling.

STORAGE: Store in flammable liquids storage area. Keep container closed. Store away from heat, ignition sources, and open flame in accordance with applicable regulations.

SPECIAL PRECAUTIONS: Keep out of sewers and waterways. Avoid strong oxidizers. Report spills to appropriate authorities. USE AS MOTOR FUEL ONLY.

8.0 EXPOSURE CONTROLS / PERSONAL PROTECTION

EYE: None required; however, use of eye protection is good industrial practice.

SKIN: Avoid prolonged or repeated skin contact. Wear protective clothing and gloves if prolonged or repeated contact is likely.

INHALATION: Use with adequate ventilation. Avoid breathing vapor and/or mist. If ventilation is inadequate, use NIOSH certified respirator that will protect against organic vapor and dust/mist.

ENGINEERING CONTROLS: Control airborne concentrations below the exposure guidelines.

EXPOSURE GUIDELINES:

Component	CAS#	Exposure Limits
Gasoline	8006-61-9	OSHA PEL: 300 ppm (1989); Not established. (1971) OSHA STEL: 500 ppm (1989); Not established. (1971) ACGIH TLV-TWA: 300 ppm ACGIH TLV-STEL: 500 ppm
Benzene	71-43-2	OSHA PEL: 1 ppm OSHA STEL: 5 ppm ACGIH TLV-TWA: 0.5 ppm (skin) ACGIH TLV-STEL: 2.5 ppm (skin) Mexico TWA: 10 ppm Mexico STEL: 25 ppm
Butane	106-97-8	OSHA PEL: 800 ppm (1989); Not established. (1971) ACGIH TLV-TWA: 800 ppm Mexico TWA: 800 ppm
Cyclohexane	110-82-7	OSHA PEL: 300 ppm (1989)(1971) ACGIH TLV-TWA: 300 ppm Mexico TWA: 300 ppm Mexico STEL: 375 ppm
Ethylbenzene	100-41-4	OSHA PEL: 100 ppm (1989)(1971) OSHA STEL: 125 ppm(1989); Not established. (1971) ACGIH TLV-TWA: 100 ppm ACGIH TLV-STEL: 125 ppm Mexico TWA: 100 ppm Mexico STEL: 125 ppm

Heptane	142-82-5	OSHA PEL: 400 ppm (1989); 500 ppm (1971) OSHA STEL: 500 ppm (1989); Not established. (1971) ACGIH TLV-TWA: 400 ppm ACGIH TLV-STEL: 500 ppm Mexico TWA: 400 ppm (skin) Mexico STEL: 500 ppm (skin)
Hexane	110-54-3	OSHA PEL: 50 ppm (1989); 500 ppm (1971) ACGIH TLV-TWA: 50 ppm (skin) Mexico TWA: 100 ppm
Pentane	109-66-0	OSHA PEL: 600 ppm (1989); 1000 ppm (1971) OSHA STEL: 750 ppm (1989); Not established. (1971) ACGIH TLV-TWA: 600 ppm Mexico TWA: 600 ppm Mexico STEL: 760 ppm
Toluene	108-88-3	OSHA PEL: 100 ppm (1989); 200 ppm (1971) OSHA STEL: 150 ppm (1989); Not established. (1971) OSHA Ceiling: 300 ppm (1971) ACGIH TLV-TWA: 50 ppm (skin) Mexico TWA: 100 ppm Mexico STEL: 150 ppm
Trimethylbenzene	95-63-6	OSHA PEL: 25 ppm (1989); Not established. (1971) ACGIH TLV-TWA: 25 ppm Mexico TWA: 25 ppm Mexico STEL: 35 ppm
Xylene	1330-20-7	OSHA PEL: 100 ppm (1989)(1971) OSHA STEL: 150 ppm (1989); Not established. (1971) ACGIH TLV-TWA: 100 ppm ACGIH TLV-STEL: 150 ppm Mexico TWA: 100 ppm (skin) Mexico STEL: 150 ppm (skin)

9.0 CHEMICAL AND PHYSICAL PROPERTIES

APPEARANCE AND ODOR: Clear. Liquid. Hydrocarbon odor.

pH: Not determined.

VAPOR PRESSURE: 7-15 lb RVP (ASTM D323)

VAPOR DENSITY: 3.0-4.0

BOILING POINT: 80.0-430.0°F (range)

MELTING POINT: Not determined.

SOLUBILITY IN WATER: Negligible, below 0.1%.

SPECIFIC GRAVITY (WATER=1): 0.75

10.0 STABILITY AND REACTIVITY

STABILITY: Burning can be started easily.

CONDITIONS TO AVOID: Keep away from ignition sources (e.g. heat, sparks, and open flames).

MATERIALS TO AVOID: Avoid chlorine, fluorine, and other strong oxidizers.

HAZARDOUS DECOMPOSITION: None identified.

HAZARDOUS POLYMERIZATION: Will not occur.

11.0 TOXICOLOGICAL INFORMATION

ACUTE TOXICITY DATA:

EYE IRRITATION: This product had a primary eye irritation score (PEIS) of 0/110.0 (rabbit)

SKIN IRRITATION: This product had a primary skin irritation score (PDIS) of 1.1/8.0 (rabbit)

DERMAL LD50: greater than 5 ml/kg (rabbit).

ORAL LD50: 18.8 ml/kg (rat).

INHALATION LC50: 20.7 mg/l (rat)

OTHER TOXICITY DATA: Excess exposure to vapors may produce headaches, dizziness, nausea, drowsiness, irritation of eyes, nose and throat and central nervous system depression. Aspiration of this material into the lungs can cause chemical pneumonia and can be fatal. Aspiration into the lungs can occur while vomiting after ingestion of this product. Inhalation of unleaded gasoline vapors did not produce birth defects in laboratory animals. Ingestion of this material can cause gastrointestinal irritation and diarrhea.

In a long-term inhalation study of whole unleaded gasoline vapors, exposure-related kidney damage and kidney tumors were observed in male rats. Similar kidney effects were not seen in female rats or in mice. At the highest exposure level (2056 ppm), female mice had an increased incidence of liver tumors. Results from subsequent scientific studies have shown that a broad variety of chemicals cause these kidney effects only in the male rat. Further studies have discovered the means by which the physiology of the male rat uniquely predispose it to these effects. Consequently, the Risk Assessment Forum of the Environmental Protection Agency has recognized that these responses are not predictive of a human health hazard. The liver tumors that were increased in the high-dose female mice are likewise of questionable significance because of their high spontaneous occurrence even without chemical exposure and because the rate of their occurrence is accelerated by a broad spectrum of chemicals not commonly considered to be carcinogens (e.g., phenobarbital). Thus, the significance of the mouse liver tumor response in terms of human health is questionable.

Gasoline is a complex mixture of hydrocarbons and contains benzene (typically no more than 2 volume%), toluene, and xylene. Chronic exposure to high levels of benzene has been shown to cause cancer (leukemia) in humans and other adverse blood effects (anemia). Benzene is considered a human carcinogen by IARC, NTP and OSHA. Over exposure to xylene and toluene can cause irritation to the upper respiratory tract, headache and narcosis. Some liver damage and lung inflammation were seen in chronic studies on xylene in guinea pigs but not in rats.

Solvent "sniffing" (abuse) or intentional overexposure to vapors can produce serious central nervous system effects, including unconsciousness, and possibly death.

12.0 ECOLOGICAL INFORMATION

Ecological testing has not been conducted on this material by BP Amoco.

13.0 DISPOSAL INFORMATION

Residues and spilled material are hazardous waste due to ignitability. Disposal must be in accordance with applicable federal, state, or local regulations. Enclosed-controlled incineration is recommended unless directed otherwise by applicable ordinances.

The container for this product can present explosion or fire hazards, even when emptied! To avoid risk of injury, do not cut, puncture, or weld on or near this container. Since the emptied containers retain product residue, follow label warnings even after container is emptied.

14.0 TRANSPORTATION INFORMATION

U.S. DEPT OF TRANSPORTATION

Shipping Name	Gasoline
Hazard Class	3
Identification Number	UN1203
Packing Group	II

INTERNATIONAL INFORMATION:

Sea (IMO/IMDG)

Shipping Name	Gasoline
Class	3.1
Packing Group	II
UN Number	UN1203

Air (ICAO/IATA)

Shipping Name	Gasoline , UN1203
Class	3
Packing Group	II

European Road/Rail (ADR/RID)

Shipping Name	Not determined.

Canadian Transportation of Dangerous Goods

Shipping Name	Gasoline
Hazard Class	3
UN Number	UN1203
Packing Group	II

15.0 REGULATORY INFORMATION

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR Part 302.4): This product is exempt from the CERCLA reporting requirements under 40 CFR Part 302.4. However, if spilled into waters of the United States, it may be reportable under 33 CFR Part 153 if it produces a sheen.

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR Part 355): This product is not regulated under Section 302 of SARA and 40 CFR Part 355.

SARA TITLE III SECTIONS 311/312 HAZARDOUS CATEGORIZATION (40 CFR Part 370): This product is defined as hazardous by OSHA under 29 CFR Part 1910.1200(d). Hazardous categories for this product are: Acute = yes; Chronic = yes; Fire = yes; Pressure = no; Reactive = no.

SARA TITLE III SECTION 313 (40 CFR Part 372): This product contains the following substance(s), which is on the Toxic Chemicals List in 40 CFR Part 372:

Component/CAS Number	Weight Percent
Benzene 71-43-2	3
Trimethylbenzene 95-63-6	3
Cyclohexane 110-82-7	1
Ethylbenzene 100-41-4	2
Xylene 1330-20-7	10
Hexane 110-54-3	10
Toluene 108-88-3	12

U.S. INVENTORY (TSCA): Listed on inventory.

OSHA HAZARD COMMUNICATION STANDARD: Flammable liquid. Irritant. Contains components listed by ACGIH. Contains components listed by OSHA. Contains a carcinogenic component.

WHMIS Controlled Product Classification: B2, D2A, D2B.

EC INVENTORY (EINECS/ELINCS): Not determined.

JAPAN INVENTORY (MITI): Not determined.

AUSTRALIA INVENTORY (AICS): Not determined.

KOREA INVENTORY (ECL): Not determined.

CANADA INVENTORY (DSL): Not determined.

PHILIPPINE INVENTORY (PICCS): Not determined.

16.0 OTHER INFORMATION

This material contains an ingredient/ingredients present on the following State Right-To-Know lists:

-Florida- -Massachusetts- -New Jersey- -Pennsylvania- -California- -Minnesota-

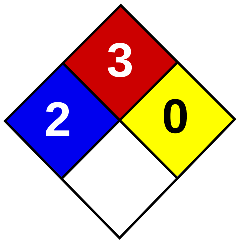
This product contains an ingredient/ingredients known to the state of California to cause cancer and/or reproductive toxicity.

Prepared by:

Environment, Health and Safety Department

Issued: July 16, 1999

This Material Safety Data Sheet conforms to the requirements of ANSI Z400.1.



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet

Xylenes MSDS

Section 1: Chemical Product and Company Identification

Product Name: Xylenes

Catalog Codes: SLX1075, SLX1129, SLX1042, SLX1096

CAS#: 1330-20-7

RTECS: ZE2100000

TSCA: TSCA 8(b) inventory: Xylenes

CI#: Not available.

Synonym: Xylenes; Dimethylbenzene; xylol; methyltoluene

Chemical Name: Xylenes (o-, m-, p- isomers)

Chemical Formula: C6H4(CH3)2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Xylenes	1330-20-7	100

Toxicological Data on Ingredients: Xylenes: ORAL (LD50): Acute: 4300 mg/kg [Rat]. 2119 mg/kg [Mouse]. DERMAL (LD50): Acute: >1700 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, liver, mucous membranes, bone marrow, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 464°C (867.2°F)

Flash Points: CLOSED CUP: 24°C (75.2°F). (Tagliabue.) OPEN CUP: 37.8°C (100°F).

Flammable Limits: LOWER: 1% UPPER: 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Slightly explosive in presence of open flames and sparks, of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Vapors may travel to source of ignition and flash back.

Special Remarks on Explosion Hazards:
Vapors may form explosive mixtures with air. Containers may explode when heated. May polymerize explosively when heated. An attempt to chlorinate xylene with 1,3-Dichloro-5,5-dimethyl-2,4-imidazolidindione (dichlorohydrantoin) caused a violent explosion

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined

areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 (ppm) [Canada] TWA: 435 (mg/m3) [Canada] TWA: 434 STEL: 651 (mg/m3) from ACGIH (TLV) [United States] TWA: 100 STEL: 150 (ppm) from ACGIH (TLV) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweetish.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless. Clear

pH (1% soln/water): Not available.

Boiling Point: 138.5°C (281.3°F)

Melting Point: -47.4°C (-53.3°F)

Critical Temperature: Not available.

Specific Gravity: 0.864 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 1 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.1

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Insoluble in cold water, hot water. Miscible with absolute alcohol, ether, and many other organic liquids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatibles

Incompatibility with various substances: Reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Store away from acetic acid, nitric acid, chlorine, bromine, and fluorine.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2119 mg/kg [Mouse]. Acute dermal toxicity (LD50): >1700 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5000 4 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: blood, kidneys, liver, mucous membranes, bone marrow, central nervous system (CNS).

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals:
Lowest Lethal Dose: LDL [Human] - Route: Oral; Dose: 50 mg/kg LCL [Man] - Route: Oral; Dose: 10000 ppm/6H

Special Remarks on Chronic Effects on Humans:
Detected in maternal milk in human. Passes through the placental barrier in animal. Embryotoxic and/or foetotoxic in animal. May cause adverse reproductive effects (male and femael fertility (spontaneous abortion and fetotoxicity)) and birth defects based animal data.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. Can be absorbed through skin. Eyes: Causes eye irritation. Inhalation: Vapor causes respiratory tract and mucous membrane irritation. May affect central nervous system and behavior (General anesthetic/CNS depressant with effects including headache, weakness, memory loss, irritability, dizziness, giddiness, loss of coordination and judgement, respiratory depression/arrest or difficulty breathing, loss of appetite, nausea, vomiting, shivering, and possible coma and death). May also affects blood, sense organs, liver, and peripheral nerves. Ingestion: May cause gastrointestinal irritation including abdominal pain, vomiting, and nausea. May also affect liver and urinary system/ kidneys. May cause effects similar to those of acute inhalation. Chronic Potential Health Effects: Chronic inhalation may affect the urinary system (kidneys) blood (anemia), bone marrow (hyperplasia of bone marrow) brain/behavior/Central Nervous system. Chronic inhalation may alsocause mucosal bleeding. Chronic ingestion may affect the liver and metabolism (loss of appetite) and may affect urinary system (kidney damage)

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Xylenes UNNA: 1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Xylenes Illinois chemical safety act: Xylenes New York acutely hazardous substances: Xylenes Rhode Island RTK hazardous substances: Xylenes Pennsylvania RTK: Xylenes Minnesota: Xylenes Michigan critical material: Xylenes Massachusetts RTK: Xylenes Massachusetts spill list: Xylenes New Jersey: Xylenes New Jersey spill list: Xylenes Louisiana spill reporting: Xylenes California Director's List of Hazardous Substances: Xylenes TSCA 8(b) inventory: Xylenes SARA 302/304/311/312 hazardous chemicals: Xylenes SARA 313 toxic chemical notification and release reporting: Xylenes CERCLA: Hazardous substances.: Xylenes: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R10- Flammable. R21- Harmful in contact with skin. R36/38- Irritating to eyes and skin. S2- Keep out of the reach of children. S36/37- Wear suitable protective clothing and gloves. S46- If swallowed, seek medical advice immediately and show this container or label.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

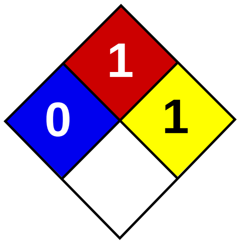
Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/11/2005 12:54 PM

Last Updated: 06/09/2012 12:00 PM



Health	1
Fire	1
Reactivity	1
Personal Protection	E

Material Safety Data Sheet

Zinc Metal MSDS

Section 1: Chemical Product and Company Identification

Product Name: Zinc Metal

Catalog Codes: SLZ1054, SLZ1159, SLZ1267, SLZ1099, SLZ1204

CAS#: 7440-66-6

RTECS: ZG8600000

TSCA: TSCA 8(b) inventory: Zinc Metal

CI#: Not applicable.

Synonym: Zinc Metal Sheets; Zinc Metal Shot; Zinc Metal Strips

Chemical Name: Zinc Metal

Chemical Formula: Zn

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Zinc Metal	7440-66-6	100

Toxicological Data on Ingredients: Zinc Metal LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 480°C (896°F)

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances:
Slightly flammable to flammable in presence of open flames and sparks, of heat, of oxidizing materials, of acids, of alkalis, of moisture. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Zinc + NaOH causes ignition. Oxidation of zinc by potassium proceeds with incandescence. Residues from zinc dust /acetic acid reduction operations may ignite after long delay if discarded into waste bins with paper. Incandescent reaction when Zinc and Arsenic or Tellurium, or Selenium are combined. When hydrazine mononitrate is heated in contact with zinc, a flamming decomposition occurs at temperatures a little above its melting point. Contact with acids and alkali hydroxides (sodium hydroxide, postasium hydroxide, calcium hydroxide, etc.) results in evolution of hydrogen with sufficient heat of reaction to ignite the hydrogen gas. Zinc foil ignites if traces of moisture are present. It is water reactive and produces flammable gases on contact with water. It may ignite on contact with water or moist air.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Flammable solid that, in contact with water, emits flammable gases. Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Cover with dry earth, sand or other non-combustible material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not breathe dust. Keep away from incompatibles such as oxidizing agents, acids, alkalis, moisture.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area. Keep from any possible contact with water. Do not allow water to get into container because of violent reaction.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Lustrous solid. Metal solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 65.39 g/mole

Color: Bluish-grey

pH (1% soln/water): Not applicable.

Boiling Point: 907°C (1664.6°F)

Melting Point: 419°C (786.2°F)

Critical Temperature: Not available.

Specific Gravity: Not available.

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water, methanol, diethyl ether, n-octanol, acetone.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, incompatible materials, moisture

Incompatibility with various substances:
Reactive with oxidizing agents, acids, alkalis. Slightly reactive to reactive with moisture. The product may react violently with water to emit flammable but non toxic gases.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with acids, halogenated hydrocarbons, NH4NO3, barium oxide, Ba(NO3)2, Cadmium, CS2, chlorates, Cl2, CrO3, F2, Hydroxylamine, Pb(N3)2, MnCl2, HNO3, performic acid, KClO3, KNO3, N2O2, Selenium, NaClO3, Na2O2, Sulfur, Te, water, (NH4)2S, As2O3, CS2, CaCl2, chlorinated rubber, catalytic metals, halocarbons, o-nitroanisole, nitrobenzene, nonmetals, oxidants, paint primer base, pentacarbonoyliron, transition metal halides, seleninyl bromide, HCl, H2SO4, (Mg +Ba(NO3)2 +BaO2), (ethyl acetoacetate +tribromoneopentyl alcohol. Contact with Alkali Hydroxides(Sodium Hydroxide, Potassium Hydroxide, Calcium Hydroxide, etc) results in evolution of hydrogen. Ammonium nitrate + zinc + water causes a violent reaction with evolution of steam and zinc oxide. May react with water.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: May cause skin irritation. Dermal exposure to zinc may produce leg pains, fatigue, anorexia and weight loss. Eyes: May cause eye irritation. Ingestion: May be harmul if swallowed. May cause digestive tract irritation with tightness in throat, nausea, vomiting, diarrhea, loss of appetite, malaise, abdominal pain. fever, and chills.
May affect behavior/central nervous system and autonomic nervous system with ataxia, lethargy, staggering gait, mild derrangement in cerebellar function, lightheadness, dizzness, irritability, muscular stiffness, and pain. May also affect blood.
Inhalation: Inhalation of zinc dust or fumes may cause respiratory tract and mucous membrane irritation with cough and chest pain. It can also cause "metal fume fever", a flu-like condition characterized appearance of chills, headached fever, maliase, fatigue, sweating, extreme thirst, aches in the legs and chest, and difficulty in breathing. A sweet taste may also be be present in metal fume fever, as well as a dry throat, aches, nausea, and vomiting, and pale grey cyanosis. The toxicological properties of this substance have not been fully investisgated.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: Not available.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
New York release reporting list: Zinc Metal Rhode Island RTK hazardous substances: Zinc Metal Pennsylvania RTK: Zinc Metal Florida: Zinc Metal Michigan critical material: Zinc Metal Massachusetts RTK: Zinc Metal New Jersey: Zinc Metal California Director's List of Hazardous Substances: Zinc Metal TSCA 8(b) inventory: Zinc Metal TSCA 12(b) one time export: Zinc Metal SARA 313 toxic chemical notification and release reporting: Zinc Metal CERCLA: Hazardous substances.: Zinc Metal: 1000 lbs. (453.6 kg)

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not Available

DSCL (EEC):
R15- Contact with water liberates extremely flammable gases. R17- Spontaneously flammable in air. S7/8- Keep container tightly closed and dry.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 1

Reactivity: 1

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 0

Flammability: 1

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 12:18 AM

Last Updated: 06/09/2012 12:00 PM

APPENDIX F

JOBSITE SAFETY INSPECTION CHECKLIST

Jobsite Safety Inspection Checklist

Date: ______________________________ **Inspected By:** ______________________________

Location: ______________________________ **Project #:** ______________________________

Check one of the following: **A:** Acceptable **NA**: Not Applicable **D**: Deficient

	A	**NA**	**D**	**Remarks**
1. HASP available on site or inspection?				
2. Health & Safety Compliance agreement appropriately signed by Langan employees and subcontractors?				
3. Hospital route map with directions posted on site?				
4. Emergency Notification List posted on site?				
5. First Aid kit available and properly stocked?				
6. Personnel trained in CPR/First Aid on site?				
7. MSDS readily available, and all workers knowledgeable about the specific chemicals and compounds to which they may be exposed?				
8. Appropriate PPE being worn by Langan employees and subcontractors?				
9. Project site safe practices ("Standing Orders") posted?				
10. Project staff have 40-hour/8-hour/Supervisor HAZWOPER training?				
11. Project staff medically cleared to work in hazardous waste sites and fit-tested to wear respirators, if needed?				
12. Respiratory protection readily available?				
13. Health & Safety Incident Report forms available?				
14. Air monitoring instruments calibrated daily and results recorded on the Daily Instrument Calibration check sheet?				
15. Air monitoring readings recorded on the air monitoring data sheet/field log book?				
16. Subcontract workers have received 40-hour/8-hour/Supervisory HAZWOPER training, as appropriate?				
17. Subcontract workers medically cleared to work on site, and fit-tested for respirator wear?				
18. Subcontract workers have respirators readily available?				
19. Mark outs of underground utilities done prior to initiating any subsurface activities?				
20. Decontamination procedures being followed as outlined in HASP?				
21. Are tools in good condition and properly used?				
22. Drilling performed in areas free from underground objects including utilities?				
23. Adequate size/type fire extinguisher supplied?				

24. Equipment at least 20 feet from overhead power lines?				
25. Evidence that drilling operator is responsible for the safety of his rig.				
26. Trench sides shored, sloped back, or boxed?				
27. Underground utilities located and authorities contacted before digging?				
28. Ladders in trench (25-foot spacing)?				
29. Excavated material placed more than 2 feet away from excavation edge?				
30. Public protected from exposure to open excavation?				
31. People entering the excavation regarding it as a permit-required confined space and following appropriate procedures?				
32. Confined space entry permit is completed and posted?				
33. All persons knowledgeable about the conditions and characteristics of the confined space?				
34. All persons engaged in confined space operations have been trained in safe entry and rescue (non-entry)?				
35. Full body harnesses, lifelines, and hoisting apparatus available for rescue needs?				
36. Attendant and/or supervisor certified in basic first aid and CPR?				
37. Confined space atmosphere checked before entry and continuously while the work is going on?				
38. Results of confined space atmosphere testing recorded?				
39. Evidence of coordination with off-site rescue services to perform entry rescue, if needed?				
40. Are extension cords rated for this work being used and are they properly maintained?				
41. Are Ground Fault Circuit Interrupters provided and being used?				

Unsafe Acts: ____

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Notes: ____

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APPENDIX G

JOB SAFETY ANALYSIS FORMS

- **Blank Form**
- **Direct-Push Soil Borings**
- **Environmental Sampling**
- **Field Sampling**
- **Monitoring Well Development**
- **Monitoring Well Installation**
- **Soil Screening for Off-Site Disposal**

LANGAN	**Job Safety Analysis (JSA)** **Health and Safety**
JSA TITLE: **JSA NUMBER:**	**DATE CREATED:** **CREATED BY:** **REVISION DATE:** **REVISED BY:**

Langan employees must review and revise the Job Safety Analysis (JSA) as needed to address the any site specific hazards not identified. Employees must provide their signatures on the last page of the JSA indicating they have review the JSA and are aware the potential hazards associated with this work and will follow the provided preventive or corrective measures.

PERSONAL PROTECTIVE EQUIPMENT REQUIRED: (PPE): ■ Required		☒ As Needed
☐ Steel-toed boots	☐ Nitrile gloves	☐ Dermal Protection (Specify)
☐ Long-sleeved shirt	☐ Leather/ Cut-resistant gloves	☐ High visibility vest/clothing
☐ Safety glasses	☐ Face Shield	☐ Hard hat
ADDITIONAL PERSONAL PROTECTIVE EQUIPMENT NEEDED (Provide specific type(s) or descriptions)		
☐ Air Monitoring:	☐ Respirators:	☐ Other:
☐ Dermal Protection:	☐ Cartridges:	☐ Other:

JOB STEPS	**POTENTIAL HAZARDS**	**PREVENTATIVE OR CORRECTIVE ACTION**
1.	1. 2.	1a. 1b. 2a. 2b.
2.	1.	1.
3.	1.	1.
Additional items identified in the field.		
Additional Items.		

If additional items are identified during daily work activities, please notify all relevant personnel about the change and document on this JSA.

LANGAN	**JSA NUMBER:** **DATE:** 04/03/2014 **REVISION DATE:**	**OFFICE:** NYC **PROJECT MANAGER:** **SAFETY OFFICER:**
SITE: **JOB TITLE OR TASK:** **Soil Screening For Off-Site Disposal**	**PERSON(S) PERFORMING JOB:**	**ANALYSIS BY: William Bohrer** **REVIEWED BY:** Tony Moffa

REQUIRED PERSONAL PROTECTIVE EQUIPMENT (PPE) AND/OR PERTINENT JOB SAFETY FORMS:

Minimum PPE: Safety Glasses, Hard Hat, Steel toe boots, Sleeved shirt and pants, Traffic/Safety Vest, Nitrile Gloves

Additional PPE (as needed): Leather, Hearing protection, Traffic Cones

Monitoring Equipment (as needed): Photoionization Detector (PID)

Job Safety Form:

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
1.Daily Tailgate Safety Meeting	None	All employees assigned to this task will attend a daily tailgate safety meeting, which will include the pertinent JSA's,
2. Unpack Equipment	1. Slip, trips, and falls 2. Physical hazards including strains and hand injury	1. Be aware of hazards in area, place orange safety cones in areas of potential STFs could occur. Where possible, remove tripping hazards. 2. Use proper lifting and bending techniques and do not lift heavy loads without assistance , use assistance as necessary. Avoid putting hands near pinch points. Wear leather work gloves when handling equipment of other heavy materials. Use proper cutting tool to open cardboard boxes.
3. Initial Site Arrival- Assess Site Conditions	1. Traffic	1. Be alert. Secure area from through traffic

SEQUENCE OF BASIC JOB STEPS	**POTENTIAL HAZARDS**	**PREVENTATIVE OR CORRECTIVE ACTION**
4. Calibrate PID a. Fill Tedlar Bag with Span Gas b. Follow manufacturer's instructions c. Complete fresh air calibration first	1. Pinch points when connecting regulator to valve seat 2. overinflating Tedlar bag	1. Check threads on regulator and span gas bottle for condition, if threads are damaged do not use 2. Carefully thread regulator onto span gas bottle 3. Monitor Tedlar bag during filling, turn off gas when bag is nearly filled. 4. Do not leave Tedlar bag unattended 5. When calibration is complete, vent bag and store empty in equipment box .
5. Survey excavated soil samples from excavation bucket	1. Slip/trip hazards 2. Contact with front loader 3. Contact with impacted soil 4. Vapor Phase	1. Visually inspect path to excavator for slip/trip hazards; mark a pathway free of slip/trip hazards 2. Before entering front loader work area, make visual contact with operator to insure operator is aware of your presence 3. Use nitrile gloves 4. Have available ½ mask if there is a potential for high vapor phase 5. When ready to survey filled bucket, insist that operator has rested bucket on ground and is aware of your actions 6. Using a gloved finger, poke holes in the soil and place PID intake wand just in the hole, loosely cover hole with hand not holding PID 7. Record PID reading, repeat process several times with same bucket to insure reading is representative. 8. NEVER CLIMB THE SIDE OF A DUMP TRUCK TO SURVEY SOIL LOAD!
6. Leaving the site	1. Contaminated vehicle/ PPE	1. Wash hands promptly. Contaminated PPE should be disposed of on-site. Remove boots and soiled clothing for secure storage in trunk.
Additional items identified in the field.		

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
Additional Items.		
If additional items are identified during daily work activities, please notify all relevant personnel about the change and document on this JSA.		

Date of JSA review: ____________________________________

Print Name	Sign Name	Company
		Langan
		Langan
		Langan

LANGAN	**JSA NUMBER:** **DATE:** 08/04/10 **REVISION DATE:** 7/28/11	**OFFICE:** **PROJECT MANAGER:** **SAFETY OFFICER:**
SITE: **JOB TITLE OR TASK:** **Direct-Push Soil Borings**	**PERSON(S) PERFORMING JOB:**	**ANALYSIS BY:** **REVIEWED BY:** Tony Moffa

REQUIRED PERSONAL PROTECTIVE EQUIPMENT (PPE) AND/OR PERTINENT JOB SAFETY FORMS:

Minimum PPE:	Steel-toed boots, long-sleeved shirt, nitrile gloves, safety glasses, hard hat
Additional PPE (as needed):	Cut-resistant or work gloves, Tyvek sleeves, high visibility vest
Monitoring Equipment:	Photo-ionization detector (PID)
Job Safety Form:	Tailgate Meeting

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
1. Daily Tailgate Safety Meeting	1. None	1. All employees assigned to this task will attend a daily tailgate safety meeting, which will include the pertinent JSA's, Standard Operating Procedures (SOPs), types of potential hazards, and actual hazards present and controls for those hazards.
2. Move equipment to work site	1. Back strain when lifting heavy equipment	1a. Use proper lifting technique (use legs for bending and lifting and not the back). Use wheeled transport for heavy equipment. Get assistance when handling loads greater than 50 lbs. 1b. Minimize distance to vehicle
	2. Slips/trips/falls while moving equipment	2a. Use proper lifting technique (use legs for bending and lifting and not the back). Use wheeled transport for heavy equipment. Get assistance when handling loads greater than 50 lbs. 2b. Minimize distance to vehicle 2c. Have unobstructed path to vehicle or collection point 2d. Do not lift/walk with boxes that are heavy/difficult to lift
	3. Traffic (if applicable)	3. Wear high visibility vests and exercise caution.
	4. Pinched fingers or running over toes during geoprobe set-up	4a. Wear proper PPE (cut-resistant gloves)

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
2. Move equipment to work site (continued)	5. Overturn drill rig while transporting to loading dock on flat-bed tow truck	4b. Stay alert, be aware of geoprobe rig at all times 5a. Drill rig should be parked in center of flat-bed tow truck 5b. Emergency brake shall be used at all times during transport on the flat-bed truck 5c. All unnecessary personnel should stay away from the flat-bed truck during moving activities
3. Set-up geoprobe rig at desired location	1. Slips/trips/falls while moving equipment	1a. All personnel should be constantly watching for trip hazards, such as uneven terrain, holes, ditches, stretched wires or ropes or other materials in their path 1b. Proper housekeeping of materials during sampling events 1c. Mark significant below-grade hazards (i.e. holes, trenches) with safety cones or spray paint
	2. Pinched fingers or running over toes during geoprobe set-up	2a. Wear proper PPE (cut-resistant gloves) 2b. Stay alert, be aware of geoprobe rig at all times
	3. Clothing entanglement	3. Wear proper attire for geoprobe rig (no loose clothing, strings, etc.)
	4. Electrocution/falling equipment and debris from raising geoprobe rig mast	4a. Wear proper PPE (hard hats) 4b. Be aware of locations at all times; look up, down and around before raising mast 4c. Check geoprobe drill rig mast prior to raising for loose objects/debris
	5. Carbon monoxide poisoning	5. Properly ventilate exhaust from geoprobe rig when working indoors or in areas of poor ventilation
	6. Geoprobe rig roll-over	6a. Do not move rig with mast raised 6b. Set stabilizers prior to raising mast, if applicable 6c. Inspect work area; if area appears unstable, area should be assessed by a qualified professional engineer or the MIP boring location should be moved
	7. Geoprobe rig movement	7a. All field personnel should stay clear of the geoprobe rig while moving 7b. Use a spotter when backing up the geoprobe rig

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
4. Advance geoprobe rods below ground surface to desired depth	1. Strain wrist/bruise palm while preparing geoprobe rods	1a. Wear proper PPE (cut-resistant gloves) 1b. Use proper technique for preparing geoprobe rods; use second person if necessary
	2. Pinched fingers while preparing geoprobe/MIP rods	2. Wear proper PPE (cut-resistant gloves)
	3. Injury due to encountering below grade utilities	3a. Markout all utilities prior to advancing the MIP boring using utility plans, geophysical contractor, or site personnel knowledge 3b. Clear all subsurface soil borings to a minimum of 5 feet below grade
4. Advance geoprobe/MIP rods below ground surface to desired depth (continued)	4. Back strain while preparing geoprobe rods	4. Use proper lifting technique (use legs for bending and lifting and not the back); obtain assistance if needed
	5. Clothing entanglement while advancing geoprobe rods	5. Wear proper attire for geoprobe rig (no loose clothing, strings, etc.)
	6. Carbon monoxide poisoning	6. Properly ventilate exhaust from geoprobe rig when working indoors or in areas of poor ventilation
	7. Bruised/broken toes/feet from dropping equipment and geoprobe rods	7. Wear proper PPE (steel-toe boots); Work in a safe manner to prevent dropped rod
	8. High noise levels	8. Wear proper PPE (hearing protection)
	9. Injury from faulty equipment	9. Geoprobe contractor shall inspect all equipment prior to use
5. Remove and open acetate liner	1. Pinched fingers while removing macrocore	1. Wear proper PPE (nitrile and cut-resistant gloves)
	2. Cuts/lacerations when cutting acetate liner open	2a. **OPEN BLADES ARE PROHIBITED FROM USE AT THE SITE**; use acetate liner cutting tool 2b. Wear proper PPE (cut-resistant gloves) 2c. Cut acetate liner away from body
	3. Exposure to hazardous vapors	3a. Do not place face over acetate liner when opening 3b. Monitor hazardous vapors in air with PID; upgrade PPE as necessary based on levels contained in the Health and Safety Plan
	4. Skin contact with contaminated soil	4. Wear proper PPE (nitrile gloves)
6. Remove soil from acetate liner and place in a 55-gallon drum	1. Cuts/lacerations from acetate liner	1. Wear proper PPE (cut-resistant gloves)
	2. Pinched fingers/hand while opening/closing 55-gallon drum	2a. Wear proper PPE (cut-resistant gloves) 2b. Keep fingers/hands away from pinch points
	3. Skin contact with contaminated soil	3. Wear proper PPE (nitrile gloves)
	4. Soil debris in eyes	4. Wear proper PPE (safety glasses)

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
7. Repeat steps 4 and 5 until desired depth is reached	1. See Steps 4 and 5	1. See Steps 4 and 5
8. Remove geoprobe rods and place in storage rack	1. Clothing entanglement while removing geoprobe rods 2. Back strain while removing geoprobe rods 3. Pinched fingers while removing geoprobe rods 4. Carbon monoxide poisoning	1. Wear proper attire for geoprobe rig (no loose clothing, strings, etc.) 2. Use proper lifting technique (use legs for bending and lifting and not the back); obtain assistance if needed 3. Wear proper PPE (cut-resistant gloves) 4. Properly ventilate exhaust from geoprobe rig when working indoors or in areas of poor ventilation
8. Remove geoprobe rods and place in storage rack (continued)	5. High noise levels 6. Injury from faulty equipment	5. Wear proper PPE (hearing protection) 6. Geoprobe contractor shall inspect all equipment prior to use
9. Tremie-grout borehole with a cement-bentonite grout mixture	1. Splashed cement-benonite grout on face/eyes 2. Injury from faulty equipment 3. Back strain while mixing cement/bentonite grout 4. Pinched fingers while using grout mixer	1. Wear proper PPE (safety glasses) 2. Geoprobe contractor shall inspect all equipment prior to use 3. Use proper lifting/bending technique (use legs for bending and lifting and not the back); obtain assistance if needed 4. Wear proper PPE (nitrile gloves and cut-resistant gloves)
10. Decontaminate geoprobe rods	1. Splashed decontamination water on face/eyes 2. Back strain while decontaminating geoprobe rods	1. Wear proper PPE (safety glasses) 2. Use proper lifting/bending technique (use legs for bending and lifting and not the back); obtain assistance if needed
11. Patch soil boring location to return to pre-existing conditions (e.g. concrete, asphalt, grass)	1. Cuts or lacerations from cutting concrete/asphalt bag 2. Splashed concrete on eyes/face during mixing 3. Hammer fingers/hands when patching asphalt	1. **OPEN BLADES ARE PROHIBITED FROM USE AT THE SITE**; use scissors. 2. Wear proper PPE (safety glasses) 3a. Wear proper PPE (cut-resistant gloves) 3b. Be aware of hands/fingers during hammering

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
12. Pack up equipment	1. Back strain when lifting heavy equipment 2. Slips/trips/falls while moving equipment 3. Traffic (if applicable) 4. Pinched fingers or running over toes during geoprobe set-up	1a. Use proper lifting technique (use legs for bending and lifting and not the back). Use wheeled transport for heavy equipment. Get assistance when handling loads greater than 50 lbs. 1b. Minimize distance to vehicle 2a. Use proper lifting technique (use legs for bending and lifting and not the back). Use wheeled transport for heavy equipment. Get assistance when handling loads greater than 50 lbs. 2b. Minimize distance to vehicle 2c. Have unobstructed path to vehicle or collection point 2d. Do not lift/walk with boxes that are heavy/difficult to lift 3. Wear high visibility vests and exercise caution. 4a. Wear proper PPE (cut-resistant gloves) 4b. Stay alert, be aware of geoprobe rig at all times
13. Transport drums to central staging location	1. Back, arm or shoulder strain from moving drums 2. Pinch fingers/hand in drum cart when moving drums 3. Pinch fingers/hand when operating lift-gate on vehicle 4. Contact with potentially contaminated groundwater when moving improperly sealed drums 5. Slips when moving drum 6. Drop drum on feet/toes	1. Use drum cart for moving drums; keep back in neutral position while raising barrel with drum cart; obtain assistance when moving the drum, if needed 2. Wear proper PPE (cut-resistant gloves); keep fingers away from pinch-points 3. Wear proper PPE (cut-resistant gloves); keep fingers away from pinch-points 4. Wear proper PPE (nitrile gloves under work gloves); properly seal drum to prevent leaks 5. Make sure route to move drum and storage space is dry and free from obstructions 6. Wear proper PPE (steel-toe shoes); Work in a safe manner to prevent dropped drum

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
14. All activities	1. Slips, Trips, and Falls	1a. All personnel should be constantly watching for trip hazards, such as uneven terrain, holes, ditches, stretched wires or ropes or other materials in their path 1b. Proper housekeeping of materials during sampling events 1c. Mark significant below-grade hazards (i.e. holes, trenches) with safety cones or spray paint 1d. Wear proper footwear for terrain and scope of work (steel-toe boots) 1e. Rainy, snowy, or icy conditions will warrant a more cautious work attitude. Employees should change work speed and style to fit the weather conditions
	2. Hand injuries during manual handling of materials	2a. Workers should inspect materials for jagged or sharp edges, and rough or slippery surfaces 2b. Workers should keep fingers away from pinch and shear points, especially when setting down materials 2c. Workers should wipe off greasy, wet, slippery or dirty objects before attempting to handle them 2d. Cut-resistant gloves should be worn at all times except when the gloves create a hindrance to completing the task in a safe manner
	3. Foot injuries	3. Steel-toed boots should be used for protection of the feet
	4. Back injuries	4a. All three main factors in manual lifting (load location, task repetition, and load weight) must be considered when evaluating what is safe or unsafe to lift; obtain assistance when possible 4b. All manual lifting of heavy or bulky objects shall be carefully planned to avoid injuries or damage to equipment
	5. Vehicular traffic	5. Employees shall wear high-visibility shirts or safety vests when performing work in high traffic areas; use cones where appropriate to designate work area; notify building occupants and fork lift operators of work areas

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
14. All activities (continued)	6. Wildlife a. Stray dogs b. Mice/rats c. Vectors (i.e. mosquitoes, bees, etc.)	6a. Employees shall be aware of their surroundings at all times, including the presence of wildlife 6b. Employees shall not approach any stray dogs 6c. Employees shall carry/use Halt in the event a stray dog may attack 6d. Use bug spray when needed 6e. Employees shall wear long-sleeve shirts during all activities at the site
	7. Heat Stress/Cold Stress	7. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather); drink plenty of fluids to avoid dehydration; take breaks as necessary to avoid heat/cold stress
	8. Crime	8. Employees shall be aware that the site is in a high crime area and work shall be performed in pairs, particularly in isolated areas of the facility and surrounding area
Additional items identified in the field.		
Additional Items.		

If additional items are identified during daily work activities, please notify all relevant personnel about the change and document on this JSA.

Date of JSA review: ________________________________

Print Name	Sign Name	Company
		Langan
		Langan

Task: Direct-Push Soil Borings

JSA No.:

		Langan

LANGAN	**JSA NUMBER:** **DATE:** **REVISION DATE:** 08/06/12	**OFFICE:** **PROJECT MANAGER:** **SAFETY OFFICER:**
SITE: **JOB TITLE OR TASK:** **Environmental Sampling**	**PERSON(S) PERFORMING JOB:**	**ANALYSIS BY:** **REVIEWED BY:** Tony Moffa
REQUIRED PERSONAL PROTECTIVE EQUIPMENT (PPE) AND/OR PERTINENT JOB SAFETY FORMS:		
Minimum PPE: Safety Glasses, Hard Hat, Steel toe boots, Sleeved shirt and pants		
Additional PPE (as needed): Leather and/or Nitrile gloves, Hearing protection, Traffic/Safety vest		
Monitoring Equipment (as needed):		
Job Safety Form:		

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
1. Daily Tailgate Safety Meeting	None	All employees assigned to this task will attend a daily tailgate safety meeting, which will include the pertinent JSA's,
2. Unpack Equipment	1. Slip, trips, and falls 2. Physical hazards including strains and hand injury	1. Be aware of hazards in area, place orange safety cones in areas of potential STFs could occur. Where possible, remove tripping hazards. 2. Use proper lifting and bending techniques and do not lift heavy loads without assistance , use assistance as necessary. Avoid putting hands near pinch points. Wear leather work gloves when handling equipment of other heavy materials. Use proper cutting tool to open cardboard boxes.
3. Initial Site Arrival- Assess Site Conditions	1. Traffic	1. Be alert. Secure area from through traffic

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
4. Collect Sanitary Sewer Samples a. Open/close manhole covers	1. Explosive Environment 2. Covers falling on fingers and toes 3. Muscle strain	1. Explosive conditions require use of safe equipment at all times. Identify escape route. 2. Wear appropriate PPE. Use tools to remove cover. 3. Use proper ergonomics when lifting heavy objects; use appropriate mechanical assistance and tools when possible to pry and lift off covers.
5. Collecting soil gas samples	1. Encountering electric and gas utility lines.	1. Before probing, have all utilities located. Identify escape route,
6. Collecting soil samples	1. Encountering electric and gas utility lines, 2. Slip/trip hazards	1. Have all utilities located; 2. Be Alert. Position pumps and other sampling equipment in an orderly and safe fashion.
7. Icing samples. Transporting coolers and equipment.	1. Slip Hazard 2. Muscle and back injury	1. Drain water away from coolers. Wear proper PPE, such as boots. 3. Use proper ergonomics when lifting and moving coolers and equipment
8. Leaving the site	1. Contaminated vehicle/ PPE	1. Wash hands promptly. Contaminated PPE should be disposed of on-site. Remove boots and soiled clothing for secure storage in trunk.
Additional items identified in the field.		
Additional Items.		

If additional items are identified during daily work activities, please notify all relevant personnel about the change and document on this JSA.

Date of JSA review: ______________________________________

Print Name	Sign Name	Company
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LANGAN	**JSA NUMBER:** **DATE:** **REVISION DATE:** 08/06/12	**OFFICE:** **PROJECT MANAGER:** **SAFETY OFFICER:**
SITE: **JOB TITLE OR TASK:** **Field Sampling**	**PERSON(S) PERFORMING JOB:**	**ANALYSIS BY:** **REVIEWED BY:** Tony Moffa
REQUIRED PERSONAL PROTECTIVE EQUIPMENT (PPE) AND/OR PERTINENT JOB SAFETY FORMS:		
Minimum PPE: Safety Glasses, Hard Hat, Steel toe boots, Sleeved shirt and pants		
Additional PPE (as needed): Leather and/or Nitrile gloves, Hearing protection, Traffic/Safety vest		
Monitoring Equipment (as needed):		
Job Safety Form:		

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
1.Daily Tailgate Safety Meeting	None	All employees assigned to this task will attend a daily tailgate safety meeting, which will include the pertinent JSA's,
2. Unpack Equipment	1. Slip, trips, and falls 2. Physical hazards including strains and hand injury	1. Be aware of hazards in area, place orange safety cones in areas of potential STFs could occur. Where possible, remove tripping hazards. 2. Use proper lifting and bending techniques and do not lift heavy loads without assistance , use assistance as necessary.
3. Initial Site Arrival- Assess Site Conditions	1. Traffic	1. Be alert. Secure area from through traffic
4. Surface water sampling	1. Contaminated media. Skin/eye contact with biological agents and chemicals	1. Wear site appropriate PPE. Review MSDS for all chemicals being handled.
5. Sampling from bridges	1. Struck by vehicles	1. Wear safety vest. Use buddy system
6. Icing samples. Transporting coolers and equipment.	1. Slip Hazard 2. Muscle and back injury	1. Drain water away from coolers. Wear proper PPE, such as boots. 1. Use proper ergonomics when lifting and moving coolers and equipment

Task: Environmental Sampling
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SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
7. Leaving the site	1. Contaminated vehicle/ PPE	1. Wash hands promptly. Contaminated PPE should be disposed of on-site. Remove boots and soiled clothing for secure storage in trunk.
Additional items identified in the field.		
Additional Items.		
If additional items are identified during daily work activities, please notify all relevant personnel about the change and document on this JSA.		

Date of JSA review: ____

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Langan's goal is to be SAFE! - (Stay Accident-Free Every day!)

LANGAN

Job Safety Analysis (JSA)
Health and Safety

JSA Title: **Groundwater Sampling**

JSA Number: **JSA008-01**

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.

PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):

☒ Safety Shoes	☒ Long Sleeves	☒ Safety Vest (Class 2)	☒ Hard Hat	☒ Hearing Protection
☒ Safety Glasses	☐ Safety Goggles	☐ Face Shield	☒ Nitrile Gloves	☐ PVC Gloves
☒ Leather Gloves	☐ Cut Resist. Gloves	☒ Fall Protection	☐ Fire Resistant Clothing	☐ Rubber Boots
☐ Insect/Animal Repellent	☐ Ivy Blocker/Cleaner	☐ Traffic Cones/Signs	☐ Life Vest/Jacket	
☒ Other: Tyvek sleeves, Dermal Protection, PID				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
1. Transport equipment to work area	1. Back Strain 2. Slips/ Trips/ Falls 3. Traffic 4. Cuts/abrasions from equipment 5. Contusions from dropped equipment	1. Use proper lifting techniuqes / Use wheeled transport 2. Minimize distance to work area / Have unobstructed path to work area / Follow good housekeeping procedures 3. Wear proper PPE (high visibility vest or clothing) 4. Wear proper PPE (leather gloves, long sleeves) 5. Wear proper PPE (safety shoes)
2. Remove well cover	1. Scrape knuckles/hand 2. Strain wrist/bruise plam 3. Pinch fingers or hand	1. Wear proper PPE (leather gloves) 2. Using a hammer, tap the end of the wrench to loosen grip of bolts 3. Wear proper PPE (leather gloves)
3. Remove well cap and lock	1. Well can pops from pressure 2. Exposure to hazardous substances through inhalation or dermal exposure 3. Scrape knuckles/hand 4. Strain write/bruise palm	1. Remove cap slowly to relieve pressure / Do not place face over well when opening / Wear proper PPE (safety glasses) 2. Use direct air monitoring/reading instrument (i.e. PID) / Be familiar with and follow actions prescribed in the HASP / Wear proper PPE (nitrile gloves) 3. Wear proper PPE (leather gloves) 4. Using hammer, tap the end of the wrench to loosen grip
4. Measure head-space vapor levels	1. Exposure to hazardous substances through inhalation	1. Do not place face over well when collecting measurement
5. Remove deciated tubing (if necessary)	1. Exposure to hazardous substances through inhalation or dermal exposure 2. Tubing swings around after removal	1. Wear proper PPE (nitrile gloves, Tyvek sleeves) 2. Wear proper PPE (safety glasses)
6. Set-up plastic sheeting for work site around the well	1. Lacerations when cutting plastic sheeting	1. Use scissors to cut plastic sheeting / Cut motions should always be away from body and body parts
7. Measure depth to water	1. Exposure to hazardous substances through inhalation or dermal exposure 2. Pinch fingers or hand in water level instrument	1. Wear proper PPE (nitrile gloves) 2. Wear proper PPE (leather gloves)

JSA Title: Groundwater Sampling
JSA Number: JSA008-01

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
8. Calibrate monitoring equipment	1. Skin or eye contact with calibration chemicals 2. Pinch fingers or hand in monitoring equipment	1. Wear proper PPE (safety glasses, nitrile gloves) 2. Wear proper PPE (leather gloves) / Avoid pinch points
9. Install sampling pump in well	1. Hand injuries during installation of pump 2. Lacerations when cutting tubing 3. Back strain during installation of pump 4. Physical hazards associated with manual lifting of heavy equipment 5. Back strain from starting generator 6. Burns from hot exhaust from generator 7. Electrical shock from improper use of generator and pump 8. Contaminated water spray from loose connections	1. Wear proper PPE (leather gloves, nitrile gloves) 2. Use safey tubing cutter 3. Use proper lifting techniques 4. Use proper lifting techniques / Use wheeled transport for heavy equipment 5. Use arm when starting generator / Do not over-strain if generator does not start 6. Do not touch generator near exhaust / Use proper handle to carry / Allow generator to cool down before moving 7. Properly plug in pump to generator / Do not allow the pump or generator to contact water / Check for breaks in the cord 8. Check all tubing connections to ensure they are tight and secure
10. Purge water	1. Contact with potentially contamined groundwater 2. Back strain from lifting buckets of water 3. Tripping potential on sample discharge lines and pump electric line	1. Wear proper PPE (safety glasses, nitrile gloves) 2. Use proper lifting techniques / Use wheeled transport 3. Organize discharge of electric line to keep out of way as much as possible / Mark potential tripping hazards with caution tape or safety cones
11. Sample water collection	1. Contact with potentially contaminated groundwater through dermal exposure 2. Contact with and burns from acid used for sample preservation 3. Tripping potential on sample discharge lines and pump electric line 4. Lacerations from broken sample bottles 5. Back strain when transporting coolers full of collected samples 6. Slips/ Trips/ Falls	1. Wear proper PPE (safety glasses, nitrile gloves) 2. Wear proper PPE (safety glasses, nitrile gloves) / Ensure sample bottle lids are secure before use and after sample collection 3. Organize line to keep out of the way as much as possible / Mark potential tripping hazards with caution tape or safety cones 4. Do not over-tighten bottle caps / Handle bottles safely to prevent breakage / Wrap glass bottles in bubble wrap, if possible 5. Use proper lifting techniques / Use wheeled transport / Seek assistance if coolers weight exceeds 50lbs. / Minimize distance to vehicle 6. Have unobstructed path to vehicle or collection point / Follow good housekeeping procedures / Do not lift/walk with coolers that are too heavy/difficult to lift
12. Remove pump and pack up equipment	1. Back strain when removing pump or lifting heavy equipment	1. Use proper lifting technique / Use wheeled transport for heavy equipment
13. Replace well cap and lock	1. Scrape fingers/hand 2. Strain wrist/bruise palm	1. Wear proper PPE (leather gloves) 2. Using hammer, tap the end of the well cap to tighten grip
14. Replace well cover	1. Scrape knuckles/hand 2. Strain write/bruise palm 3. Pinch fingers or hand	1. Wear proper PPE (leather gloves) 2. Using hammer, tap the end of the wrench to tighten the grip of the bolts 3. Wear proper PPE (leather gloves)
15. Transport drums to disposal staging location	1. Back, arm or shoulder strain from moving drums 2. Pinch hazard 3. Contact with potentially contaminated groundwater when moving improperly sealed drums 4. Slips/ Trips/ Falls when moving drum 5. Drop drum on feet/toes	1. Use drum cart for moving drums / Use proper lifting techniques / Obtain assistance, if needed 2. Wear proper PPE (leather gloves) 3. Wear proper PPE (nitrile gloves under leather gloves) / Properly seal drum to prevent leak 4. Ensure route to move drum to storage space is dry and free from obstructions 5. Wear proper PP (safety shoes)

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
16. Place used PPE in designated dispoal drum	1. Pressure build-up inside drum 2. Pinch hazard	1. Remove cap from bung hole in drum to relieve pressure 2. Wear proper PPE (leather gloves)
17. Decontaminate equipment	1. Splashing water/soap from decontamination 2. Contact with potentially contaminated groundwater through dermal exposure 3. Electrical shock from broken electric cords	1. Wear proper PPE (safety glasses) 2. Wear proper PPE (safety glasses, dermal protection) 3. Properly plug in pump to generator / Do not allow the pump or generator to contact water / Check for breaks in the cord
18. All activities	1. Slips/ Trips/ Falls 2. Hand injuries, cuts or lacerations during manual handling of materials 3. Foot injuries 4. Back injuries 5. Traffic 6. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 7. High Noise levels 8. Overhead hazards 9. Heat Stress/ Cold Stress 10. Eye Injuries	1. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 2. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 3. Wear Langan approved safety shoes 4. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 5. Wear high visibility clothing & vest / Use cones or signs to designate work area 6. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 7. Wear hearing protection 8. Wear hard hat / Avoid areas were overhead hazards exist. 9. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 10. Wear safety glasses
Additional items.		
Additional Items identified while in the field. (Delete row if not needed.)		

JSA Title: Groundwater Sampling
JSA Number: JSA008-01

Print Name	**Sign Name**	**Date**
Prepared by:		
Reviewed by:		

LANGAN	**JSA NUMBER:** 003568901-009 **DATE:** 10/03/11 **REVISION DATE:**	**OFFICE:** Doylestown **PROJECT MANAGER:** Rich LoCastro **SAFETY OFFICER:** Shelly Beitler
SITE: FPE - Newark **JOB TITLE OR TASK:** Monitoring Well Development	**PERSON(S) PERFORMING JOB:** Shelly Beitler Matt Shrensel	**ANALYSIS BY:** Shelly Beitler **REVIEWED BY:** Rich LoCastro Tony Moffa

REQUIRED PERSONAL PROTECTIVE EQUIPMENT (PPE) AND/OR PERTINENT JOB SAFETY FORMS:

Minimum PPE:	Steel-toed boots, long-sleeved shirt, nitrile gloves, safety glasses, hard hat
Additional PPE (as needed):	Cut-resistant or work gloves, Tyvek sleeves, high visibility vest, face shield
Monitoring Equipment:	None
Job Safety Form:	Tailgate Meeting

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
1. Daily Tailgate Safety Meeting	1. None	1. All employees assigned to this task will attend a daily tailgate safety meeting, which will include the pertinent JSA's, Standard Operating Procedures (SOPs), types of potential hazards, and actual hazards present and controls for those hazards.
2. Move equipment to work site	1. Back strain when lifting heavy equipment	1a. Use proper lifting technique (use legs for bending and lifting and not the back). Use wheeled transport for heavy equipment. Get assistance when handling loads > 50 lbs. 1b. Minimize distance to vehicle
	2. Slips/trips/falls while moving equipment	2a. Use proper lifting technique (use legs for bending and lifting and not the back). Use wheeled transport for heavy equipment. Get assistance when handling loads > 50 lbs. 2b. Minimize distance to vehicle 2c. Have unobstructed path to vehicle or collection point 2d. Do not lift/walk with boxes that are heavy/difficult to lift
	3. Traffic (if applicable)	3. Wear high visibility vests and exercise caution.
3. Measure depth to water	1. Exposure to hazardous substances	1. Wear proper PPE (nitrile gloves)
	2. Pinch fingers in water level instrument	2. Wear proper PPE (cut-resistant gloves)

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
4. Install tremie pipe in the monitoring well and connect to water source	1. Pinch fingers when connecting pipes 2. Hand injuries during installation of tremie pipe 3. Back strain from holding tremie pipe 4. High pressure water spray from poor connections	1. Wear proper PPE (nitrile gloves) 2. Wear proper PPE (nitrile gloves) 3. Use legs and arms and not the back when installing the pump; Use two people when lowering a pump greater than 80 feet 4a. Check all connections to make sure they are tight and secure 4b. Wear proper PPE (safety glasses)
5. Install pump in well a. Connect pump to sample tubing b. Lower pump to desired depth in well c. Connect sample tubing to flow cell d. Turn on power source (generator) e. Connect pump to power source (generator)	1. Hand injuries during installation of pump 2. Lacerations when cutting tubing 3. Back strain during installation of pump 4. Physical hazards associated with manual lifting of pump, generator and other heavy equipment 5. Back strain from starting generator 6. Burns from hot exhaust from generator 7. Electrical shock from improper use of generator and pump	1. Wear proper PPE (cut-resistant and nitrile gloves) when installing pump 2. OPEN BLADES ARE PROHIBITED FROM USE AT THE SITE; use safety tubing cutter 3. Use legs and arms and not the back when installing the pump; Use two people when lowering a pump greater than 80 feet 4. Lift heavy objects using proper lifting technique (use legs for bending and lifting and not the back). Use wheeled transport for heavy equipment. Obtain assistance when handling loads greater than 50 lbs. 5. Use arm when starting generator; do not overstrain if generator does not start 6. Do not touch generator near exhaust; use proper handle to carry; allow generator to cool down before moving 7. Properly plug in pump to generator; do not allow the pump or generator to contact water; check for breaks in the cord
6. Develop monitoring well a. Jet water into well using tremie-pipe b. Connect pump to tubing b. Lower pump to desired depth in well c. Connect tubing to flow cell d. Turn on power source (generator) e. Connect pump to power source (generator) f. Turn on pump and adjust to desired flow rate g. Surge pump up and down well screen to remove sediment h. Containerize all purge water	1. Hand injuries during installation of pump 2. Lacerations when cutting tubing 3. Back strain during installation of pump 4. Physical hazards associated with manual lifting of pump, generator and other heavy equipment	1. Wear proper PPE (cut-resistant gloves and nitrile gloves) when installing pump 2. **OPEN BLADES ARE PROHIBITED FROM USE AT THE SITE**; use safety tubing cutter 3. Use legs and arms and not the back when installing the pump; Use two people when lowering a pump greater than 80 feet 4. Lift heavy objects using proper lifting technique (use legs for bending and lifting and not the back). Use wheeled transport for heavy equipment. Obtain assistance when handling loads greater than 50 lbs.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
6. Develop monitoring well (continued)	5. Back strain from starting generator 6. Burns from hot exhaust from generator 7. Electrical shock from improper use of generator and pump 8. Contaminated water spray from loose connections or tubing output	5. Use arm when starting generator; do not overstrain if generator does not start 6. Do not touch generator near exhaust; use proper handle to carry; allow generator to cool down before moving 7. Properly plug in pump to generator; do not allow the pump or generator to contact water; check for breaks in the cord 8a. Check all tubing connections to make sure they are tight and secure 8b. Wear proper PPE (safety glasses, face shields)
7. Pack up equipment	1. Back strain when lifting heavy equipment 2. Slips/trips/falls while moving equipment 3. Traffic (if applicable)	1a. Use proper lifting technique (use legs for bending and lifting and not the back). Use wheeled transport for heavy equipment. Get assistance when handling loads > 50 lbs. 1b. Minimize distance to vehicle 2a. Use proper lifting technique (use legs for bending and lifting and not the back). Use wheeled transport for heavy equipment. Get assistance when handling loads > 50 lbs. 2b. Minimize distance to vehicle 2c. Have unobstructed path to vehicle or collection point 2d. Do not lift/walk with boxes that are heavy/difficult to lift 3. Wear high visibility vests and exercise caution.
8. Transport drums to central staging location	1. Back, arm or shoulder strain from moving drums 2. Pinch fingers/hand in drum cart when moving drums 3. Pinch fingers/hand when operating lift-gate on vehicle 4. Contact with potentially contaminated groundwater when moving improperly sealed drums 5. Slips when moving drum 6. Drop drum on feet/toes	1. Use drum cart for moving drums; keep back in neutral position while raising barrel with drum cart; obtain assistance when moving the drum, if needed 2. Wear proper PPE (cut-resistant gloves); keep fingers away from pinch-points 3. Wear proper PPE (cut-resistant gloves); keep fingers away from pinch-points 4. Wear proper PPE (nitrile gloves under cut-resistant gloves); properly seal drum to prevent leaks 5. Make sure route to move drum and storage space is dry and free from obstructions 6. Wear proper PPE (steel-toe shoes); Work in a safe manner to prevent dropped drum

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
9. All activities	1. Slips, Trips, and Falls	1a. All personnel should be constantly watching for trip hazards, such as uneven terrain, holes, ditches, stretched wires or ropes or other materials in their path 1b. Proper housekeeping of materials during sampling events 1c. Mark significant below-grade hazards (i.e. holes, trenches) with safety cones or spray paint 1d. Wear proper footwear for terrain and scope of work (steel-toe boots) 1e. Rainy, snowy, or icy conditions will warrant a more cautious work attitude. Employees should change work speed and style to fit the weather conditions
	2. Hand injuries during manual handling of materials	2a. Workers should inspect materials for jagged or sharp edges, and rough or slippery surfaces 2b. Workers should keep fingers away from pinch and shear points, especially when setting down materials 2c. Workers should wipe off greasy, wet, slippery or dirty objects before attempting to handle them 2d. Cut-resistant gloves should be worn at all times except when the gloves create a hindrance to completing the task in a safe manner
	3. Foot injuries	3. Steel-toed boots should be used for protection of the feet
	4. Back injuries	4a. All three main factors in manual lifting (load location, task repetition, and load weight) must be considered when evaluating what is safe or unsafe to lift; obtain assistance when possible 4b. All manual lifting of heavy or bulky objects shall be carefully planned to avoid injuries or damage to equipment
	5. Vehicular traffic	5. Employees shall wear high-visibility shirts or safety vests when performing work in high traffic areas; use cones where appropriate to designate work area; notify building occupants and fork lift operators of work areas

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
9. All activities (continued)	6. Wildlife a. Stray dogs b. Mice/rats c. Vectors (i.e. mosquitoes, bees, etc.)	6a. Employees shall be aware of their surroundings at all times, including the presence of wildlife 6b. Employees shall not approach any stray dogs 6c. Employees shall carry/use Halt in the event a stray dog may attack 6d. Use bug spray when needed 6e. Employees shall wear long-sleeve shirts during all activities at the site
	7. Heat Stress/Cold Stress	7. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather); drink plenty of fluids to avoid dehydration; take breaks as necessary to avoid heat/cold stress
	8. Crime	8. Employees shall be aware that the site is in a high crime area and work shall be performed in pairs, particularly in isolated areas of the facility and surrounding area

LANGAN	**JSA NUMBER:** **DATE:** 08/04/10 **REVISION DATE:** 7/28/11	**OFFICE:** **PROJECT MANAGER:** **SAFETY OFFICER:**
SITE: **JOB TITLE OR TASK:** Monitoring Well Installation	**PERSON(S) PERFORMING JOB:**	**ANALYSIS BY:** **REVIEWED BY:** Tony Moffa

REQUIRED PERSONAL PROTECTIVE EQUIPMENT (PPE) AND/OR PERTINENT JOB SAFETY FORMS:

Minimum PPE:	Steel-toed boots, long-sleeved shirt, nitrile gloves, safety glasses, hard hat
Additional PPE (as needed):	Cut-resistant or work gloves, Tyvek sleeves, high visibility vest
Monitoring Equipment:	Photo-ionization detector (PID)
Job Safety Form:	Tailgate Meeting

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
1. Daily Tailgate Safety Meeting	1. None	1. All employees assigned to this task will attend a daily tailgate safety meeting, which will include the pertinent JSA's, Standard Operating Procedures (SOPs), types of potential hazards, and actual hazards present and controls for those hazards.
2. Move equipment to work site	1. Back strain when lifting heavy equipment 2. Slips/trips/falls while moving equipment 3. Traffic (if applicable) 4. Pinched fingers or running over toes during geoprobe set-up	1a. Use proper lifting technique (use legs for bending and lifting and not the back). Use wheeled transport for heavy equipment. Get assistance when handling loads greater than 50 lbs. 1b. Minimize distance to vehicle 2a. Use proper lifting technique (use legs for bending and lifting and not the back). Use wheeled transport for heavy equipment. Get assistance when handling loads greater than 50 lbs. 2b. Minimize distance to vehicle 2c. Have unobstructed path to vehicle or collection point 2d. Do not lift/walk with boxes that are heavy/difficult to lift 3. Wear high visibility vests and exercise caution. 4a. Wear proper PPE (cut-resistant gloves)

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
2. Move equipment to work site (continued)		4b. Stay alert, be aware of geoprobe rig at all times
	5. Overturn drill rig while transporting to loading dock on flat-bed tow truck	5a. Drill rig should be parked in center of flat-bed tow truck 5b. Emergency brake shall be used at all times during transport on the flat-bed truck 5c. All unnecessary personnel should stay away from the flat-bed truck during moving activities
3. Set-up geoprobe rig at desired location	1. Slips/trips/falls while moving equipment	1a. All personnel should be constantly watching for trip hazards, such as uneven terrain, holes, ditches, stretched wires or ropes or other materials in their path 1b. Proper housekeeping of materials during sampling events 1c. Mark significant below-grade hazards (i.e. holes, trenches) with safety cones or spray paint
	2. Pinched fingers or running over toes during geoprobe set-up	2a. Wear proper PPE (cut-resistant gloves) 2b. Stay alert, be aware of geoprobe rig at all times
	3. Clothing entanglement	3. Wear proper attire for geoprobe rig (no loose clothing, strings, etc.)
	4. Electrocution/falling equipment and debris from raising geoprobe rig mast	4a. Wear proper PPE (hard hats) 4b. Be aware of locations at all times; look up, down and around before raising mast 4c. Check geoprobe drill rig mast prior to raising for loose objects/debris
	5. Carbon monoxide poisoning	5. Properly ventilate exhaust from geoprobe rig when working indoors or in areas of poor ventilation
	6. Geoprobe rig roll-over	6a. Do not move rig with mast raised 6b. Set stabilizers prior to raising mast, if applicable 6c. Inspect work area; if area appears unstable, area should be assessed by a qualified professional engineer or the MIP boring location should be moved
	7. Geoprobe rig movement	7a. All field personnel should stay clear of the geoprobe rig while moving 7b. Use a spotter when backing up the geoprobe rig

SEQUENCE OF BASIC JOB STEPS	**POTENTIAL HAZARDS**	**PREVENTATIVE OR CORRECTIVE ACTION**
4. Advance geoprobe rods below ground surface to desired depth	1. Strain wrist/bruise palm while preparing geoprobe rods 2. Pinched fingers while preparing geoprobe/MIP rods 3. Injury due to encountering below grade utilities 4. Back strain while preparing geoprobe rods 5. Clothing entanglement while advancing geoprobe rods 6. Carbon monoxide poisoning 7. Bruised/broken toes/feet from dropping equipment and geoprobe rods 8. High noise levels 9. Injury from faulty equipment	1a. Wear proper PPE (cut-resistant gloves) 1b. Use proper technique for preparing geoprobe rods; use second person if necessary 2. Wear proper PPE (cut-resistant gloves) 3a. Markout all utilities prior to advancing the MIP boring using utility plans, geophysical contractor, or site personnel knowledge 3b. Clear all subsurface soil borings to a minimum of 5 feet below grade 4. Use proper lifting technique (use legs for bending and lifting and not the back); obtain assistance if needed 5. Wear proper attire for geoprobe rig (no loose clothing, strings, etc.) 6. Properly ventilate exhaust from geoprobe rig when working indoors or in areas of poor ventilation 7. Wear proper PPE (steel-toe boots); Work in a safe manner to prevent dropped rod 8. Wear proper PPE (hearing protection) 9. Geoprobe contractor shall inspect all equipment prior to use
5. Remove and open acetate liner	1. Pinched fingers while removing macrocore 2. Cuts/lacerations when cutting acetate liner open 3. Exposure to hazardous vapors 4. Skin contact with contaminated soil	1. Wear proper PPE (nitrile and cut-resistant gloves) 2a. **OPEN BLADES ARE PROHIBITED FROM USE AT THE SITE**; use acetate liner cutting tool 2b. Wear proper PPE (cut-resistant gloves) 2c. Cut acetate liner away from body 3a. Do not place face over acetate liner when opening 3b. Monitor hazardous vapors in air with PID; upgrade PPE as necessary based on levels contained in the Health and Safety Plan 4. Wear proper PPE (nitrile gloves)

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
6. Remove soil from acetate liner and place in a 55-gallon drum	1. Cuts/lacerations from acetate liner 2. Pinched fingers/hand while opening/closing 55-gallon drum 3. Skin contact with contaminated soil 4. Soil debris in eyes	1. Wear proper PPE (cut-resistant gloves) 2a. Wear proper PPE (cut-resistant gloves) 2b. Keep fingers/hands away from pinch points 3. Wear proper PPE (nitrile gloves, long-sleeve shirt) 4. Wear proper PPE (safety glasses)
7. Repeat steps 4 and 5 until desired depth is reached	1. See Steps 4 and 5	1. See Steps 4 and 5
8. Remove geoprobe rods and place in storage rack	1. Clothing entanglement while removing geoprobe rods 2. Back strain while removing geoprobe rods 3. Pinched fingers while removing geoprobe rods 4. Carbon monoxide poisoning 5. High noise levels 6. Injury from faulty equipment	1. Wear proper attire for geoprobe rig (no loose clothing, strings, etc.) 2. Use proper lifting technique (use legs for bending and lifting and not the back); obtain assistance if needed 3. Wear proper PPE (cut-resistant gloves) 4. Properly ventilate exhaust from geoprobe rig when working indoors or in areas of poor ventilation 5. Wear proper PPE (hearing protection) 6. Geoprobe contractor shall inspect all equipment prior to use
9. Attach hollow-stem augers to the geoprobe rig; advance augers and attach additional augers until desired depth is reached	1. Strain wrist/bruise palm while attaching augers 2. Pinched fingers while attaching augers 3. Back strain while lifting and attaching augers and shoving drill cuttings in 55-gallon drums 4. Clothing entanglement while advancing augers 5. Carbon monoxide poisoning 6. Bruised/broken toes/feet from dropping equipment and augers 7. High noise levels 8. Injury from faulty equipment 9. Skin contact with contaminated soil	1a. Wear proper PPE (cut-resistant gloves) 1b. Use proper technique for attaching augers; use second person if necessary 2. Wear proper PPE (cut-resistant gloves); keep fingers away from pinch points 3. Use proper lifting technique (use legs for bending and lifting and not the back); obtain assistance if needed 4. Wear proper attire for geoprobe rig (no loose clothing, strings, etc.) 5. Properly ventilate exhaust when working indoors or in areas of poor ventilation 6. Wear proper PPE (steel-toe boots); Work in a safe manner to prevent dropped augers/equipment 7. Wear proper PPE (hearing protection) 8. Geoprobe contractor shall inspect all equipment prior to use 9. Wear proper PPE (nitrile gloves, long-sleeve shirt)

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
	10. High noise levels	10. Wear proper PPE (hearing protection)
10. Install monitoring well	1. Pinched fingers while constructing PVC monitoring well 2. Lacerations/abrasions while cutting PVC monitoring well 3. Back/arm strain while setting PVC monitoring well inside augers 4. Lacerations/abrasions from cutting open bags of sand and bentonite 5. Back/arm strain while filling annulus space with sand and bentonite	1. Wear proper PPE (nitrile gloves and cut-resistant gloves) 2a. **OPEN BLADES ARE PROHIBITED FROM USE AT THE SITE**; use appropriate PVC cutting tools 2b. Cut away from the body 2c. Wear proper PPE (cut-resistant gloves) 3. Use proper lifting/bending technique (use legs for bending and lifting and not the back); obtain assistance if needed 4a. **OPEN BLADES ARE PROHIBITED FROM USE AT THE SITE**; use scissors 4b. Wear proper PPE (cut-resistant gloves) 5. Use proper lifting/bending technique (use legs for bending and lifting and not the back); obtain assistance if needed
11. Tremie-grout annulus space above bentonite seal	1. Splashed cement-benonite grout on face/eyes 2. Injury from faulty equipment 3. Back strain while mixing cement/bentonite grout 4. Pinched fingers while using grout mixer	1. Wear proper PPE (safety glasses) 2. Geoprobe contractor shall inspect all equipment prior to use 3. Use proper lifting/bending technique (use legs for bending and lifting and not the back); obtain assistance if needed 4. Wear proper PPE (nitrile gloves and cut-resistant gloves)
12. Install flush-mount monitoring well pad	1. Splashed concrete on eyes/face during mixing 2. Pinched fingers when opening/closing monitoring well manhole 3. Cuts or lacerations from opening concrete bag	1. Wear proper PPE (safety glasses) 2. Wear proper PPE (cut-resistant gloves); keep fingers away from pinch points 3a. **OPEN BLADES ARE PROHIBITED FROM USE AT THE SITE**; use scissors 3b. Wear proper PPE (cut-resistant gloves)
13. Decontaminate geoprobe rods and augers	1. Splashed decontamination water/debris on face/eyes 2. Back strain while decontaminating geoprobe rods and augers 3. Injury from high-pressure washer 4. Injury from faulty decontamination equipment	1. Wear proper PPE (safety glasses) 2. Use proper lifting/bending technique (use legs for bending and lifting and not the back); obtain assistance if needed 3. Wear proper PPE (cut-resistant gloves, safety glasses); be aware of pressure 4. Contractor shall inspect all equipment prior to use

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
14. Develop monitoring well a. Connect pump to sample tubing b. Lower pump to desired depth in well c. Connect sample tubing to flow cell d. Turn on power source (generator) e. Connect pump to power source (generator) f. Turn on pump and adjust to desired flow rate g. Surge pump up and down well screen to remove sediment	1. Hand injuries during installation of pump	1. Wear proper PPE (cut-resistant gloves and nitrile gloves) when installing pump
	2. Lacerations when cutting tubing	2. **OPEN BLADES ARE PROHIBITED FROM USE AT THE SITE**; use safety tubing cutter
	3. Back strain during installation of pump	3. Use legs and arms and not the back when installing the pump; Use two people when lowering a pump greater than 80 feet
	4. Physical hazards associated with manual lifting of pump, generator and other heavy equipment	4. Lift heavy objects using proper lifting technique (use legs for bending and lifting and not the back). Use wheeled transport for heavy equipment. Obtain assistance when handling loads greater than 50 lbs.
	5. Back strain from starting generator	5. Use arm when starting generator; do not overstrain if generator does not start
	6. Burns from hot exhaust from generator	6. Do not touch generator near exhaust; use proper handle to carry; allow generator to cool down before moving
	7. Electrical shock from improper use of generator and pump	7. Properly plug in pump to generator; do not allow the pump or generator to contact water; check for breaks in the cord
	8. Contaminated water spray from loose connections	8. Check all tubing connections to make sure they are tight and secure

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
15. Pack up equipment	1. Back strain when lifting heavy equipment 2. Slips/trips/falls while moving equipment 3. Traffic (if applicable) 4. Pinched fingers or running over toes during geoprobe set-up	1a. Use proper lifting technique (use legs for bending and lifting and not the back). Use wheeled transport for heavy equipment. Get assistance when handling loads greater than 50 lbs. 1b. Minimize distance to vehicle 2a. Use proper lifting technique (use legs for bending and lifting and not the back). Use wheeled transport for heavy equipment. Get assistance when handling loads greater than 50 lbs. 2b. Minimize distance to vehicle 2c. Have unobstructed path to vehicle or collection point 2d. Do not lift/walk with boxes that are heavy/difficult to lift 3. Wear high visibility vests and exercise caution. 4a. Wear proper PPE (cut-resistant gloves) 4b. Stay alert, be aware of geoprobe rig at all times
16. Transport drums to central staging location	1. Back, arm or shoulder strain from moving drums 2. Pinch fingers/hand in drum cart when moving drums 3. Pinch fingers/hand when operating lift-gate on vehicle 4. Contact with potentially contaminated groundwater when moving improperly sealed drums 5. Slips when moving drum 6. Drop drum on feet/toes	1. Use drum cart for moving drums; keep back in neutral position while raising barrel with drum cart; obtain assistance when moving the drum, if needed 2. Wear proper PPE (cut-resistant gloves); keep fingers away from pinch-points 3. Wear proper PPE (cut-resistant gloves); keep fingers away from pinch-points 4. Wear proper PPE (nitrile gloves under cut-resistant gloves); properly seal drum to prevent leaks 5. Make sure route to move drum and storage space is dry and free from obstructions 6. Wear proper PPE (steel-toe shoes); Work in a safe manner to prevent dropped drum
17. All activities	1. Slips, Trips, and Falls	1a. All personnel should be constantly watching for trip hazards, such as uneven terrain, holes, ditches, stretched wires or ropes or other materials in their path 1b. Proper housekeeping of materials during sampling events

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
		1c. Mark significant below-grade hazards (i.e. holes, trenches) with safety cones or spray paint 1d. Wear proper footwear for terrain and scope of work (steel-toe boots) 1e. Rainy, snowy, or icy conditions will warrant a more cautious work attitude. Employees should change work speed and style to fit the weather conditions
	2. Hand injuries during manual handling of materials	2a. Workers should inspect materials for jagged or sharp edges, and rough or slippery surfaces 2b. Workers should keep fingers away from pinch and shear points, especially when setting down materials 2c. Workers should wipe off greasy, wet, slippery or dirty objects before attempting to handle them 2d. Cut-resistant gloves should be worn at all times except when the gloves create a hindrance to completing the task in a safe manner
	3. Foot injuries	3. Steel-toed boots should be used for protection of the feet

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
17. All activities (continued)	4. Back injuries	4a. All three main factors in manual lifting (load location, task repetition, and load weight) must be considered when evaluating what is safe or unsafe to lift; obtain assistance when possible 4b. All manual lifting of heavy or bulky objects shall be carefully planned to avoid injuries or damage to equipment
	5. Vehicular traffic	5. Employees shall wear high-visibility shirts or safety vests when performing work in high traffic areas; use cones where appropriate to designate work area; notify building occupants and fork lift operators of work areas
	6. Wildlife a. Stray dogs b. Mice/rats c. Vectors (i.e. mosquitoes, bees, etc.)	6a. Employees shall be aware of their surroundings at all times, including the presence of wildlife 6b. Employees shall not approach any stray dogs 6c. Employees shall carry/use Halt in the event a stray dog may attack 6d. Use bug spray when needed 6e. Employees shall wear long-sleeve shirts during all activities at the site
	7. Heat Stress/Cold Stress	7. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather); drink plenty of fluids to avoid dehydration; take breaks as necessary to avoid heat/cold stress
	8. Crime	8. Employees shall be aware that the site is in a high crime area and work shall be performed in pairs, particularly in isolated areas of the facility and surrounding area
Additional items identified in the field.		
Additional Items.		

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
If additional items are identified during daily work activities, please notify all relevant personnel about the change and document on this JSA.		

Date of JSA review: ____

Print Name	Sign Name	Company
		Langan
		Langan
		Langan

APPENDIX H

TAILGATE SAFETY BRIEFING

LANGAN TAILGATE SAFETY BRIEFING

Date: ____________________ Time: ____________________

Leader: ____________________ Location: ____________________

Work Task: ____

SAFETY TOPICS (*provide some detail of discussion points*)

Chemical Exposure Hazards and Control: ____

____

Physical Hazards and Control: ____

Air Monitoring: ____

PPE: ____

Communications: ____

Safe Work Practices: ____

____

Emergency Response: ____

Hospital/Medical Center Location: ____

Phone Numbers: ____

Other: ____

FOR FOLLOW-UP (the issues, responsibilities, due dates, etc.**)**

____

____

____

ATTENDEES

PRINT NAME	COMPANY	SIGNATURE

APPENDIX C
QUALITY ASSURANCE PROJECT PLAN

Quality Assurance Project Plan

for

23-10 Queens Plaza South
Long Island City, New York

Prepared For:

QPS 23-10 Developer LLC
c/o Property Markets Group, Inc.
111 Fifth Avenue, 6th Floor
New York, New York 10003

Prepared By:

Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C.
21 Penn Plaza
360 West 31st Street, 8th Floor
New York, New York 10001

June 2015
170244603

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1.0 PROJECT DESCRIPTION

1.1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) is for the 27,269 square-foot (±0.62 acres) property at 23-10 Queens Plaza South in Long Island City, New York (the "Site"). The Site was entered into the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) by QPS 23-10 Development LLC (the owner), as a Volunteer on August 8, 2014. BCP Site No. C241160 was assigned to the Site by NYSDEC. Additional Site information including Site maps and data collected previously by Langan and others is provided in the Interim Remedial Measure Work Plan (IRMWP).

This QAPP specifies analytical methods to be used to ensure that data collected during Site management are precise, accurate, representative, comparable, complete, and meet the sensitivity requirements of the project.

1.2 PROJECT OBJECTIVES

The environmental objectives of the IRMWP are as follows:

- Remove potential sources of contamination and prevent additional environmental impacts to site media (soil, groundwater, and soil vapor) through the removal of the ASTs, USTs, associated fuel lines, and storage drums;
- Remove known subsurface contamination through LNAPL recovery and excavation of impacted soil.
- With the cellar slab removed, install the horizontal piping for the SMD system.

The proposed IRM consists of the following tasks:

- Decommissioning and removal of one registered, 10,000-gallon aboveground storage tank (AST) (Petroleum Bulk Storage [PBS] No. 2-017345);
- Cleaning of the cellar slab with oil-removing and oil-absorbent products, and removal of any petroleum-containing drums, barrels, or other storage containers representing a threat of possible release to the environment;

- Demolition of the existing cellar slab and excavation to about 2.5 feet below slab grade (bsg) to allow for field screening of exposed soil, installation of a submembrane depressurization piping and site cap;
- Decommissioning and removal of four unregistered, 550-gallon underground storage tanks (USTs) and any unknown USTs;
- Additional excavation to the extent practical to remove grossly-impacted media, if encountered;
- Installation of recovery sumps/wells in the southwestern portion of the building to recover light non-aqueous phase liquid (LNAPL), and periodic LNAPL recovery using conventional LNAPL recovery technology;
- Collection of baseline groundwater samples from existing wells;
- Collection of endpoint documentation soil samples from the base of the excavation;
- Backfilling of excavations, as necessary;
- Installation of subslab piping and gravel permeation layer for a submembrane depressurization system; and
- Registration of all unregistered USTs under PBS No. 2-017345.

The IRM described herein will be performed in accordance with applicable federal, state, and city regulations. An estimated remediation schedule is provided in Appendix A. A Construction Health and Safety Plan (CHASP) is provided as Appendix B. These objectives have been established in order to protect public health and the environment for the anticipated commercial use development at the Site.

1.3 SCOPE OF WORK

Implementation of the Remedial Actions will include waste characterization sampling; limited handling of contaminated and soil and groundwater; documentation sampling; and backfilling. Disturbed soil will be sampled for laboratory analysis per disposal facility requirements, and visually examined, screened, and characterized to determine whether it is suitable for re-use or will be properly disposed at an approved disposal facility. Groundwater is unlikely to be encountered during implementation of the IRMWP; however, if encountered, groundwater may be sampled to determine the necessity of treatment prior to discharge to the New York City sewer system under a New York City Department of Environmental Protection (NYCDEP) permit. Clean material may need to be imported to the site for use as backfill. A dust, odor, and organic vapor control and monitoring plan will be implemented during ground intrusive activities.

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

- Waste Characterization Soil Sampling – Soil samples for waste classification and disposal purposes will be collected during the remedial excavation. Soil samples will be collected at a frequency depending on the disposal facility requirements. Laboratory tests for characterization of a waste stream typically include all or a subset of the following list and will be determined by the facility's permit requirements: Total Petroleum Hydrocarbons (TPH); Target Compound List (TCL) volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs); polychlorinated biphenyls (PCBs); Target Analyte List (TAL) metals; pesticides and herbicides; 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; Diesel Range Organics (DRO); and/or Gasoline Range Organics (GRO).
- Baseline Groundwater Sampling – Groundwater samples will be collected to document the pre-remediation concentrations of VOCs in groundwater. Groundwater remediation will be a component of the forthcoming Remedial Action Work Plan, and baseline samples provide a comparison to determine the efficacy of the remediation. Groundwater samples will be collected from eight existing wells in accordance with EPA low-flow guidance and analyzed for TCL and Part 375 VOCs.
- Documentation Soil Sampling – Soil samples will be collected after reaching final excavation depths and prior to backfilling to document any contamination that will remain on site. Documentation samples would be collected at a frequency in accordance with DER-10 and analyzed for Part 375 and TCL/TAL VOCs, SVOCs, and metals (pesticides and PCBs may be added to the analytical scope during IRMWP review).
- Backfill - The clean fill would be segregated at a source/facility that is free of environmental contaminants. Qualified environmental personnel would collect representative samples at a frequency consistent with NYSDEC DER-10 Table 5.4(e)10 or CP-51 / Soil Cleanup Guidance (Table 4). The samples would be analyzed for Part 375 VOCs (EPA Method 8260), SVOCs (EPA Method 8270), pesticides/PCBs (EPA Method 8082/8081) and metals/inorganics by an NYSDOH ELAP-certified laboratory. Acceptable backfill material would not exceed Unrestricted Use SCOs. Upon meeting these criteria, the certified-

clean fill would be transported to the site and segregated from impacted material, as necessary, on plastic sheeting until it is used as backfill.

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. 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 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 and groundwater 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. For soil vapor or air samples, analytical accuracy will be assessed by examining the percent recoveries that are added to each sample, internal standards, laboratory method blanks, and instrument calibration.
- **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

Any future remedial activities and investigations will be overseen by Langan or another environmental consultant for QPS 23-10 Developer, LLC or a future owner. The environmental consultant will also arrange data analysis and reporting tasks. The analytical services will be performed by an ELAP-certified laboratory. Data validation services will be performed by approved data validation contractor(s).

For the required sampling as stated in the SMP, sampling will be conducted by Langan, the analytical services will be performed by York Analytical Laboratories, Inc. of Stratford, Conn. (NYSDOH ELAP certification number 10854). Data validation services will be performed by Emily Strake; résumé attached (Attachment A).

Key contacts for this project are as follows:

QPS 23-10 Developer, LLC:	Mr. Chris Hunter Telephone: (646) 681-3314
Langan Project Manager:	Mr. Michael Burke, CHMM Telephone: (212) 479-5582
Langan Quality Assurance Officer (QAO):	Mr. Gerald Nicholls, PE Telephone: (212) 479-5427
Program Quality Assurance Monitor:	Mr. Paul McMahon Telephone: (212) 479-5451
Data Validator:	Ms. Emily Strake Telephone: (215) 491-6526
Laboratory Representative:	York Analytical Laboratories, Inc. Phil Murphy Telephone: (203) 598-1371

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 the engineering controls on 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.

4.1 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 and acceptable based on professional judgement. For results greater than 2x the RL, the acceptance criteria is a relative percent difference (RPD) of ≤50% (soil and air), <30% (water). RLs and method detection limits (MDL) are provided in Attachment B.

4.2 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, 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 will be evaluated against laboratory blanks (preparation or method) and evaluated against field samples collected on the same day to determine potential for bias. Trip blanks are not required for non-aqueous matrices but are planned for non-aqueous matrices where high concentrations of VOCs are anticipated.

Laboratory accuracy is assessed by evaluating the percent recoveries of matrix spike/matrix spike duplicate (MS/MSD) samples, laboratory control samples (LCS), surrogate compound recoveries, and the results of method preparation blanks. MS/MSD, LCS, and surrogate percent recoveries will be 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.

4.3 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.

Air, soil vapor, 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.

4.4 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 will be 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 are 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 methods, laboratory-issued SOPs, the laboratory's Quality Assurance Manual, and this QAPP. The laboratory is required to be properly certified and accredited.

4.5 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 will be 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 will be comparable when similar sampling and analytical methods are used as documented in the QAPP. Comparability will be 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 will be evaluated to determine whether they may be combined with contemporary data sets.

4.6 SENSITIVITY

Sensitivity is the ability of the instrument or method to detect target analytes at the levels of interest. The project director 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 director 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.

Site-specific MS and MSD samples will be prepared and analyzed by the analytical laboratory by spiking an aliquot of submitted sample volume with analytes of interest. Additional sample volume is not required by the laboratory for this purpose. An MS/MSD analysis will be analyzed at a rate of 1 out of every 20 samples, or one per analytical batch. MS/MSD samples are only required for soil and groundwater samples.

5.0 SAMPLE COLLECTION AND FIELD DATA ACQUISITION PROCEDURES

Soil and groundwater sampling will be conducted in accordance with the established NYSDEC protocols contained in DER-10/Technical Guidance for Site Investigation and Remediation (May2010) and title 6 of the New York Codes Rules and Regulations Part 375. Air sampling, if necessary, will be conducted in accordance with the established New York State Department of Health (NYSDOH) protocols contained in the Guidance for Evaluating Soil Vapor Intrusion in the State of New York (October 2006). 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 notes 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 will be made in waterproof, permanent blue or black ink. No erasures will be allowed. If an incorrect entry is made, the information 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 will be 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.
- 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 in accordance with the sample nomenclature guidance included in Attachment D, 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.

5.2 EQUIPMENT CALIBRATION AND PREVENTATIVE MAINTENANCE

A photoionization detector (PID) will be used during the sampling activities to evaluate work zone action levels, collect pre- and post-sample readings for air samples, screen soil samples, and collect monitoring well headspace readings. 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

A water quality meter (YSI 6820 or similar) will be used during purging of groundwater to measure pH, specific conductance, temperature, dissolved oxygen, turbidity and oxidation-reduction-potential (ORP), every ten minutes. A portable turbidity meter (LaMotte or similar) may also be used to measure turbidity. Water-quality meters should be calibrated and the results documented before use each day using standardized field calibration procedures and calibration checks.

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

Air samples

Prior to sample collection, a pre-sampling inspection will be conducted to document chemicals and potential subsurface pathways at the Site. The pre-sampling inspection will assess the potential for impacts from chemical storage within the building. Air samples will be collected into laboratory-supplied, batch certified-clean Summa® canisters calibrated for a sampling rate of two hours. The pressure gauges on each calibrated flow controller should be monitored throughout sample collection. Sample collection should be stopped when the pressure reading reaches -4 mmHg.

Soil Samples

Soil samples will be visually classified and 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 either EnCore® or Terra Core® sampling equipment. For analysis of non-volatile parameters, samples will be homogenized and placed into glass jars. 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, analysis of collected soil sample will meet all quality assurance criteria set forth by this QAPP and DER-10.

Groundwater Samples

Groundwater sampling will be conducted using low-flow sampling procedures following USEPA guidance ("Low Stress [low flow] Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells", EQASOP-GW 001, January 19, 2010).

During purging, field parameters should be measured, including: water level drawdown, purge rate, pH, specific conductance, temperature, dissolved oxygen, turbidity and oxidation-reduction-potential (ORP), every ten minutes using a water quality meter (YSI 6820 or similar) and a depth-to-water interface probe that should be decontaminated between wells. Samples should generally not be collected until the field parameters have stabilized. Field parameters will be considered stable once three sets of measurements are within ±0.1 standard units for pH, ±3% for conductivity and temperature, ±10 millivolts for ORP, and ±10% for turbidity and dissolved oxygen. Purge rates should be adjusted to keep the drawdown in the well to less than 0.3 feet, as practical. Additionally, an attempt should be made to achieve a stable turbidity reading of less than 10 Nephelometric Turbidity Units (NTU) prior to sampling. If the turbidity reading does not stabilize at reading of less than 10 NTU for a given well, then both filtered and unfiltered samples should be collected from that well. If necessary, field filtration should be performed using a 0.45 micron disposable in-line filter. Groundwater samples should be collected after parameters have stabilized as noted above or the readings are within the precision of the meter. Deviations from the stabilization and drawdown criteria, if any, should be noted on the sampling logs.

Samples should be collected directly into laboratory-supplied jars. 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 groundwater samples will meet the holding times required for each analyte as specified in Attachment C. In addition, analysis of collected groundwater sample will meet all quality assurance criteria set forth by this QAPP and DER-10.

Sample Field Blanks and Duplicates

Field blanks will be collected for quality assurance purposes at a rate of one per 20 investigative samples per matrix (soil and groundwater only). Field blanks will be obtained by pouring laboratory-demonstrated analyte-free water on or through a decontaminated sampling device following use and implementation of decontamination protocols. The water will be collected off of the sampling device into a laboratory-provided sample container for analysis. Field blank samples will be analyzed for the complete list of analytes on the day of sampling. Trip blanks will be collected at a rate of one per day if soil samples are analyzed for VOCs during that 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 investigative samples per matrix 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. If soil or groundwater samples are being collected, the laboratory will also prepare and supply the required trip blanks and field blank sample containers and reagent preservatives. Sample bottle containers, including the field blank containers, will be placed into 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° ±2° C.

Soil and/or groundwater samples collected in the field for laboratory analysis will be placed directly into the laboratory-supplied sample containers. 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°±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

Air sample canisters can be stored and transported without additional packaging. Soil and groundwater sample containers 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. The cooler will be taped closed 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 (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 by a laboratory-provided courier under the chain-of-custody protocols described in Section 5.9.
- 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

Decontamination procedures will be used for non-dedicated sampling equipment. Decontamination of field personnel is discussed in the Construction Health and Safety Plan (CHASP) included in Appendix B 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.

Residual fluids (such as purge water) will be collected and stored in DOT-approved (or equivalent) 55-gallon drums in a designated storage area at the site. The residual fluids will be transported to the on-site wastewater treatment plant or analyzed, characterized and disposed off-site in accordance with applicable federal and state regulations. Residual fluids such as decontamination water may be discharged to the ground surface, however, if gross contamination is observed, the residual fluids will be collected, stored, and transported similar purge water or other residual fluids.

5.9 CHAIN-OF-CUSTODY PROCEDURES

A chain-of-custody protocol has been established for collected samples that 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 the shipping courier, 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 sample collected. The sample identification number, date and time of sample collection, analysis requested and other pertinent information (e.g.,

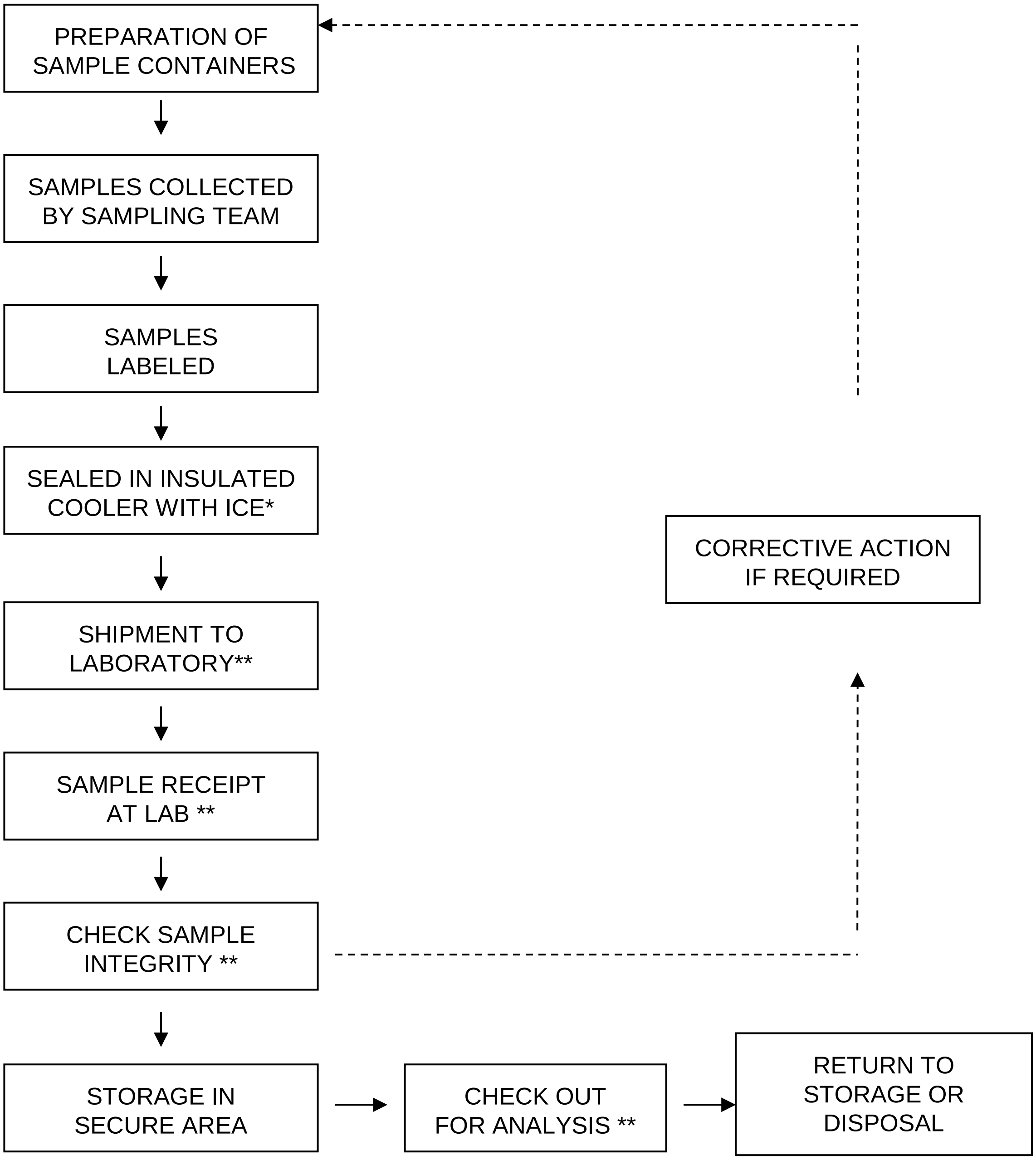
preservatives) will be recorded on the form. All entries will be made in waterproof, permanent blue or black ink.

- 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 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 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.

If soil and/or groundwater samples are collected, sample coolers will be accompanied by the chain-of-custody form, sealed in a Ziploc® bag (or equivalent) and placed on top of the samples or taped to the inside of the cooler lid. If applicable, a shipping bill will be completed for each cooler and the shipping bill number recorded on the chain-of-custody form.

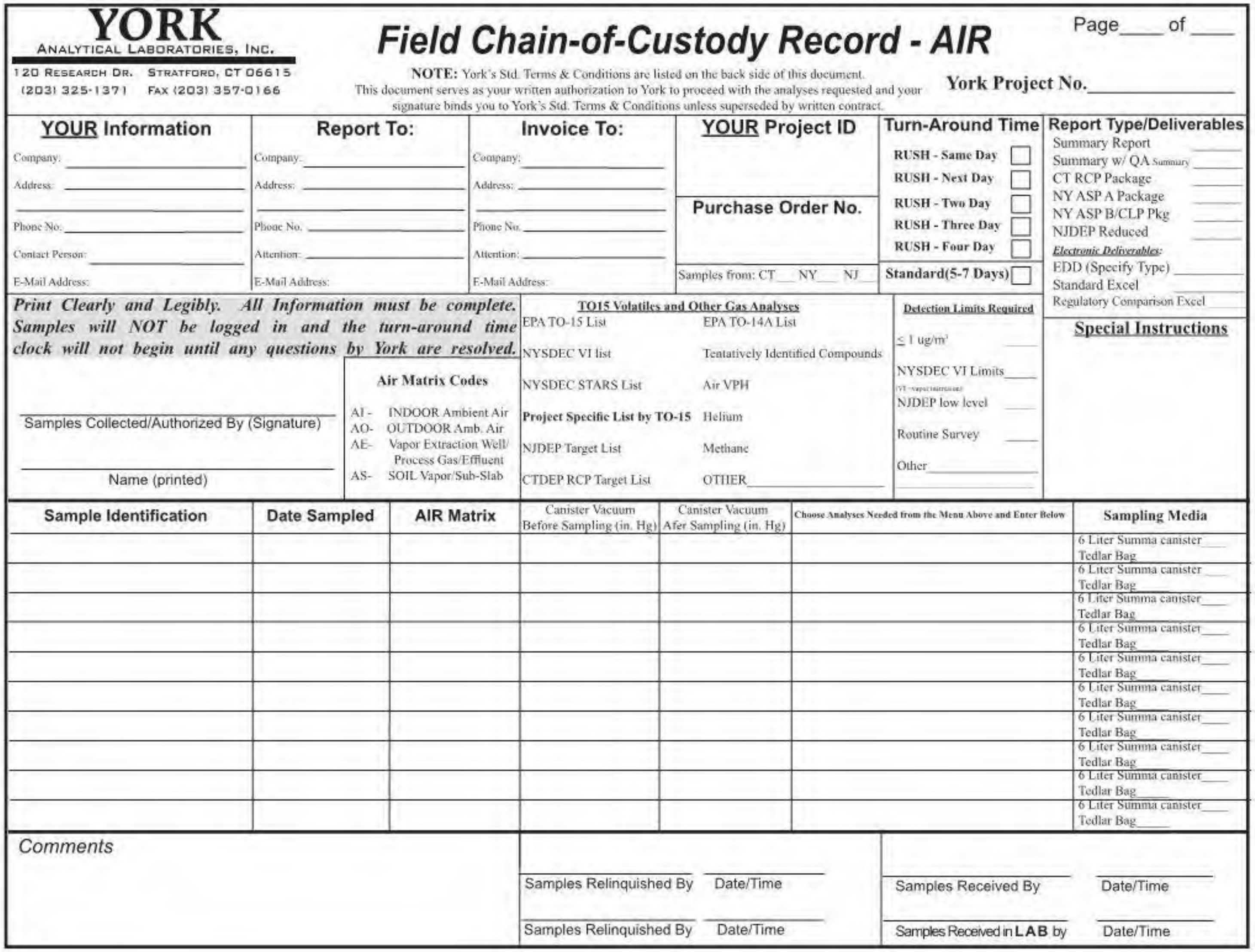
Samples will be packaged for shipment to the laboratory with the appropriate chain-of-custody form. A copy of the form will be retained by the sampling team for the project file and the original will be sent to the laboratory with the samples. Bills of lading will also be retained as part of the documentation 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. A flow chart showing a sample custody process is included as Figure 5.1, and chain-of-custody forms from York are included as Figures 5.2 and 5.3.

Figure 5.1 Sample Custody



*SUMMA CANISTERS SHOULD NOT BE ICED
** REQUIRES SIGN-OFF ON CHAIN-OF-CUSTODY FORM

Figure 5.2 Sample Chain-of-Custody Form – Air Sample



YORK
ANALYTICAL LABORATORIES, INC.
120 RESEARCH DR. STRATFORD, CT 06615
(203) 325-1371 FAX (203) 357-0166

Field Chain-of-Custody Record - AIR

Page____ of ____

NOTE: York's Std. Terms & Conditions are listed on the back side of this document. This document serves as your written authorization to York to proceed with the analyses requested and your signature binds you to York's Std. Terms & Conditions unless superseded by written contract.

York Project No._______________

YOUR Information
Company: ______________
Address: ______________
____
Phone No: ______________
Contact Person: ______________
E-Mail Address:

Report To:
Company: ______________
Address: ______________
____
Phone No. ______________
Attention: ______________
E-Mail Address:

Invoice To:
Company: ______________
Address: ______________
____
Phone No. ______________
Attention: ______________
E-Mail Address:

YOUR Project ID

Purchase Order No.

Samples from: CT___ NY___ NJ___

Turn-Around Time
RUSH - Same Day ☐
RUSH - Next Day ☐
RUSH - Two Day ☐
RUSH - Three Day ☐
RUSH - Four Day ☐
Standard(5-7 Days) ☐

Report Type/Deliverables
Summary Report ______
Summary w/ QA Summary ______
CT RCP Package ______
NY ASP A Package ______
NY ASP B/CLP Pkg ______
NJDEP Reduced ______
Electronic Deliverables:
EDD (Specify Type) ______
Standard Excel ______
Regulatory Comparison Excel ______

Special Instructions

Print Clearly and Legibly. All Information must be complete. Samples will NOT be logged in and the turn-around time clock will not begin until any questions by York are resolved.

____
Samples Collected/Authorized By (Signature)

____
Name (printed)

Air Matrix Codes
AI - INDOOR Ambient Air
AO- OUTDOOR Amb. Air
AE- Vapor Extraction Well/ Process Gas/Effluent
AS- SOIL Vapor/Sub-Slab

TO15 Volatiles and Other Gas Analyses

EPA TO-15 List	EPA TO-14A List
NYSDEC VI list	Tentatively Identified Compounds
NYSDEC STARS List	Air VPH
Project Specific List by TO-15	Helium
NJDEP Target List	Methane
CTDEP RCP Target List	OTHER______________

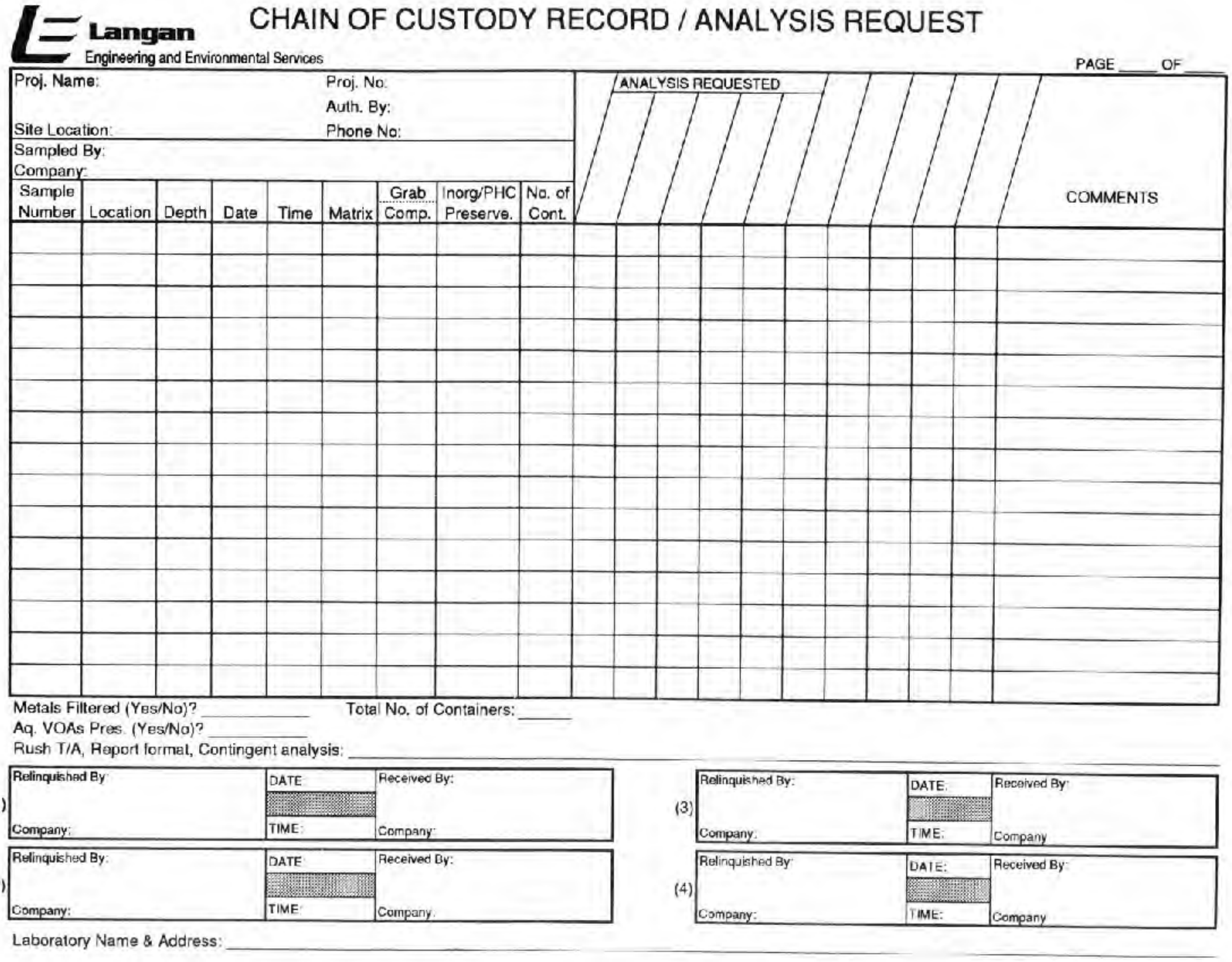
Detection Limits Required
$\leq$ 1 ug/m³ ______
NYSDEC VI Limits______
(VI - vapor intrusion)
NJDEP low level ______
Routine Survey ______
Other______________

Sample Identification	Date Sampled	AIR Matrix	Canister Vacuum Before Sampling (in. Hg)	Canister Vacuum Afer Sampling (in. Hg)	Choose Analyses Needed from the Menu Above and Enter Below	Sampling Media
						6 Liter Summa canister___ Tedlar Bag___
						6 Liter Summa canister___ Tedlar Bag___
						6 Liter Summa canister___ Tedlar Bag___
						6 Liter Summa canister___ Tedlar Bag___
						6 Liter Summa canister___ Tedlar Bag___
						6 Liter Summa canister___ Tedlar Bag___
						6 Liter Summa canister___ Tedlar Bag___
						6 Liter Summa canister___ Tedlar Bag___
						6 Liter Summa canister___ Tedlar Bag___
						6 Liter Summa canister___ Tedlar Bag___

Comments

Samples Relinquished By ______ Date/Time ______
Samples Relinquished By ______ Date/Time ______
Samples Received By ______ Date/Time ______
Samples Received in **LAB** by ______ Date/Time ______

Figure 5.3 Sample Chain-of-Custody Form – Soil and Groundwater



Langan
Engineering and Environmental Services

CHAIN OF CUSTODY RECORD / ANALYSIS REQUEST

PAGE ____ OF ____

Proj. Name:
Proj. No:
Auth. By:
Site Location:
Phone No:
Sampled By:
Company:

Sample Number	Location	Depth	Date	Time	Matrix	Grab Comp.	Inorg/PHC Preserve.	No. of Cont.	ANALYSIS REQUESTED										COMMENTS

Metals Filtered (Yes/No)? __________ Total No. of Containers: _____
Aq. VOAs Pres. (Yes/No)? __________
Rush T/A, Report format, Contingent analysis: ______________

(1)	Relinquished By: Company:	DATE: TIME:	Received By: Company:
(2)	Relinquished By: Company:	DATE: TIME:	Received By: Company:
(3)	Relinquished By: Company:	DATE: TIME:	Received By: Company
(4)	Relinquished By: Company:	DATE: TIME:	Received By: Company

Laboratory Name & Address: ______________

Laboratory chains-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, the environmental consultant 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 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. Samples for VOCs will be maintained in satellite storage areas within the VOC laboratory. 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. 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 ASCII format from the laboratory information management system (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% 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;
- 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 12.1 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

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 REEFERENCES

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.

Attachment A

Résumés

Emily G. Strake

Project Chemist/ Risk Assessor
Human Health Risk Assessment
Chemical Data Validation

15 years in the industry ~ 2 years with Langan

Ms. Strake has fifteen 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, SWRCB, DTSC, DNREC, PADEP, NJDEP, 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 over nine years of experience assessing potential adverse health effect to humans from exposure to hazardous contaminants in soil, sediment, groundwater, surface water, ambient and indoor air, and various types of animal, fish, and plant materials. She understands and applies environmental cleanup guidance and policies associated with multiple federal and state agencies. Additionally, she has broad experience in the development of preliminary remediation goals and site-specific action levels. She is proficient with the USEPA and Cal/EPA Johnson and Ettinger Model for Subsurface Vapor Intrusion into Buildings, USEPA's Adult Lead Methodology, DTSC's Leadspread 7 and 8, and statistical evaluation of data using USEPA's ProUCL software.

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.

Ms. Strake has several years' experience analyzing investigative samples, writing laboratory Standard Operating Procedures (SOPs), and managing all

Education

M.B.A., Business Administration
The University of Scranton

B.S., Chemistry
Cedar Crest College

Memberships

Interstate Technology and Regulatory Council

Society for Risk Analysis

Training

Candidate, Certified Industrial Environmental Toxicologist. National Registry of Environmental Professionals.

40 hr. OSHA HAZWOPER Training/Nov 2002

8 hr. HAZWOPER Supervisor/June 2004

8 hr. OSHA HAZWOPER Refresher/Oct 2012

American Red Cross First Aid & CPR certified

Publications/Presentations

Decision Making at Contaminated Sites: Issues and Options in Human Health Risk Assessment. Interstate Technology and Regulatory Council

Alternate Approaches for Act 2 Risk Assessments Using Site-Specific Information. Pennsylvania Brownfields Conference

Tools from NJDEP's Attainment Guidance to Support Site Closure
LSRP Summit V

EPA Region IX Vapor Intrusion Policy for Silicon Valley
2014 Environmental Workshop

aspects of procedures and analyses for Optical Emission Spectrometry, X-Ray Fluorescence, Ignition analysis, and Atomic Absorption. Her experience also includes operating and performing routine instrument maintenance for GC/MS and IR. Ms. Strake has worked extensively on developing rapid soil characterization programs for PCB and pesticide analyses utilizing enzyme-linked immunosorbent assays, and was also involved in efforts to develop new instrumentation to quantify microbial nitrification of ammonium.

Selected Project Experience

Human Health Risk Assessment

- Major League Soccer's San Jose Earthquakes Stadium – Utilized the Johnson and Ettinger advanced soil gas model to calculate risk and hazard associated with inhalation of chlorinated solvents for the redevelopment of a public soccer stadium. Soil gas data was modeled assuming three soil stratum and site-specific soil, building, and exposure parameters. The Earthquakes' stadium is set to open in 2015.
- Exelon - Developed a human health risk assessment for a utility-owned former Manufactured Gas Plant (MGP) site in Pennsylvania, under Pennsylvania's Act 2 Program. Used ProUCL 4.0 statistical software to determine upper limits for full data sets and non-detect data. Conducted vapor intrusion modeling (via the Johnson & Ettinger model) and prepared vapor intrusion reports showing that risks to volatile organic compounds in soils and groundwater were not impacting indoor air quality.
- Texas Instruments – Participated in a collaboration with Robert Ettinger and Geosyntec Consulting to develop comments to USEPA Region IX and the San Francisco Regional Water Quality Control Board regarding vapor intrusion at South Bay Superfund Sites. The focus of the response was to outline scientific and policy objections to EPA's recommended TCE interim short-term indoor air response action levels and guidelines, and to clarify the use of California-modified indoor air screening levels for assessing and responding to TCE and PCE subsurface vapor intrusion into indoor air.
- DuPont - Worked as a key participant in the human health risk evaluation of mercury associated with legacy contamination of the South River located in Waynesboro, Virginia.
- Veteran's Affairs - Completed a human health risk evaluation of the potential future risk associated with inhalation of indoor air for the Veteran's Administration. Soil, soil gas, and groundwater samples were collected as part of the site characterization. Achieved DTSC approval of the risk assessment approach and conclusions.
- Santa Clara Landfill – Developed a human health risk assessment to characterize risk associated with exposure to landfill gas at the Santa Clara All Purpose Landfill. The risk assessment evaluated specific compounds in landfill gas, their concentrations, spatial patterns, and extent throughout the site, and assessed the potential for vapor intrusion associated with a proposed future redevelopment.
- Avon - Completed a human health risk assessment in accordance with NYSDEC guidance for a redevelopment property located in Rye, New York. The objective of the evaluation was to characterize the risks associated with potential future human

exposures to soil and groundwater affected by a release from the Site's former No. 2 fuel oil UST. The intended future use of the Site was a playground to be utilized by the general public for open play on commercial recreational equipment.

- Golden Gate National Parks Conservancy – Peer reviewed a Preliminary Endangerment Assessment Report for the Battery East Trail. The assessment included a human health risk evaluation that estimated carcinogenic risk from exposure to PAHs and dioxin/furans in soil using toxic equivalency to benzo(a)pyrene and 2,3,7,8-TCDD.
- Sunoco Refineries – Derived site-specific soil PRGs for lead using the EPA's adult lead model for two former Sunoco refineries. Completed receptor evaluations in accordance with USEPA risk assessment guidance to develop exposure parameters under current and reasonably anticipated future land use scenarios.
- Honeywell - Completed a focused human health risk evaluation of PAH contaminants for under NJDEP's Site Remediation Program. Applied a blended approach of qualitative risk characterization and quantitative risk calculation to propose closure of AOCs following the remedial investigation.
- Delaware City Refinery - Performed comprehensive human health risk assessment for a petroleum refinery in Delaware City, Delaware. The risk assessment was the basis for a thorough characterization and assessment of potential risks posed by site-specific conditions. Developed various human exposure scenarios by using both Federal and State-Specific guidance for soil, groundwater, and surface water exposure.
- Occidental Chemical - Completed multiple AOC-specific risk assessments utilizing and applying the guidance set forth by the DTSC's Human Health Risk Assessment Note 1 (Default Exposure Factors for Use in Risk Assessment), Note 3 (Recommended Methodology for Use of USEPA Regional Screening Levels, and Note 4 (Screening Level Human Health Risk Assessments).
- Floreffe Terminal - Performed human health risk assessment for contamination resulting from a 3.9 million gallon diesel oil tank collapse along the Monongahela River. Evaluated potential impacts to human health via exposure to soil, groundwater, and surface water. Calculated site-specific standards for soil remediation.
- DOW Chemical - Calculated Medium Specific Concentrations (MSCs) for unregulated contaminants using the PADEP protocols to assist in the clean-up of a monomer tank explosion in Bristol, Pennsylvania. Selected appropriate surrogate toxicity data and evaluated novel on-site constituents by analogy.
- Ryder – Developed Alternative Direct Exposure Criteria for PAH-impacted fill material at a commercial facility. Site-specific soil screening levels for incidental ingestion of soil were calculated following a forward risk evaluation for current on-site receptors.
- Rohm and Haas - Prepared an Act 2 site-specific human health risk assessment for the oldest industrial facility in the United States, located in southeast Philadelphia. The objective of the risk assessment was to determine achievable possible future land-use options under Pennsylvania's Land Recycling Program. The risk assessment included evolution of multiple site-COPCs and constituent suites: VOCs, SVOCs, PCBs, pesticides, and metals

(including lead). Evaluated the potential for indoor air inhalation through J&E modeling of soil gas and groundwater.

- Regency - Conducted vapor intrusion modeling for a dry cleaning facility in the Philadelphia area. Predictive modeling using the Johnson and Ettinger approach indicated that estimated contaminant levels would not adversely affect human receptors.

Chemical Data Quality

- Audited multiple accredited laboratories in New Jersey and Pennsylvania on behalf of clients using USEPA Guidance on Technical Audits and Related Assessments for Environmental Data Operations. The audits included full-suite USEPA and SW-846 methodology; and included reviewing staff experience and training records, equipment and facilities, policies, practices, procedures, and documentation for sample receipt, analysis, instrument maintenance, standard preparation, calibration and traceability, control charting, corrective actions, data reduction and review, report generation, and waste disposal.
- Reviewed and validated data packages for RCRA Facilities Investigation at a Philadelphia-area chemical site; issued data validation reports to project personnel and regulatory agencies. The reviews included evaluation of quarterly groundwater, soil, and soil vapor matrices. Participated in RCRA groundwater sampling, developed and executed the investigation’s QAPP, and coordinated with the laboratory to schedule and perform field-sampling events.
- Completed Data Usability Summary Reports in accordance with NYSDEC DER-10 guidance for soil, groundwater, sediment surface water, soil gas, ambient air and indoor air analytical results.
- Acted as the Quality Assurance Officer for several long-term projects in Pennsylvania, Maryland, and New Jersey, Delaware, responsible for the achievement of all forms of QA/QC as it related to sampling, analysis, and data evaluation.
- Participated in a CERCLA site investigation; assessed the usability of sample results for numerous matrices including dust, sediment, soils, and various aqueous matrices for a remedial investigation under the Contract Laboratory Program. Implemented an on-site pesticide immunoassay program to delineate soil contamination in real-time.
- EQuIS data manager for database migration of historical groundwater results associated with remediation activities; assisted with natural attenuation data evaluation and gained experience in geochemical trends associated with intrinsic biodegradation.
- Coordinated the collection of fish tissue samples and determined the validity of the analytical results associated with CERCLA and RCRA site characterizations. Assessed duck blood analytical results for the Connecticut Department of Energy and Environmental Protection Bureau of Natural Resources.

Attachment B

Laboratory Reporting Limits and Method Detection Limits

Method	Matrix	Analyte	MDL	RL	Units
VOC					
EPA 8260C	Water	1,1,1,2-Tetrachloroethane	0.2	0.5	ug/L
EPA 8260C	Water	1,1,1-Trichloroethane	0.2	0.5	ug/L
EPA 8260C	Water	1,1,2,2-Tetrachloroethane	0.2	0.5	ug/L
EPA 8260C	Water	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	0.2	0.5	ug/L
EPA 8260C	Water	1,1,2-Trichloroethane	0.2	0.5	ug/L
EPA 8260C	Water	1,1-Dichloroethane	0.2	0.5	ug/L
EPA 8260C	Water	1,1-Dichloroethylene	0.2	0.5	ug/L
EPA 8260C	Water	Bromochloromethane	0.2	0.5	ug/L
EPA 8260C	Water	1,2,3-Trichloropropane	0.2	0.5	ug/L
EPA 8260C	Water	1,2,4-Trichlorobenzene	0.2	0.5	ug/L
EPA 8260C	Water	1,2,4-Trimethylbenzene	0.2	0.5	ug/L
EPA 8260C	Water	1,2-Dibromo-3-chloropropane	0.2	0.5	ug/L
EPA 8260C	Water	1,2-Dibromoethane	0.2	0.5	ug/L
EPA 8260C	Water	1,2-Dichlorobenzene	0.2	0.5	ug/L
EPA 8260C	Water	1,2-Dichloroethane	0.2	0.5	ug/L
EPA 8260C	Water	1,2-Dichloropropane	0.2	0.5	ug/L
EPA 8260C	Water	1,3,5-Trimethylbenzene	0.2	0.5	ug/L
EPA 8260C	Water	1,3-Dichlorobenzene	0.2	0.5	ug/L
EPA 8260C	Water	1,4-Dichlorobenzene	0.2	0.5	ug/L
EPA 8260C	Water	1,4-Dioxane	40	80	ug/L
EPA 8260C	Water	Cyclohexane	0.2	0.5	ug/L
EPA 8260C	Water	2-Butanone	0.2	0.5	ug/L
EPA 8260C	Water	2-Hexanone	0.2	0.5	ug/L
EPA 8260C	Water	4-Methyl-2-pentanone	0.2	0.5	ug/L
EPA 8260C	Water	Acetone	1	2	ug/L
EPA 8260C	Water	Acrolein	0.2	0.5	ug/L
EPA 8260C	Water	Acrylonitrile	0.2	0.5	ug/L
EPA 8260C	Water	Benzene	0.2	0.5	ug/L
EPA 8260C	Water	Bromodichloromethane	0.2	0.5	ug/L
Method	**Matrix**	**Analyte**	**MDL**	**RL**	**Units**
VOC					
EPA 8260C	Water	Bromoform	0.2	0.5	ug/L
EPA 8260C	Water	Bromomethane	0.2	0.5	ug/L
EPA 8260C	Water	Carbon disulfide	0.2	0.5	ug/L
EPA 8260C	Water	Carbon tetrachloride	0.2	0.5	ug/L
EPA 8260C	Water	Chlorobenzene	0.2	0.5	ug/L
EPA 8260C	Water	Chloroethane	0.2	0.5	ug/L
EPA 8260C	Water	Chloroform	0.2	0.5	ug/L
EPA 8260C	Water	Chloromethane	0.2	0.5	ug/L
EPA 8260C	Water	cis-1,2-Dichloroethylene	0.2	0.5	ug/L
EPA 8260C	Water	cis-1,3-Dichloropropylene	0.2	0.5	ug/L
EPA 8260C	Water	Dibromochloromethane	0.2	0.5	ug/L
EPA 8260C	Water	Dibromomethane	0.2	0.5	ug/L
EPA 8260C	Water	Dichlorodifluoromethane	0.2	0.5	ug/L
EPA 8260C	Water	Naphthalene	1	2	ug/L
EPA 8260C	Water	Ethyl Benzene	0.2	0.5	ug/L
EPA 8260C	Water	Methylcyclohexane	0.2	0.5	ug/L
EPA 8260C	Water	Hexachlorobutadiene	0.2	0.5	ug/L
EPA 8260C	Water	Isopropylbenzene	0.2	0.5	ug/L
EPA 8260C	Water	Methyl acetate	0.2	0.5	ug/L
EPA 8260C	Water	Methyl tert-butyl ether (MTBE)	0.2	0.5	ug/L
EPA 8260C	Water	Methylene chloride	1	2	ug/L
EPA 8260C	Water	n-Butylbenzene	0.2	0.5	ug/L
EPA 8260C	Water	n-Propylbenzene	0.2	0.5	ug/L
EPA 8260C	Water	o-Xylene	0.2	0.5	ug/L
EPA 8260C	Water	p- & m- Xylenes	0.5	1	ug/L
EPA 8260C	Water	1,2,3-Trichlorobenzene	0.2	0.5	ug/L
EPA 8260C	Water	p-Isopropyltoluene	0.2	0.5	ug/L
EPA 8260C	Water	sec-Butylbenzene	0.2	0.5	ug/L
EPA 8260C	Water	Styrene	0.2	0.5	ug/L
Method	**Matrix**	**Analyte**	**MDL**	**RL**	**Units**

APPENDIX B
LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS

VOC					
EPA 8260C	Water	tert-Butyl alcohol (TBA)	0.5	1	ug/L
EPA 8260C	Water	tert-Butylbenzene	0.2	0.5	ug/L
EPA 8260C	Water	Tetrachloroethylene	0.2	0.5	ug/L
EPA 8260C	Water	Toluene	0.2	0.5	ug/L
EPA 8260C	Water	trans-1,2-Dichloroethylene	0.2	0.5	ug/L
EPA 8260C	Water	trans-1,3-Dichloropropylene	0.2	0.5	ug/L
EPA 8260C	Water	Trichloroethylene	0.2	0.5	ug/L
EPA 8260C	Water	Trichlorofluoromethane	0.2	0.5	ug/L
EPA 8260C	Water	Vinyl Chloride	0.2	0.5	ug/L
EPA 8260C	Water	Xylenes, Total	0.6	1.5	ug/L

Method	Matrix	Analyte	MDL	RL	Units
SVOC					
EPA 8270D	Water	Acenaphthene	0.05	0.05	ug/L
EPA 8270D	Water	Acenaphthylene	0.05	0.05	ug/L
EPA 8270D	Water	Acetophenone	2.5	5	ug/L
EPA 8270D	Water	Aniline	2.5	5	ug/L
EPA 8270D	Water	Anthracene	0.05	0.05	ug/L
EPA 8270D	Water	Atrazine	0.5	0.5	ug/L
EPA 8270D	Water	Benzaldehyde	2.5	5	ug/L
EPA 8270D	Water	Benzidine	10	20	ug/L
EPA 8270D	Water	Benzo(a)anthracene	0.05	0.05	ug/L
EPA 8270D	Water	Benzo(a)pyrene	0.05	0.05	ug/L
EPA 8270D	Water	Benzo(b)fluoranthene	0.05	0.05	ug/L
EPA 8270D	Water	Benzo(g,h,i)perylene	0.05	0.05	ug/L
EPA 8270D	Water	Benzoic acid	25	50	ug/L
EPA 8270D	Water	Benzo(k)fluoranthene	0.05	0.05	ug/L
EPA 8270D	Water	Benzyl alcohol	2.5	5	ug/L
EPA 8270D	Water	Benzyl butyl phthalate	2.5	5	ug/L
EPA 8270D	Water	1,1'-Biphenyl	2.5	5	ug/L
EPA 8270D	Water	4-Bromophenyl phenyl ether	2.5	5	ug/L
EPA 8270D	Water	Caprolactam	2.5	5	ug/L
EPA 8270D	Water	Carbazole	2.5	5	ug/L
EPA 8270D	Water	4-Chloro-3-methylphenol	2.5	5	ug/L
EPA 8270D	Water	4-Chloroaniline	2.5	5	ug/L
EPA 8270D	Water	Bis(2-chloroethoxy)methane	2.5	5	ug/L
EPA 8270D	Water	Bis(2-chloroethyl)ether	2.5	5	ug/L
EPA 8270D	Water	Bis(2-chloroisopropyl)ether	2.5	5	ug/L
EPA 8270D	Water	2-Chloronaphthalene	2.5	5	ug/L
EPA 8270D	Water	2-Chlorophenol	2.5	5	ug/L
EPA 8270D	Water	4-Chlorophenyl phenyl ether	2.5	5	ug/L
EPA 8270D	Water	Chrysene	0.05	0.05	ug/L
Method	**Matrix**	**Analyte**	**MDL**	**RL**	**Units**
SVOC					
EPA 8270D	Water	Dibenzo(a,h)anthracene	0.05	0.05	ug/L
EPA 8270D	Water	Dibenzofuran	2.5	5	ug/L
EPA 8270D	Water	Di-n-butyl phthalate	2.5	5	ug/L
EPA 8270D	Water	1,4-Dichlorobenzene	2.5	5	ug/L
EPA 8270D	Water	1,2-Dichlorobenzene	2.5	5	ug/L
EPA 8270D	Water	1,3-Dichlorobenzene	2.5	5	ug/L
EPA 8270D	Water	3,3'-Dichlorobenzidine	2.5	5	ug/L
EPA 8270D	Water	2,4-Dichlorophenol	2.5	5	ug/L
EPA 8270D	Water	Diethyl phthalate	2.5	5	ug/L
EPA 8270D	Water	2,4-Dimethylphenol	2.5	5	ug/L
EPA 8270D	Water	Dimethyl phthalate	2.5	5	ug/L
EPA 8270D	Water	4,6-Dinitro-2-methylphenol	2.5	5	ug/L
EPA 8270D	Water	2,4-Dinitrophenol	2.5	5	ug/L
EPA 8270D	Water	2,4-Dinitrotoluene	2.5	5	ug/L
EPA 8270D	Water	2,6-Dinitrotoluene	2.5	5	ug/L
EPA 8270D	Water	Di-n-octyl phthalate	2.5	5	ug/L
EPA 8270D	Water	1,2-Diphenylhydrazine (as Azobenzene)	2.5	5	ug/L
EPA 8270D	Water	Bis(2-ethylhexyl)phthalate	0.5	0.5	ug/L
EPA 8270D	Water	Fluoranthene	0.05	0.05	ug/L
EPA 8270D	Water	Fluorene	0.05	0.05	ug/L
EPA 8270D	Water	Hexachlorobenzene	0.02	0.02	ug/L
EPA 8270D	Water	Hexachlorobutadiene	0.5	0.5	ug/L
EPA 8270D	Water	Hexachlorocyclopentadiene	2.5	5	ug/L
EPA 8270D	Water	Hexachloroethane	0.5	0.5	ug/L
EPA 8270D	Water	Indeno(1,2,3-cd)pyrene	0.05	0.05	ug/L
EPA 8270D	Water	Isophorone	2.5	5	ug/L
EPA 8270D	Water	2-Methylnaphthalene	2.5	5	ug/L
EPA 8270D	Water	2-Methylphenol	2.5	5	ug/L
EPA 8270D	Water	3- & 4-Methylphenols	2.5	5	ug/L

APPENDIX B
LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS

Method	Matrix	Analyte	MDL	RL	Units
SVOC					
EPA 8270D	Water	Naphthalene	0.05	0.05	ug/L
EPA 8270D	Water	3-Nitroaniline	2.5	5	ug/L
EPA 8270D	Water	4-Nitroaniline	2.5	5	ug/L
EPA 8270D	Water	2-Nitroaniline	2.5	5	ug/L
EPA 8270D	Water	Nitrobenzene	0.25	0.25	ug/L
EPA 8270D	Water	4-Nitrophenol	2.5	5	ug/L
EPA 8270D	Water	2-Nitrophenol	2.5	5	ug/L
EPA 8270D	Water	N-nitroso-di-n-propylamine	2.5	5	ug/L
EPA 8270D	Water	N-Nitrosodimethylamine	0.5	0.5	ug/L
EPA 8270D	Water	N-Nitrosodiphenylamine	2.5	5	ug/L
EPA 8270D	Water	Pentachlorophenol	0.25	0.25	ug/L
EPA 8270D	Water	Phenanthrene	0.05	0.05	ug/L
EPA 8270D	Water	Phenol	2.5	5	ug/L
EPA 8270D	Water	Pyrene	0.05	0.05	ug/L
EPA 8270D	Water	Pyridine	2.5	5	ug/L
EPA 8270D	Water	1,2,4,5-Tetrachlorobenzene	2.5	5	ug/L
EPA 8270D	Water	2,3,4,6-Tetrachlorophenol	2.5	5	ug/L
EPA 8270D	Water	1,2,4-Trichlorobenzene	2.5	5	ug/L
EPA 8270D	Water	2,4,6-Trichlorophenol	2.5	5	ug/L
EPA 8270D	Water	2,4,5-Trichlorophenol	2.5	5	ug/L

Method	Matrix	Analyte	MDL	RL	Units
Pesticides					
EPA 8081B	Water	Aldrin	0.004	0.004	ug/L
EPA 8081B	Water	alpha-BHC	0.004	0.004	ug/L
EPA 8081B	Water	beta-BHC	0.004	0.004	ug/L
EPA 8081B	Water	delta-BHC	0.004	0.004	ug/L
EPA 8081B	Water	gamma-BHC (Lindane)	0.004	0.004	ug/L
EPA 8081B	Water	gamma-Chlordane	0.01	0.01	ug/L
EPA 8081B	Water	alpha-Chlordane	0.004	0.004	ug/L
EPA 8081B	Water	Chlordane, total	0.04	0.04	ug/L
EPA 8081B	Water	4,4'-DDD	0.004	0.004	ug/L
EPA 8081B	Water	4,4'-DDE	0.004	0.004	ug/L
EPA 8081B	Water	4,4'-DDT	0.004	0.004	ug/L
EPA 8081B	Water	Dieldrin	0.002	0.002	ug/L
EPA 8081B	Water	Endosulfan I	0.004	0.004	ug/L
EPA 8081B	Water	Endosulfan II	0.004	0.004	ug/L
EPA 8081B	Water	Endosulfan sulfate	0.004	0.004	ug/L
EPA 8081B	Water	Endrin	0.004	0.004	ug/L
EPA 8081B	Water	Endrin aldehyde	0.01	0.01	ug/L
EPA 8081B	Water	Endrin ketone	0.01	0.01	ug/L
EPA 8081B	Water	Heptachlor	0.004	0.004	ug/L
EPA 8081B	Water	Heptachlor epoxide	0.004	0.004	ug/L
EPA 8081B	Water	Methoxychlor	0.004	0.004	ug/L
EPA 8081B	Water	Toxaphene	0.1	0.1	ug/L

Method	Matrix	Analyte	MDL	RL	Units
PCBs					
EPA 8082A	Water	Aroclor 1016	0.05	0.05	ug/L
EPA 8082A	Water	Aroclor 1221	0.05	0.05	ug/L
EPA 8082A	Water	Aroclor 1232	0.05	0.05	ug/L
EPA 8082A	Water	Aroclor 1242	0.05	0.05	ug/L
EPA 8082A	Water	Aroclor 1248	0.05	0.05	ug/L
EPA 8082A	Water	Aroclor 1254	0.05	0.05	ug/L
EPA 8082A	Water	Aroclor 1260	0.05	0.05	ug/L
EPA 8082A	Water	Aroclor 1262	0.05	0.05	ug/L
EPA 8082A	Water	Aroclor 1268	0.05	0.05	ug/L
EPA 8082A	Water	Total PCBs	0.05	0.05	ug/L

Method	Matrix	Analyte	MDL	RL	Units
Herbicides					
EPA 8151A	Water	2,4-D	5	5	ug/L
EPA 8151A	Water	2,4,5-TP (Silvex)	5	5	ug/L
EPA 8151A	Water	2,4,5-T	5	5	ug/L

APPENDIX B
LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS

Method	Matrix	Analyte	MDL	RL	Units
Metals					
EPA 6010C	Water	Aluminum	0.01	0.01	mg/L
EPA 6010C	Water	Antimony	0.005	0.005	mg/L
EPA 6010C	Water	Arsenic	0.004	0.004	mg/L
EPA 6010C	Water	Barium	0.01	0.01	mg/L
EPA 6010C	Water	Beryllium	0.001	0.001	mg/L
EPA 6010C	Water	Cadmium	0.003	0.003	mg/L
EPA 6010C	Water	Calcium	0.05	0.05	mg/L
EPA 6010C	Water	Chromium	0.005	0.005	mg/L
EPA 6010C	Water	Cobalt	0.005	0.005	mg/L
EPA 6010C	Water	Copper	0.003	0.003	mg/L
EPA 6010C	Water	Iron	0.02	0.02	mg/L
EPA 6010C	Water	Lead	0.003	0.003	mg/L
EPA 6010C	Water	Magnesium	0.05	0.05	mg/L
EPA 6010C	Water	Manganese	0.005	0.005	mg/L
EPA 7473	Water	Mercury	0.002	0.002	mg/L
EPA 6010C	Water	Nickel	0.005	0.005	mg/L
EPA 6010C	Water	Potassium	0.05	0.05	mg/L
EPA 6010C	Water	Selenium	0.01	0.01	mg/L
EPA 6010C	Water	Silver	0.005	0.005	mg/L
EPA 6010C	Water	Sodium	0.1	0.1	mg/L
EPA 6010C	Water	Thallium	0.005	0.005	mg/L
EPA 6010C	Water	Vanadium	0.01	0.01	mg/L
EPA 6010C	Water	Zinc	0.01	0.01	mg/L

APPENDIX B
LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS

Method	Matrix	Analyte	MDL	RL	Units
VOC					
EPA 8260C	Soil	1,1,1,2-Tetrachloroethane	2.5	5	ug/kg
EPA 8260C	Soil	1,1,1-Trichloroethane	2.5	5	ug/kg
EPA 8260C	Soil	1,1,2,2-Tetrachloroethane	2.5	5	ug/kg
EPA 8260C	Soil	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	2.5	5	ug/kg
EPA 8260C	Soil	1,1,2-Trichloroethane	2.5	5	ug/kg
EPA 8260C	Soil	1,1-Dichloroethane	2.5	5	ug/kg
EPA 8260C	Soil	1,1-Dichloroethylene	2.5	5	ug/kg
EPA 8260C	Soil	Bromochloromethane	2.5	5	ug/kg
EPA 8260C	Soil	1,2,3-Trichloropropane	2.5	5	ug/kg
EPA 8260C	Soil	1,2,4-Trichlorobenzene	2.5	5	ug/kg
EPA 8260C	Soil	1,2,4-Trimethylbenzene	2.5	5	ug/kg
EPA 8260C	Soil	1,2-Dibromo-3-chloropropane	2.5	5	ug/kg
EPA 8260C	Soil	1,2-Dibromoethane	2.5	5	ug/kg
EPA 8260C	Soil	1,2-Dichlorobenzene	2.5	5	ug/kg
EPA 8260C	Soil	1,2-Dichloroethane	2.5	5	ug/kg
EPA 8260C	Soil	1,2-Dichloropropane	2.5	5	ug/kg
EPA 8260C	Soil	1,3,5-Trimethylbenzene	2.5	5	ug/kg
EPA 8260C	Soil	1,3-Dichlorobenzene	2.5	5	ug/kg
EPA 8260C	Soil	1,4-Dichlorobenzene	2.5	5	ug/kg
EPA 8260C	Soil	1,4-Dioxane	50	100	ug/kg
EPA 8260C	Soil	Cyclohexane	2.5	5	ug/kg
EPA 8260C	Soil	2-Butanone	2.5	5	ug/kg
EPA 8260C	Soil	2-Hexanone	2.5	5	ug/kg
EPA 8260C	Soil	4-Methyl-2-pentanone	2.5	5	ug/kg
EPA 8260C	Soil	Acetone	5	10	ug/kg
EPA 8260C	Soil	Acrolein	5	10	ug/kg
EPA 8260C	Soil	Acrylonitrile	2.5	5	ug/kg
EPA 8260C	Soil	Benzene	2.5	5	ug/kg
EPA 8260C	Soil	Bromodichloromethane	2.5	5	ug/kg
Method	**Matrix**	**Analyte**	**MDL**	**RL**	**Units**
VOC					
EPA 8260C	Soil	Bromoform	2.5	5	ug/kg
EPA 8260C	Soil	Bromomethane	2.5	5	ug/kg
EPA 8260C	Soil	Carbon disulfide	2.5	5	ug/kg
EPA 8260C	Soil	Carbon tetrachloride	2.5	5	ug/kg
EPA 8260C	Soil	Chlorobenzene	2.5	5	ug/kg
EPA 8260C	Soil	Chloroethane	2.5	5	ug/kg
EPA 8260C	Soil	Chloroform	2.5	5	ug/kg
EPA 8260C	Soil	Chloromethane	2.5	5	ug/kg
EPA 8260C	Soil	cis-1,2-Dichloroethylene	2.5	5	ug/kg
EPA 8260C	Soil	cis-1,3-Dichloropropylene	2.5	5	ug/kg
EPA 8260C	Soil	Dibromochloromethane	2.5	5	ug/kg
EPA 8260C	Soil	Dibromomethane	2.5	5	ug/kg
EPA 8260C	Soil	Dichlorodifluoromethane	2.5	5	ug/kg
EPA 8260C	Soil	Naphthalene	2.5	10	ug/kg
EPA 8260C	Soil	Ethyl Benzene	2.5	5	ug/kg
EPA 8260C	Soil	Methylcyclohexane	2.5	5	ug/kg
EPA 8260C	Soil	Hexachlorobutadiene	2.5	5	ug/kg
EPA 8260C	Soil	Isopropylbenzene	2.5	5	ug/kg
EPA 8260C	Soil	Methyl acetate	2.5	5	ug/kg
EPA 8260C	Soil	Methyl tert-butyl ether (MTBE)	2.5	5	ug/kg
EPA 8260C	Soil	Methylene chloride	5	10	ug/kg
EPA 8260C	Soil	n-Butylbenzene	2.5	5	ug/kg
EPA 8260C	Soil	n-Propylbenzene	2.5	5	ug/kg
EPA 8260C	Soil	1,2,3-Trichlorobenzene	2.5	5	ug/kg
EPA 8260C	Soil	o-Xylene	2.5	5	ug/kg
EPA 8260C	Soil	p- & m- Xylenes	5	10	ug/kg
EPA 8260C	Soil	p-Isopropyltoluene	2.5	5	ug/kg
EPA 8260C	Soil	sec-Butylbenzene	2.5	5	ug/kg
EPA 8260C	Soil	Styrene	2.5	5	ug/kg
EPA 8260C	Soil	tert-Butyl alcohol (TBA)	2.5	5	ug/kg

APPENDIX B
LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS

Method	Matrix	Analyte	MDL	RL	Units
VOC					
EPA 8260C	Soil	tert-Butylbenzene	2.5	5	ug/kg
EPA 8260C	Soil	Tetrachloroethylene	2.5	5	ug/kg
EPA 8260C	Soil	Toluene	2.5	5	ug/kg
EPA 8260C	Soil	trans-1,2-Dichloroethylene	2.5	5	ug/kg
EPA 8260C	Soil	trans-1,3-Dichloropropylene	2.5	5	ug/kg
EPA 8260C	Soil	Trichloroethylene	2.5	5	ug/kg
EPA 8260C	Soil	Trichlorofluoromethane	2.5	5	ug/kg
EPA 8260C	Soil	Vinyl Chloride	2.5	5	ug/kg
EPA 8260C	Soil	Xylenes, Total	7.5	15	ug/kg

Method	Matrix	Analyte	MDL	RL	Units
SVOC					
EPA 8270D	Soil	Acenaphthene	20.9	41.7	ug/kg
EPA 8270D	Soil	Acenaphthylene	20.9	41.7	ug/kg
EPA 8270D	Soil	Acetophenone	20.9	41.7	ug/kg
EPA 8270D	Soil	Aniline	83.5	167	ug/kg
EPA 8270D	Soil	Anthracene	20.9	41.7	ug/kg
EPA 8270D	Soil	Atrazine	20.9	41.7	ug/kg
EPA 8270D	Soil	Benzaldehyde	20.9	41.7	ug/kg
EPA 8270D	Soil	Benzidine	83.5	167	ug/kg
EPA 8270D	Soil	Benzo(a)anthracene	20.9	41.7	ug/kg
EPA 8270D	Soil	Benzo(a)pyrene	20.9	41.7	ug/kg
EPA 8270D	Soil	Benzo(b)fluoranthene	20.9	41.7	ug/kg
EPA 8270D	Soil	Benzo(g,h,i)perylene	20.9	41.7	ug/kg
EPA 8270D	Soil	Benzoic acid	20.9	41.7	ug/kg
EPA 8270D	Soil	Benzo(k)fluoranthene	20.9	41.7	ug/kg
EPA 8270D	Soil	Benzyl alcohol	20.9	41.7	ug/kg
EPA 8270D	Soil	Benzyl butyl phthalate	20.9	41.7	ug/kg
EPA 8270D	Soil	1,1'-Biphenyl	20.9	41.7	ug/kg
EPA 8270D	Soil	4-Bromophenyl phenyl ether	20.9	41.7	ug/kg
EPA 8270D	Soil	Caprolactam	41.7	83.3	ug/kg
EPA 8270D	Soil	Carbazole	20.9	41.7	ug/kg
EPA 8270D	Soil	4-Chloro-3-methylphenol	20.9	41.7	ug/kg
EPA 8270D	Soil	4-Chloroaniline	20.9	41.7	ug/kg
EPA 8270D	Soil	Bis(2-chloroethoxy)methane	20.9	41.7	ug/kg
EPA 8270D	Soil	Bis(2-chloroethyl)ether	20.9	41.7	ug/kg
EPA 8270D	Soil	Bis(2-chloroisopropyl)ether	20.9	41.7	ug/kg
EPA 8270D	Soil	2-Chloronaphthalene	20.9	41.7	ug/kg
EPA 8270D	Soil	2-Chlorophenol	20.9	41.7	ug/kg
EPA 8270D	Soil	4-Chlorophenyl phenyl ether	20.9	41.7	ug/kg
EPA 8270D	Soil	Chrysene	20.9	41.7	ug/kg
Method	**Matrix**	**Analyte**	**MDL**	**RL**	**Units**
SVOC					
EPA 8270D	Soil	Dibenzo(a,h)anthracene	20.9	41.7	ug/kg
EPA 8270D	Soil	Dibenzofuran	20.9	41.7	ug/kg
EPA 8270D	Soil	Di-n-butyl phthalate	20.9	41.7	ug/kg
EPA 8270D	Soil	1,2-Dichlorobenzene	20.9	41.7	ug/kg
EPA 8270D	Soil	1,3-Dichlorobenzene	20.9	41.7	ug/kg
EPA 8270D	Soil	1,4-Dichlorobenzene	20.9	41.7	ug/kg
EPA 8270D	Soil	3,3'-Dichlorobenzidine	20.9	41.7	ug/kg
EPA 8270D	Soil	2,4-Dichlorophenol	20.9	41.7	ug/kg
EPA 8270D	Soil	Diethyl phthalate	20.9	41.7	ug/kg
EPA 8270D	Soil	2,4-Dimethylphenol	20.9	41.7	ug/kg
EPA 8270D	Soil	Dimethyl phthalate	20.9	41.7	ug/kg
EPA 8270D	Soil	4,6-Dinitro-2-methylphenol	41.7	83.3	ug/kg
EPA 8270D	Soil	2,4-Dinitrophenol	41.7	83.3	ug/kg
EPA 8270D	Soil	2,4-Dinitrotoluene	20.9	41.7	ug/kg
EPA 8270D	Soil	2,6-Dinitrotoluene	20.9	41.7	ug/kg
EPA 8270D	Soil	Di-n-octyl phthalate	20.9	41.7	ug/kg
EPA 8270D	Soil	1,2-Diphenylhydrazine (as Azobenzene)	20.9	41.7	ug/kg
EPA 8270D	Soil	Bis(2-ethylhexyl)phthalate	20.9	41.7	ug/kg
EPA 8270D	Soil	Fluoranthene	20.9	41.7	ug/kg
EPA 8270D	Soil	Fluorene	20.9	41.7	ug/kg
EPA 8270D	Soil	Hexachlorobenzene	20.9	41.7	ug/kg
EPA 8270D	Soil	Hexachlorobutadiene	20.9	41.7	ug/kg
EPA 8270D	Soil	Hexachlorocyclopentadiene	20.9	41.7	ug/kg
EPA 8270D	Soil	Hexachloroethane	20.9	41.7	ug/kg
EPA 8270D	Soil	Indeno(1,2,3-cd)pyrene	20.9	41.7	ug/kg
EPA 8270D	Soil	Isophorone	20.9	41.7	ug/kg
EPA 8270D	Soil	2-Methylnaphthalene	20.9	41.7	ug/kg
EPA 8270D	Soil	2-Methylphenol	20.9	41.7	ug/kg
EPA 8270D	Soil	3- & 4-Methylphenols	20.9	41.7	ug/kg
Method	**Matrix**	**Analyte**	**MDL**	**RL**	**Units**

SVOC					
EPA 8270D	Soil	Naphthalene	20.9	41.7	ug/kg
EPA 8270D	Soil	4-Nitroaniline	41.7	83.3	ug/kg
EPA 8270D	Soil	2-Nitroaniline	41.7	83.3	ug/kg
EPA 8270D	Soil	3-Nitroaniline	41.7	83.3	ug/kg
EPA 8270D	Soil	Nitrobenzene	20.9	41.7	ug/kg
EPA 8270D	Soil	2-Nitrophenol	20.9	41.7	ug/kg
EPA 8270D	Soil	4-Nitrophenol	41.7	83.3	ug/kg
EPA 8270D	Soil	N-nitroso-di-n-propylamine	20.9	41.7	ug/kg
EPA 8270D	Soil	N-Nitrosodimethylamine	20.9	41.7	ug/kg
EPA 8270D	Soil	N-Nitrosodiphenylamine	20.9	41.7	ug/kg
EPA 8270D	Soil	Pentachlorophenol	20.9	41.7	ug/kg
EPA 8270D	Soil	Phenanthrene	20.9	41.7	ug/kg
EPA 8270D	Soil	Phenol	20.9	41.7	ug/kg
EPA 8270D	Soil	Pyrene	20.9	41.7	ug/kg
EPA 8270D	Soil	Pyridine	83.5	167	ug/kg
EPA 8270D	Soil	1,2,4,5-Tetrachlorobenzene	41.7	83.3	ug/kg
EPA 8270D	Soil	2,3,4,6-Tetrachlorophenol	41.7	83.3	ug/kg
EPA 8270D	Soil	1,2,4-Trichlorobenzene	20.9	41.7	ug/kg
EPA 8270D	Soil	2,4,6-Trichlorophenol	20.9	41.7	ug/kg
EPA 8270D	Soil	2,4,5-Trichlorophenol	20.9	41.7	ug/kg

Method	Matrix	Analyte	MDL	RL	Units
Pesticides					
EPA 8081B	Soil	Aldrin	0.33	0.33	ug/kg
EPA 8081B	Soil	alpha-BHC	0.33	0.33	ug/kg
EPA 8081B	Soil	beta-BHC	0.33	0.33	ug/kg
EPA 8081B	Soil	delta-BHC	0.33	0.33	ug/kg
EPA 8081B	Soil	gamma-BHC (Lindane)	0.33	0.33	ug/kg
EPA 8081B	Soil	gamma-Chlordane	0.33	0.33	ug/kg
EPA 8081B	Soil	alpha-Chlordane	0.33	0.33	ug/kg
EPA 8081B	Soil	Chlordane, total	1.32	1.32	ug/kg
EPA 8081B	Soil	4,4'-DDD	0.33	0.33	ug/kg
EPA 8081B	Soil	4,4'-DDE	0.33	0.33	ug/kg
EPA 8081B	Soil	4,4'-DDT	0.33	0.33	ug/kg
EPA 8081B	Soil	Dieldrin	0.33	0.33	ug/kg
EPA 8081B	Soil	Endosulfan I	0.33	0.33	ug/kg
EPA 8081B	Soil	Endosulfan II	0.33	0.33	ug/kg
EPA 8081B	Soil	Endosulfan sulfate	0.33	0.33	ug/kg
EPA 8081B	Soil	Endrin	0.33	0.33	ug/kg
EPA 8081B	Soil	Endrin aldehyde	0.33	0.33	ug/kg
EPA 8081B	Soil	Endrin ketone	0.33	0.33	ug/kg
EPA 8081B	Soil	Heptachlor	0.33	0.33	ug/kg
EPA 8081B	Soil	Heptachlor epoxide	0.33	0.33	ug/kg
EPA 8081B	Soil	Methoxychlor	1.65	1.65	ug/kg
EPA 8081B	Soil	Toxaphene	16.7	16.7	ug/kg

APPENDIX B
LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS

Method	Matrix	Analyte	MDL	RL	Units
PCBs					
EPA 8082A	Soil	Aroclor 1016	0.0167	0.0167	mg/kg
EPA 8082A	Soil	Aroclor 1221	0.0167	0.0167	mg/kg
EPA 8082A	Soil	Aroclor 1232	0.0167	0.0167	mg/kg
EPA 8082A	Soil	Aroclor 1242	0.0167	0.0167	mg/kg
EPA 8082A	Soil	Aroclor 1248	0.0167	0.0167	mg/kg
EPA 8082A	Soil	Aroclor 1254	0.0167	0.0167	mg/kg
EPA 8082A	Soil	Aroclor 1260	0.0167	0.0167	mg/kg
EPA 8082A	Soil	Aroclor 1262	0.0167	0.0167	mg/kg
EPA 8082A	Soil	Aroclor 1268	0.0167	0.0167	mg/kg
EPA 8082A	Soil	Total PCBs	0.0167	0.0167	mg/kg

Method	Matrix	Analyte	MDL	RL	Units
Herbicides					
EPA 8151A m	Soil	2,4-D	20	20	ug/kg
EPA 8151A m	Soil	2,4,5-TP (Silvex)	20	20	ug/kg
EPA 8151A m	Soil	2,4,5-T	20	20	ug/kg

Method	Matrix	Analyte	MDL	RL	Units
Metals					
EPA 6010C	Soil	Aluminum	1	1	mg/kg
EPA 6010C	Soil	Antimony	0.5	0.5	mg/kg
EPA 6010C	Soil	Arsenic	1	1	mg/kg
EPA 6010C	Soil	Barium	1	1	mg/kg
EPA 6010C	Soil	Beryllium	0.1	0.1	mg/kg
EPA 6010C	Soil	Cadmium	0.3	0.3	mg/kg
EPA 6010C	Soil	Calcium	0.5	5	mg/kg
EPA 6010C	Soil	Chromium	0.5	0.5	mg/kg
EPA 6010C	Soil	Cobalt	0.5	0.5	mg/kg
EPA 6010C	Soil	Copper	0.5	0.5	mg/kg
EPA 6010C	Soil	Iron	2	2	mg/kg
EPA 6010C	Soil	Lead	0.3	0.3	mg/kg
EPA 6010C	Soil	Magnesium	5	5	mg/kg
EPA 6010C	Soil	Manganese	0.5	0.5	mg/kg
EPA 7473	Soil	Mercury	0.03	0.03	mg/kg
EPA 6010C	Soil	Nickel	0.5	0.5	mg/kg
EPA 6010C	Soil	Potassium	5	5	mg/kg
EPA 6010C	Soil	Selenium	1	1	mg/kg
EPA 6010C	Soil	Silver	0.5	0.5	mg/kg
EPA 6010C	Soil	Sodium	10	10	mg/kg
EPA 6010C	Soil	Thallium	1	1	mg/kg
EPA 6010C	Soil	Vanadium	1	1	mg/kg
EPA 6010C	Soil	Zinc	1	1	mg/kg

ATTACHMENT B
LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS

SOIL VAPOR ANALYTE	CASNUMBER	RL	UNITS
1,1,1-Trichloroethane	71-55-6	0.55	ug/m³
1,1,2,2-Tetrachloroethane	79-34-5	0.69	ug/m³
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	76-13-1	0.77	ug/m³
1,1,2-Trichloroethane	79-00-5	0.55	ug/m³
1,1-Dichloroethane	75-34-3	0.40	ug/m³
1,1-Dichloroethylene	75-35-4	0.40	ug/m³
1,2,4-Trichlorobenzene	120-82-1	0.74	ug/m³
1,2,4-Trimethylbenzene	95-63-6	0.49	ug/m³
1,2-Dibromoethane	106-93-4	0.77	ug/m³
1,2-Dichlorobenzene	95-50-1	0.60	ug/m³
1,2-Dichloroethane	107-06-2	0.40	ug/m³
1,2-Dichloropropane	78-87-5	0.46	ug/m³
1,2-Dichlorotetrafluoroethane	76-14-2	0.70	ug/m³
1,3,5-Trimethylbenzene	108-67-8	0.49	ug/m³
1,3-Butadiene	106-99-0	0.43	ug/m³
1,3-Dichlorobenzene	541-73-1	0.60	ug/m³
1,4-Dichlorobenzene	106-46-7	0.60	ug/m³
1,4-Dioxane	123-91-1	0.36	ug/m³
2-Butanone	78-93-3	0.29	ug/m³
2-Hexanone	591-78-6	0.82	ug/m³
4-Methyl-2-pentanone	108-10-1	0.41	ug/m³
Acetone	67-64-1	0.24	ug/m³
Benzene	71-43-2	0.32	ug/m³
Benzyl chloride	100-44-7	0.52	ug/m³
Bromodichloromethane	75-27-4	0.62	ug/m³
Bromoform	75-25-2	1.0	ug/m³
Bromomethane	74-83-9	0.39	ug/m³
Carbon disulfide	75-15-0	0.31	ug/m³
Carbon tetrachloride	56-23-5	0.16	ug/m³
Chlorobenzene	108-90-7	0.46	ug/m³
Chloroethane	75-00-3	0.26	ug/m³
Chloroform	67-66-3	0.49	ug/m³
Chloromethane	74-87-3	0.21	ug/m³
cis-1,2-Dichloroethylene	156-59-2	0.40	ug/m³
cis-1,3-Dichloropropylene	10061-01-5	0.45	ug/m³
Cyclohexane	110-82-7	0.34	ug/m³
Dibromochloromethane	124-48-1	0.80	ug/m³
Dichlorodifluoromethane	75-71-8	0.49	ug/m³
Ethyl acetate	141-78-6	0.72	ug/m³
Ethyl Benzene	100-41-4	0.43	ug/m³
Hexachlorobutadiene	87-68-3	1.1	ug/m³
Isopropanol	67-63-0	0.49	ug/m³
Methyl Methacrylate	80-62-6	0.41	ug/m³
Methyl tert-butyl ether (MTBE)	1634-04-4	0.36	ug/m³
Methylene chloride	75-09-2	0.69	ug/m³
n-Heptane	142-82-5	0.41	ug/m³
n-Hexane	110-54-3	0.35	ug/m³
o-Xylene	95-47-6	0.43	ug/m³
p- & m- Xylenes	179601-23-1	0.87	ug/m³
p-Ethyltoluene	622-96-8	0.49	ug/m³
Propylene	115-07-1	0.17	ug/m³
Styrene	100-42-5	0.43	ug/m³
Tetrachloroethylene	127-18-4	0.17	ug/m³
Tetrahydrofuran	109-99-9	0.29	ug/m³
Toluene	108-88-3	0.38	ug/m³
trans-1,2-Dichloroethylene	156-60-5	0.40	ug/m³
trans-1,3-Dichloropropylene	10061-02-6	0.45	ug/m³
Trichloroethylene	79-01-6	0.13	ug/m³
Trichlorofluoromethane (Freon 11)	75-69-4	0.56	ug/m³
Vinyl acetate	108-05-4	0.35	ug/m³
Vinyl Chloride	75-01-4	0.064	ug/m³

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	Field Duplicate Samples	Equipment Blank Samples	Trip Blank Samples	Ambient Air Samples	MS/MSD Samples
Groundwater	Temperature, Turbidity, pH, ORP, Conductivity	Part 375 + TCL VOCs	EPA 8260C	Cool to 4°C; HCl to pH <2;no headspace	Three 40-mL VOC vials with Teflon®-lined cap	Analyze within 14 days of collection	1 per 20 samples (minimum 1)	1 per 20 samples (minimum 1)	1 per shipment of VOC samples	NA	1 per 20 samples
		Part 375 + TCL SVOCs	EPA 8270D	Cool to 4°C	Two 1-Liter Amber Glass	7 days to extract, 40 days after extraction to analysis					
		Part 375 + TAL Metals	EPA 6010C, EPA 7470	HNO_3	250 ml plastic	6 months, except Mercury 28 days					
		Hexavalent Chromium	EPA 7196A	Cool to 4°C	250 ml plastic	24 hours					
		Cyanide	SM 4500 C/E	NaOH plus 0.6g ascorbic acid	250 ml plastic	14 days					
		Part 375 + TCL Pesticides	EPA 8081B	Cool to 4°C	Two 1-Liter Amber for Pesticides/PCB	7 days to extract, 40 days after extraction to analysis					
		PCBs	EPA 8082A	Cool to 4°C		7 days to extract, 40 days after extraction to analysis					
Soil	Total VOCs via PID	Part 375 + TCL VOCs	EPA 8260C	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	1 per 20 samples (minimum 1)	1 per 20 samples (minimum 1)	1 per shipment of VOC samples	NA	1 per 20 samples
		Part 375 + TCL SVOCs	EPA 8270D	Cool to 4°C	4 oz. jar*	14 days extract, 40 days after extraction to analysis					
		Part 375 + TAL Metals	EPA 6010C, EPA 7470, EPA 7196A, EPA 9014/9010C	Cool to 4°C	2 oz. jar*	6 months, except Mercury 28 days					
		Part 375 + TCL Pesticides	EPA 8081B	Cool to 4°C	4 oz. jar*	14 days extract, 40 days after extraction to analysis					
		Part 375 + TCL PCBs	EPA 8082A	Cool to 4°C	4 oz. jar*	14 days extract, 40 days after extraction to analysis					
Soil Gas	Total VOCs via PID	TO-15 Listed VOCs	TO-15	Ambient Temperature	6-Liter Summa Canister	Analyze within 30 days of collection	1 per 20 samples (minimum 1)	1 per 20 samples (minimum 1)	NA	1 per 10 samples	NA
Indoor Air	Total VOCs via PID	TO-15 Listed VOCs	TO-15	Ambient Temperature	6-Liter Summa Canister	Analyze within 30 days of collection	1 per 20 samples (minimum 1)	1 per 20 samples (minimum 1)	NA	1 per 10 samples	NA

Notes:
*can be combined in one or more 8 oz. jars

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 D
IN-SITU REMEDIATION DESIGN SUMMARY

REGENESIS

Project Info

23-10 QPS
Long Island City, NY, 11101
CVOC plume
Prepared For:
Paul McMahon (Langan)

Target Treatment Zone (TTZ) Info	Unit	Value
Treatment Area	ft^2	13,200
Top Treat Depth	ft	5.0
Bot Treat Depth	ft	18.0
Vertical Treatment Interval	ft	13.0
Treatment Zone Volume	ft^3	171,600
Treatment Zone Volume	cy	6,356
Soil Type	---	sand
Porosity	cm^3/cm^3	0.25
Effective Porosity	cm^3/cm^3	0.20
Treatment Zone Pore Volume	gals	320,914
Treatment Zone Effective Pore Volume	gals	256,731
Fraction Organic Carbon (foc)	g/g	0.002
Soil Density	g/cm^3	1.7
Soil Density	lb/ft^3	108
Soil Weight	lbs	1.9E+07
Hydraulic Conductivity	ft/day	20.0
Hydraulic Conductivity	cm/sec	7.06E-03
Hydraulic Gradient	ft/ft	0.010
GW Velocity	ft/day	1.00
GW Velocity	ft/yr	365

Sources of Hydrogen Demand	Unit	Value
Dissolved Phase Contaminant Mass	lbs	2
Sorbed Phase Contaminant Mass	lbs	7
Competing Electron Acceptor Mass	lbs	241
Total Mass Contributing to H_2 Demand	**lbs**	**250**

Stoichiometric Demand	Unit	Value
Stoichiometric H_2 Demand	lbs	16
Stoichiometric HRC Demand	**lbs**	**721**
Engineering/Safety Factor	--	**1**

Application Dosing	Unit	Value
Plume Stop to be Applied	**lbs**	**33,600**
HRC to be Applied	lbs	3,600
BDI Plus to be Applied	**Liters**	**0**

PlumeStop® Application Design Summary

CVOC plume

Application Method	**Direct Push**
Spacing Within Rows (ft)	13
Spacing Between Rows (ft)	20
Application Points	**53**
Areal Extent (square ft)	13,200
Top Application Depth (ft bgs)	5
Bottom Application Depth (ft bgs)	18
PlumeStop to be Applied (lbs)	**33,600**
PlumeStop per point (lbs)	634
PlumeStop per point (gals)	76
Mixing Water (gal)	**36,251**
Mixing Water (per pt)	684
Total Application Volume (gals)	**40,277**
Injection Volume per Point (gals)	760

Field App Instructions

Anaerobic Bioremediation - HRC

HRC Application Points	53
HRC to be Applied (lbs)	3,600
HRC per point (lbs)	68
Total Application Volume (gals)	332
Injection Volume per Point (gals)	6.3

Bioagumentation - BDI Plus

BDI Plus Application Points	**53**
BDI Plus to be Applied (Liters)	**0**
BDI Plus per point (Liters)	0.0

Technical Notes/Discussion

Prepared By: *Name - Title*
Date: *6/30/2015*

Assumptions/Qualifications

In generating this preliminary estimate, Regenesis relied upon professional judgment and site specific information provided by others. Using this information as input, we performed calculations based upon known chemical and geologic relationships to generate an estimate of the mass of product and subsurface placement required to affect remediation of the site.

PlumeStop™ Colloidal Biomatrix

Securing rapid contaminant reduction and accelerated bioremediation using a dispersive injectable reagent

Jeremy Birnstingl, PhD[a]; Craig Sandefur, MS[b]; Kristen Thoreson, PhD[b]; Stephanie Rittenhouse, BS[b]; Ben Mork, PhD[b]

[a]REGENESIS UK, Bath UK; [b]REGENESIS, San Clemente, CA USA

Executive Summary

PlumeStop™ Colloidal Biomatrix (PlumeStop™) represents a new (patent pending) technology innovation designed to address the challenges of excessive time and end-point uncertainty in groundwater bioremediation. The technology secures rapid groundwater contaminant concentration reduction (days), coupled with accelerated bio-destruction. It is effective on most organic groundwater contaminants including hydrocarbons, halogenated compounds, and a wide variety of volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs).

The technical innovation allows for wide dispersion of a sorptive medium in the aqueous subsurface. The product has a dual function; it sorbs contaminants, quickly removing them from the mobile phase ('PlumeStop'), and provides a high surface area matrix favorable for microbial colonization and growth ('Biomatrix'). Contaminant availability within a risk pathway is therefore reduced while at the same time contaminant destruction is accelerated. The product can be applied in combination with compatible controlled release electron donors/acceptors.

Upon reagent injection, target contaminants partition out of the aqueous phase and into the reagent matrix, thereby removing mobile contaminants from the immediate risk pathway. Concentration of the contaminants in this manner, in a matrix conducive to degrader colonization and activity, results in a direct increase in the overall instantaneous rate of contaminant destruction, given the quasi first-order biodegradation kinetics characteristic of environmental systems. This phenomenon can be especially important at low contaminant concentrations, which may otherwise prove insufficient to support appreciable growth and activity of a degrading microflora.

The technology can be applied to inhibit spreading of contaminant plumes, to protect sensitive receptors, or to prevent contaminant migration across property boundaries. PlumeStop is also a very effective tool for control and treatment of groundwater contamination associated with low-permeability porous formations and matrix back-diffusion, promoting diffusion out of the immobile porosity while preventing groundwater impact, and for treating sites with very low contaminant concentrations.

Field studies confirm wide-area dispersion, with order of magnitude (>90%) dissolved-phase concentration reductions secured at the test sites post-application sampling, increasing to two orders of magnitude (>99%) within two months for both chlorinated solvent and hydrocarbon species alike. Laboratory data provide confirmation of post-sorption degradation enhancement, describing a significant increase in the rate of contaminant destruction in biotic matrix systems compared to abiotic matrix and biotic non-matrix controls.

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PlumeStop™ Colloidal Biomatrix

Securing rapid contaminant reduction and accelerated bioremediation using a dispersive injectable reagent

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[a]REGENESIS UK, Bath UK; [b]REGENESIS, San Clemente, CA USA

1 Introduction

This paper provides an introduction and technical overview of a new remediation product, **PlumeStop Colloidal Biomatrix** (PlumeStop™), designed to combine a rapid step-change reduction in groundwater contaminant concentrations with accelerated bio-destruction of the same.

At the basis of the technology are the core features of:

- Dispersibility of a highly sorptive medium; and,
- Enhanced biodegradation of the sorbed contamination.

These features will be addressed respectively in individual sections of this paper. Laboratory demonstration of the principles of dispersion, retained sorptive capacity and biodegradation enhancement of the product are provided. Field performance examples of the technology are then shown, and finally, typical product usage scenarios discussed.

2 Securing Sorbent Dispersibility

2.1 Material Composition

PlumeStop is an aqueous liquid wherein a colloidal solid sorbent (carbon-based) is suspended. Into this is incorporated an anti-clumping / distribution-supporting surface treatment and low-solubility / controlled availability matrix nutrients. Distribution limitation is overcome by altering the surface charge of the colloidal particles, thereby reducing interaction between particles and the soil matrix and between the particles themselves. As a consequence, the resulting material can be dispersed widely, and gradually coats the aquifer matrix rather than accumulating in localized clumps in or close to the point of application as with activated carbon products.

2.2 Dispersibility – Benefits to Application

The sorptive characteristics of granular activated carbon (GAC) are of course nothing new, and are well understood in the remediation industry (*1*). That the sorption may be coupled with biodegradation is also well known (*2*, *3*), with 'bio-GAC' a familiar term in common industry parlance. However, the solid nature of activated carbon has restricted its use in remediation principally to the *ex situ* treatment of extracted media in pump-and-treat (P&T) installations and so forth. The attraction of its use as a passive means of *in situ* groundwater treatment remains however its application has, to date, been restricted by the challenge of distributing a solid through the charged, granular medium of soil.

Solutions to this problem have included auger-based soil-mixing, trench-application, injection on tight centers and fracture-based emplacement. These come at a cost; not only are the engineering requirements significant compared to those of fluid-injection, but good access is required both above ground (e.g. absence of buildings, structures) and below ground (e.g. absence of services, structures). Limitations of depth may also be encountered, whether this is principally in terms of expense alone (e.g. mounting costs of tight injection spacing in large, deep applications) or physical constraints also (e.g. trench or soil-mixing applications).

Beyond the physical challenge of application can remain the uncertainty of the subsurface distribution. The distribution of injected powdered GAC, irrespective of particle size, carrier volume and dilution, will typically be restricted to the injection point; for example, the well-pack or near surround, or to the fractures themselves. This presents a risk of incomplete or variable clean-up. There may also be a potential for mistaking 'monitoring-well clean-up' for aquifer clean-up. This would not only be restricted to the obvious circumstance of using the same well for application and monitoring (poor practice clearly), but may also arise from a fracture-emplaced injection 'fingering' into a monitoring well giving the appearance of remediation, yet leaving the wider aquifer untreated.

The ability to secure an injectable, dispersive form of activated carbon clearly overcomes the majority of the limitations outlined above.

Beyond improving confidence of reagent delivery and addressing certain access challenges, the cost-reduction in application may be very significant. Fracture-emplacement or augered soil mixing become unnecessary – simpler injection-well or direct-push application approaches suffice. Increasing the spacing of an injection grid will itself produce benefits, not only through minimization of obstacles, but also through savings of cost, disturbance, and time on site. For example, increasing the spacing of an injection grid simply from 2 m to 3 m will reduce the required number injection points by more than 50%, while increasing the spacing to 5 m presents a reduction in required points of over 80% (Figure 1).

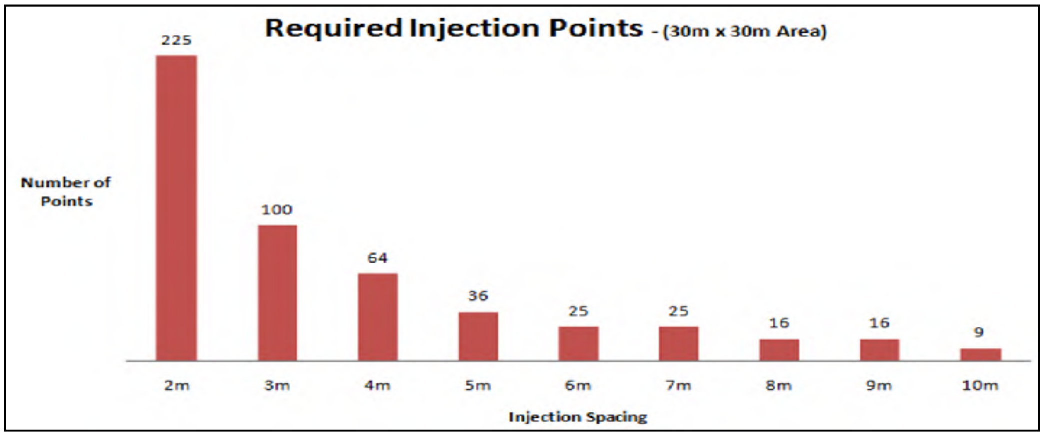

Figure 1. **Impact of injection spacing on injection point requirement for a fixed area**

3 Securing Bio-Enhancement

3.1 Introduction

The sorptive capacity of PlumeStop in itself is beneficial to remediation projects, as it is able to secure reductions in groundwater contamination and risk very rapidly, with the potential to achieve low clean-up targets in weeks or even days. The additional effect of PlumeStop to promote bio-destruction of the sorbed contaminants results in the permanent removal of the contaminant from the aquifer setting .

To explore this feature it may first be helpful to review some of the wider principles of bioremediation relevant to the process.

3.2 The Central Importance of Biological Processes

For groundwater remediation and aquifer restoration, biodegradation represents the principal destruction mechanism of organic species within the subsurface; this may either be wholly of itself, or through completing destruction initiated by other means. Biological processes are indeed recognized as *the* principal *destruction* mechanism among natural attenuation processes (*4*, *5*), and as a means of completing contaminant destruction / mineralization following mass reduction technologies such as *in situ* chemical oxidation (ISCO) (*6*).

The potential of bioremediation is perhaps not surprising given that the biodegradation of organic compounds is of central importance to carbon cycling and thus to life on earth (*7*). The sheer potency of the degradative capacity of microorganisms given appropriate conditions has long been recognized (*8*). Moreover, an understanding of the range, diversity, resilience and apparent ubiquity of their distribution continues to grow, a graphic and entertaining perspective on which is provided by Gould, 1996 (*9*).

3.3 Bioremediation – Potential and Challenges

In situ groundwater bioremediation is now itself an established remediation approach widely used around the world. However, since its early adoption as a contemporary remediation technology in the 1970s and 80s, there have been relatively few significant innovations within the sector beyond the increasing sophistication of electron donors and acceptors, and ancillary developments such as improved measurement technologies. Notwithstanding these, the technology remains challenged by a number of factors, from the forefront of which may arguably be singled out two perennial, core issues:

- **Bioremediation takes time** – despite advances in bioremediation techniques over the years it remains a relatively slow remediation approach;
- **End-points remain uncertain** – while bioremediation may be employed with confidence to efficiently and inexpensively reduce contamination by one or two orders of magnitude, the (linear) rate of destruction characteristically decreases with time, leading to uncertainty of predictable performance against very low clean-up targets.

In situ bioremediation nevertheless offers important benefits as a relatively low cost, low energy (green), minimally intrusive, destructive technology (i.e. contaminants destroyed, not simply relocated or bound), with applicability to most organic contaminants in a broad range of geological settings. These benefits would be enjoyed by a wider number of projects should the above limitations be overcome.

3.4 Analysis of the Problem

3.4.1 Biodegradation Takes Time

The basis of the time requirement of bioremediation cannot be reduced to a single factor. Some compounds simply degrade faster than others, microbial populations can take time to establish and/or acclimate, and conditions for microbial growth and activity are seldom uniformly optimal despite the skillful and earnest endeavors of environmental engineers. Beyond this, complex biological processes themselves are not instant. With respect to end-point uncertainty, the above factors are joined by others related to varied mass-transfer limitations and to the fact that microbial populations may simply require a minimum amount of substrate to maintain appreciable activity (*10*).

Within the varied factors that can limit biodegradation, however, certain principles can be seen to recur.

3.4.2 Biodegradation Kinetics

The **biodegradation rates** of given compounds are commonly cited in terms of first-order kinetics – typically as half-lives (*11*, *12*). The rates may vary from compound to compound and from setting to setting, but the principle of a quasi first-order kinetic approximation remains. Similar declines in instantaneous destruction rate (mass removed per unit time) are similarly observed for other technologies, for example, ISCO.

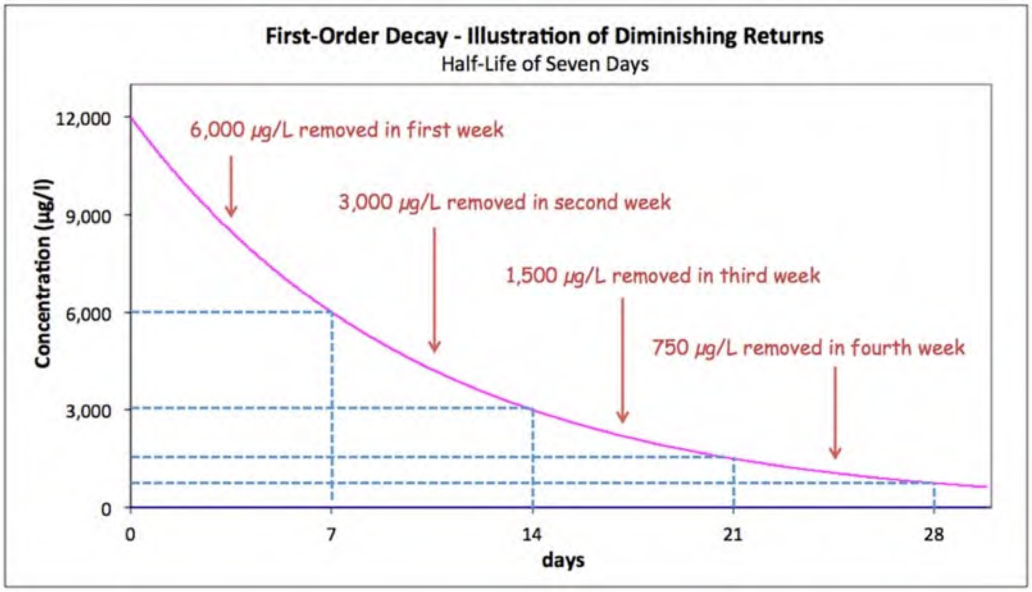

Figure 2. First-order decay – illustration of decreasing *instantaneous* mass destruction rates

At the basis of the first-order approximation is the principle of decreasing bioavailability. As the concentration of a contaminant in groundwater is reduced, the frequency of contact between contaminants and microorganisms similarly reduce as a natural consequence. The microorganisms relied upon for bioremediation predominantly exist attached to particle surfaces rather than suspended or free-swimming in the aqueous phase, or as large immobile bundles of organisms living in the interstitial spaces between aquifer mineral particles (biofilms) (*7*, *13*). The contaminant must therefore come to them if it is to be degraded – separation of the microorganism from the substrate even by a few microns can be enough to prevent degradation (*14*). Degradation rate will therefore naturally reduce over time, albeit counteracted to an extent by increasing microbial numbers and proficiency, especially in the early treatment stages.

As the groundwater clean-up proceeds further, mass-transfer constraints begin to dominate. Once the micro-organisms have depleted their immediate environment of substrate (i.e. on the micro-scale), and the groundwater becomes progressively depleted of contaminant, the rate of contaminant bio-destruction becomes increasingly influenced by the instantaneous rate of contaminant desorption into the groundwater and hence its availability to the micro-organism (*15*, *16*) and indeed by the rate of back-diffusion of contaminant out of the immobile porosity (*17*) where microbial numbers have been postulated by some to be limiting.

3.4.3 Bioremediation End-Point Uncertainty

The **uncertainty of end-point** can relate to the above phenomena owing to the practical challenge of identifying in advance the point at which the preceding factors will hit a point of balance, and a performance asymptote reached. Beyond this, declining microbial activity may be expected as substrate becomes depleted – 'starvation' in familiar terms.

The environmental conditions of bioremediation are generally favorable to copiotrophic microbial species (those that thrive on high-concentration substrate, sometimes considered 'opportunists' (*18*, *19*)) in the majority of cases, by virtue of the fact that sufficient contamination / substrate is present to require remediation in the first place. As degradation proceeds, oligotrophic conditions become prevalent where substrate availability may be insufficient to support a viable, high-activity microbial population, further exacerbating the rate-limitation principles discussed earlier. Substrate concentration thresholds for microbial activity have been variously reported (*20*, *21*, *10*, *22*).

3.5 Addressing the Problem

The astute reader will doubtlessly have observed that the challenges outlined in the two preceding sections ultimately have bioavailability at their core. Given there will be a fixed mass of contamination in the system to be treated, the above rate limitations may be overcome through either of two approaches:

- **Increasing the solution concentration** – for example using surfactants (*23*, *24*, *25*). Whilst this may be effective in overcoming the bioavailability constraint, (uncontrolled) major contaminant concentration spikes in the dissolved-phase are not welcome, beyond any additional problems the surfactants may present such as clogging of the formation or the introduction of a competing biological oxygen demand (BOD) (*26*, *27*).

- **Concentrating the contaminants and the bacteria together** – for example, using a common sorptive surface; one of the principles of catalysis[1]. This approach of concentrating the

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[1] This is indeed what REGENESIS has done with its silicate-based ISCO catalysts for percarbonate (as an anhydrous, more stable form of H_2O_2 delivery) in RegenOx™ and persulfate in PersulfOx™, eliminating the requirement for addition of consumed activators such as base, peroxide, or heat.

contaminant and bacteria on a surface in fact reduces dissolved phase contaminant concentrations benefits bioavailability and ultimately degradation.

3.6 Benefits of a Colloidal Biomatrix

The principles of increasing contaminant-microbe contact and overcoming oligotrophic limitation are addressed directly by PlumeStop. The novelty of PlumeStop as a technology lies in the ability to widely distribute (disperse) a sorptive medium using simple injection equipment and without compromise to sorptive capacity. PlumeStop injected into the aqueous subsurface quickly sorbs organic contaminants. Partitioning of contaminants out of the dissolved-phase and into the PlumeStop results in a fast and striking reduction in groundwater contaminant concentration.

Thereafter, the sorptive PlumeStop medium additionally provides a high surface-area, virgin matrix for fresh microbial colonization thereby achieving the objective of concentrating the bacteria and the contaminants together.

3.7 Core Hypothesis

The core hypothesis of the PlumeStop technology may thus be summarized as follows:

PlumeStop is injected into the subsurface as a colloidal suspension using simple liquid-injection equipment, securing wide-area dispersion (meters). Dissolved-phase contamination then partitions out of the groundwater and into/onto the PlumeStop matrix, resulting in a rapid drop in groundwater contamination (days). The net rate of sorptive partitioning is considerable owing to the extremely high relative surface area of the colloidal (1-2 µm) particles. The PlumeStop itself becomes impregnated with the contaminants, concentrating them within its structure.

Under growth conditions held optimal by a favorable electron donor / acceptor / nutrient status (engineered as necessary through application in combination with compatible reagents) microbial colonization of the PlumeStop quickly follows. The colonizing microflora will predominantly comprise degrader species, given that the contaminants impregnating the matrix provide the principal available substrate. Contaminants and microbes are thereby concentrated together, enhancing bioavailability and maintaining adequate substrate-availability (copiotrophic status) locally, irrespective of possible substrate-limited (oligotrophic) conditions in the wider aquifer. In this manner, the PlumeStop provides both a growth-medium and a substrate reservoir to support suitable microbial growth, while keeping the contaminants out of the groundwater.

This results in:

- A rapid drop in groundwater contamination;
- An increased rate of contaminant destruction;
- An ability to pursue bioremediation effectively even at very low contaminant levels.

Degradation of substrate within the matrix regenerates the sorption sites (*28*), extending and replenishing the reagent’s sorptive capacity. The PlumeStop itself is not consumed; this makes possible long-term management solutions for back-diffusion and ongoing low-level sources, thereby providing a means of long-term low-level contaminant flux management.

4 Reagent Development

4.1 Background

The dispersive biomatrix concept may be applied to a range of sorptive media, a spectrum of which has been evaluated through the course of the product development research. Once selected, the dispersibility of the medium was optimized through a series of over one hundred soil-packed column tests conducted with the objective of identifying and refining a proprietary treatment which would provide the desired step-change in dispersibility. The resulting PlumeStop composition exhibits striking performance improvements over conventional slurries and dispersed forms of carbon particles known in the scientific literature (*29*).

The medium selected for initial commercialization as PlumeStop is colloidal (micron-scale) carbon, which therefore represents the focus of the present paper. Into this is incorporated an anti-clumping / distribution-supporting surface treatment of non-toxic polymeric and molecular additives plus low-solubility / controlled availability matrix nutrients. Distribution limitation is overcome by cloaking the surface charge of the colloidal particles, thereby reducing interaction between particles and the soil matrix and between the particles themselves. As a consequence, the resulting material can be dispersed widely, and gradually coats the aquifer matrix rather than clumping in, or close to, the point of application. The stabilized colloidal composition is therefore able to achieve unprecedented subsurface distribution and site remediation performance.

A visual illustration of the dispersed PlumeStop colloid distributed among and coating sand particles is given in the scanning electron microscope (SEM) photomicrograph images in Figure 3 to Figure 5.

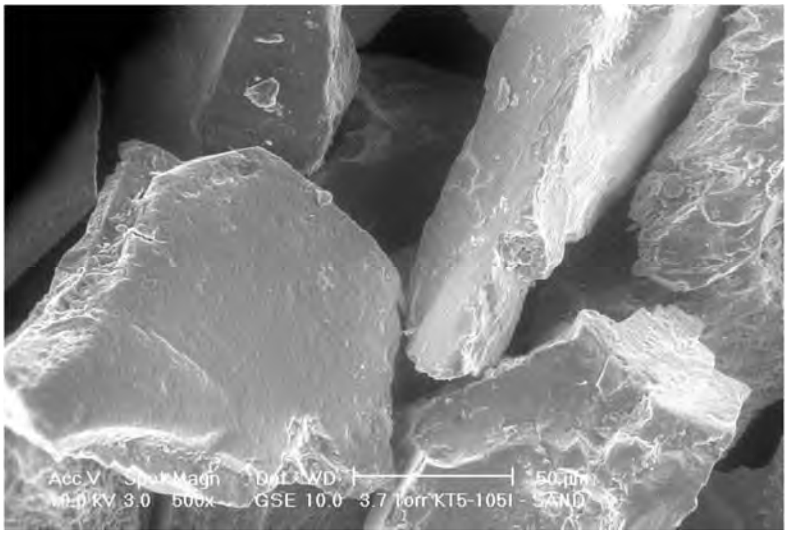

Figure 3. SEM image of sand particles without PlumeStop

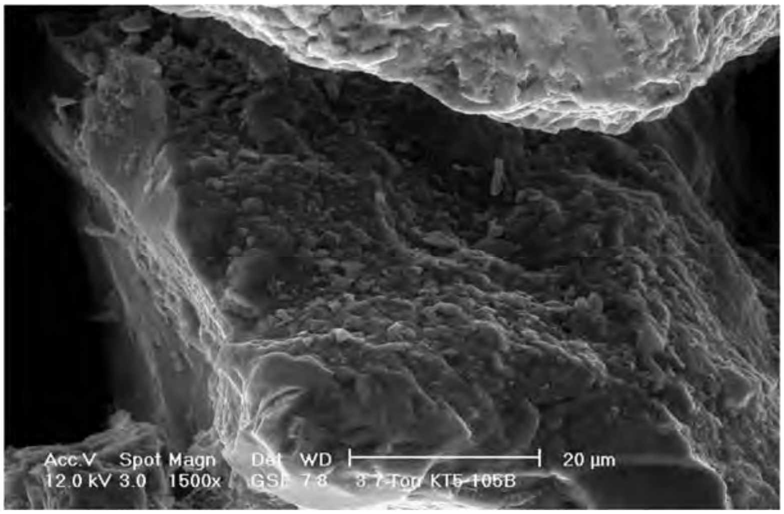

Figure 4. SEM image of sand particle coated with PlumeStop colloid (1)

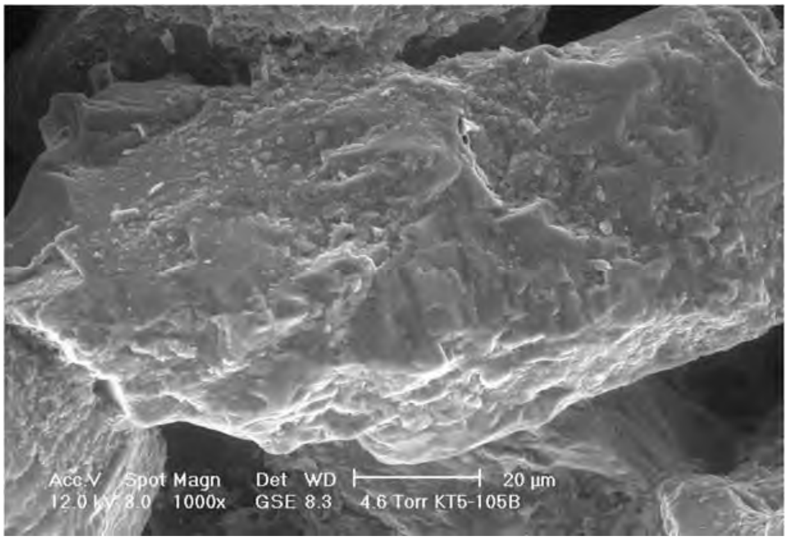

Figure 5. SEM image of sand particle coated with PlumeStop colloid (2)

4.2 Hypothesis Testing – Laboratory

The following sections of this paper describe laboratory-scale testing of the principles underpinning the core hypothesis of the PlumeStop technology. The following questions are addressed in sequence:

1. Can the colloidal biomatrix be effectively distributed through a saturated soil medium?
2. Does the treatment to secure distribution enhancement negatively affect sorption capacity?
3. Does biodegradation proceed within the biomatrix?
4. Is net contaminant degradation rate enhanced, inhibited or unaffected by sorption into the biomatrix?

4.3 Test 1. Reagent Distribution

4.3.1 Introduction

Powdered solid materials are, by nature, difficult to apply and distribute through a soil matrix by injection. Poor distribution and clumping in or close to the point of application or fracture are typically observed.

Q: Can the matrix be effectively distributed through a saturated soil medium?

4.3.2 Test description

The test set-up comprised two 50 mm (2”) internal diameter columns 600 mm (2’) in length, packed with a loamy coarse sand[2] and tap water. 25 g of 0.6% PlumeStop colloid was placed at the head of the test column, with an equivalent mass and concentration of powdered activated carbon in aqueous suspension placed at the head of the control column.

The columns were allowed to drain by gravity upon opening a tap at their base. A head of water was maintained by manual addition of water to each column, pausing the flow as necessary in either column to maintain net volume / flux consistency. A total of three pore-volumes of water was applied to each column.

4.3.3 Test results

The comparative distribution of PlumeStop and powdered activated carbon is visually illustrated in the following figures.

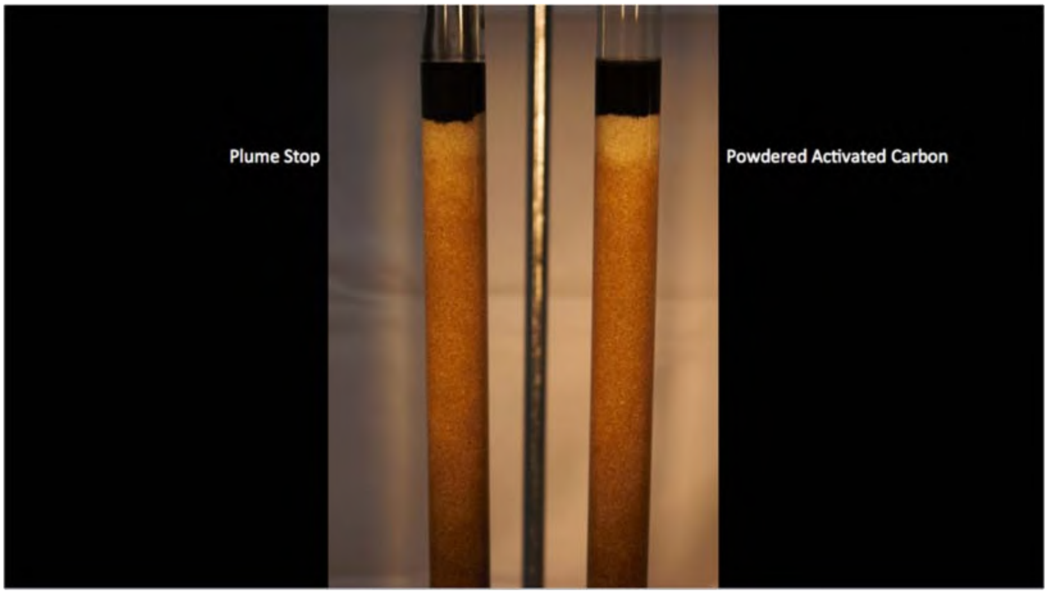

Figure 6. **Soil columns (initial)**

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[2] (48% coarse grain; 31% med; 8% fine; 2% v. fine; 11% fines.)

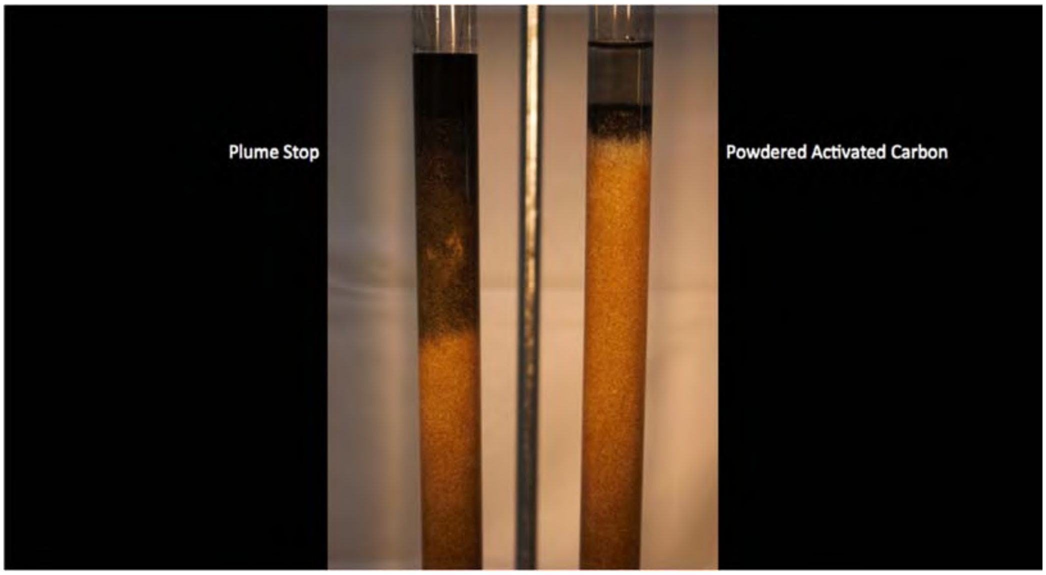


Figure 7. **Soil columns after approximately 0.3 pore volumes.**

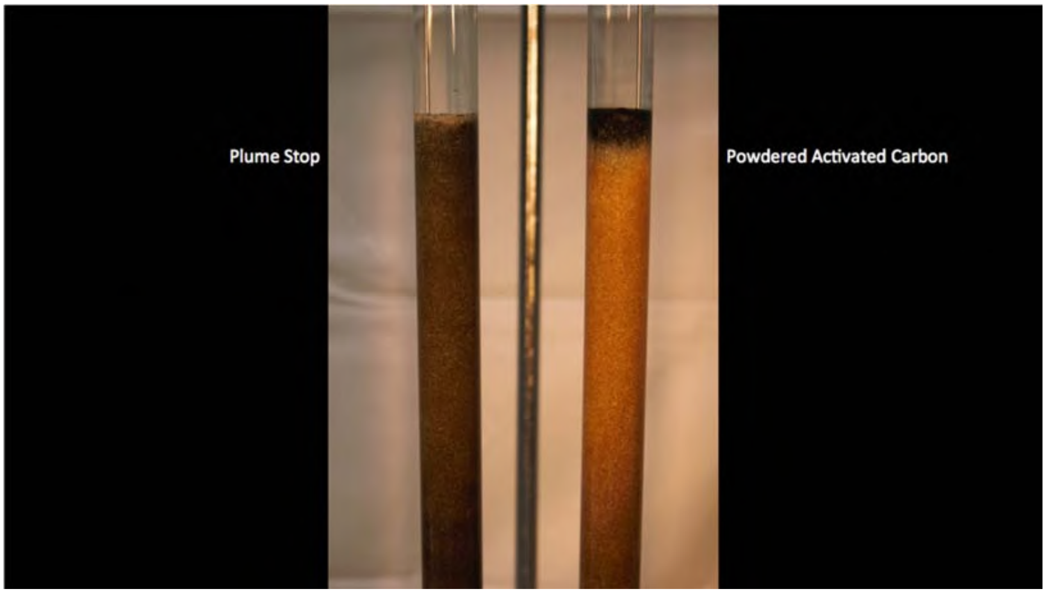


Figure 8. **Soil columns on completion of test at three pore volumes.**

4.3.4 Test conclusion

The test confirms that PlumeStop transports through 600 mm (2’) loamy coarse sand columns easily, whereas the distribution of the powdered activated carbon control was limited to approximately the top 25 mm (1”) of the column, representing a distribution difference in excess of a factor of 20 (the test being limited by the maximum length of the column).

PlumeStop material remained visually apparent throughout the column during the course the study, and showed no apparent decline / wash-out following placement during flushing of three pore volumes.

The dispersibility assertion of the PlumeStop technology hypothesis is therefore supported by this study.

4.4 Test 2. Sorption Capacity

4.4.1 Introduction

Securing an effective distribution of PlumeStop easily through a saturated soil system is clearly a core component of its function as a practical technology. The question remains however as to whether the treatment to effect this impacts negatively on the sorptive capability of the PlumeStop material.

Q: Does the treatment to secure distribution enhancement negatively affect sorption capacity?

4.4.2 Test description

The test set-up for evaluation of the sorptive capacity of PlumeStop comprised:

a) A **column study** with *o*-xylene; and,
b) The determination of the **sorption isotherm** of PlumeStop with respect to benzene.

The column study comprised two columns, through which an aqueous solution of 10,000 µg/L of *o*-xylene in tap water was passed (Figure 9). The columns were set-up identically and packed with loamy coarse sand, as per Test 1 (Section 4.3). An equal flux of aqueous xylene solution was passed in parallel through each column, and the systems run in this manner in order for the natural sorptive capacity of the soil to become equilibrated and baseline conditions to stabilize (approximately four weeks).

327 g of 0.2% PlumeStop colloidal suspension was then added to the head of the test column and allowed to distribute through it. The control column remained unchanged.

O-xylene concentrations in the effluent of each column were recorded at intervals of 1 – 3 days over the course of six weeks.

Figure 9. *O*-Xylene column study set-up

The **sorption isotherm of PlumeStop with respect to benzene** was determined through measurement of sorbed and dissolved benzene concentrations at equilibrium in multiple test systems. Benzene was applied to each system at a concentration of 50,000 µg/L. PlumeStop concentrations in each system varied over a range of 63 – 4,000 mg/L (Figure 10)

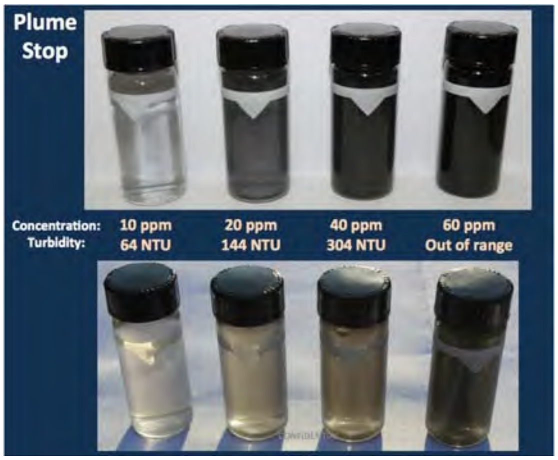


Figure 10. Serial dilution of PlumeStop – (isotherm study)

4.4.3 Test results

The comparative *o*-xylene concentrations in the effluent of the column study treatment and control systems are presented graphically in Figure 11.

O-xylene concentrations in the effluent from the PlumeStop-treated column were reduced from a baseline of approximately 11,000 µg/L to below the quantitation limit of 1,000 µg/L within ten days of application, with the response delay corresponding closely with the residence time of contaminated water within the column (i.e. drainage time of non-treated water ahead of the PlumeStop distribution). Concentrations in the treated system remained below quantitation limits through the course of the study (six weeks), over which time approximately fifteen pore volumes of ca. 11,000 µg/L *o*-xylene solution were fed through each system.

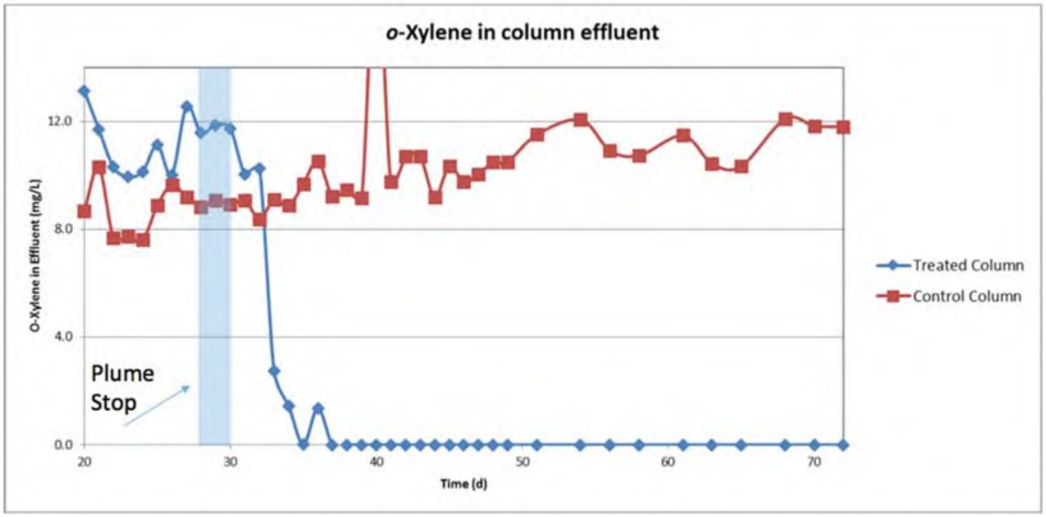


Figure 11. Comparative *o*-xylene concentrations in column effluent (PlumeStop application to test column at 28-30 days)

The sorption isotherm of benzene on PlumeStop is shown in Figure 12.

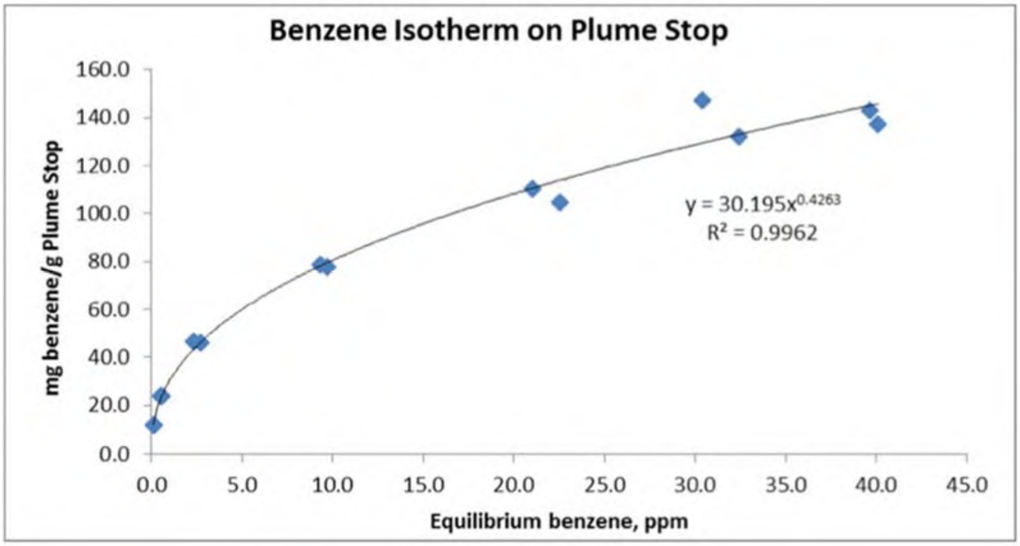


Figure 12. **Sorption isotherm of PlumeStop with respect to benzene**

4.4.4 Test conclusion

The **column study** provides confirmation that the distribution treatment of PlumeStop does not inhibit contaminant sorption – the PlumeStop in the test system was able to sorb 10,000 µg/L *o*-xylene for well over ten pore volumes.

The study additionally confirms that the PlumeStop was retained within the formation sufficiently to effect this result – the treatment not only did not inhibit sorption, but also did not result in excessive mobility leading to wash-out.

The (Freundlich) **sorption isotherms** of PlumeStop with respect to benzene provide further illustration of the retained sorptive capacity, and its relationship to concentration, which remains similar to unmodified powdered activated carbon.

The retained sorptive capacity assertion of the PlumeStop technology hypothesis is therefore supported by this study.

4.5 Test 3. Post-Sorption Biodegradation

4.5.1 Introduction

The ability of PlumeStop to be readily dispersed into and then retained by a formation while retaining its sorptive capacity provides a means of rapidly reducing or eliminating risk posed by organic groundwater contamination. This is sufficient in itself for securing common remedial objectives.

The fate of the sorbed contaminant however, may be anticipated as a natural question, given that while sorption may indeed address risk, it does not in itself destroy the contaminant. How reliable is the sorption? Will the sorption be temporary? What long-term performance can be expected? Such questions are commonly asked in relation to sorptive and binding technologies widely employed within the industry for inorganic contaminants. For these, the matter is of pressing importance owing to the fact that inorganic species such as metals remain present as elements and are not destroyed.

For organic species, the requirement for permanent binding is moderated by the fact that they may be destroyed through biological processes. The requirement for long-term binding, over decades in the case of metals for example, thus becomes irrelevant so long as there can be confidence in the destruction of the contaminants post-sorption.

The present test therefore evaluates the propensity for contaminants sorbed into the PlumeStop biomatrix to biodegrade.

Q: Does biodegradation proceed within the biomatrix?

4.5.2 Test Outline

The test comprises a batch-equilibrium study consisting of 227 ml (8 oz.) soil-water systems spiked with benzene, with or without PlumeStop (Figure 13). Each system contained 70 ml water and 10 g soil, thereby filling approximately one third of the container volume. This allowed sufficient remaining capacity for headspace analysis and the provision of adequate oxygen to maintain aerobic status throughout the study. Three treatments were included (**Table 1**).

Table 1. Batch-Equilibrium Study – Test and Control Treatments

Treatment	**Description**
Sterile control	Autoclaved soil and sodium azide (abiotic control)
PlumeStop Treated	Soil and PlumeStop (test)
Sterile PlumeStop Treated	Autoclaved soil, PlumeStop and sodium azide (abiotic control)

The tests were conducted in parallel, and run over a period of 21 days. Microcosms were sampled destructively in triplicate on days 1, 7, 14 and 21. Benzene was quantified in the aqueous phase, and also as a mass-balance extract of the total soil-water system (i.e. the aqueous and solid-phase microcosm contents together).

Figure 13. Batch-Equilibrium Study – Experimental Set-up

4.5.3 Test Results

Aqueous-phase concentrations of benzene are presented graphically in Figure 14. Data from the total system mass extractions are presented in Figure 15.

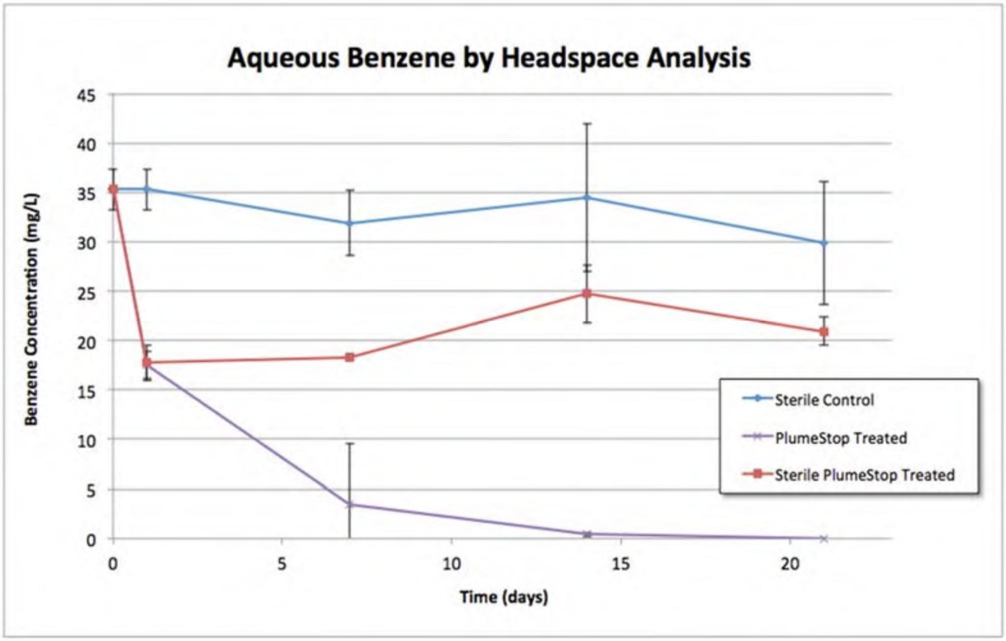


Figure 14. **Batch-Equilibrium Study – Aqueous-Phase Results**

Figure 14 illustrates a rapid and equal reduction in dissolved-phase benzene concentration in both the biotic and abiotic PlumeStop systems within the first sampling period. Thereafter, the aqueous benzene concentration in the biotic PlumeStop system continues to fall exponentially at a reduced rate, whereas that in the abiotic PlumeStop control remains broadly static. Benzene concentrations in the soil-only sterile control did not change significantly throughout the study.

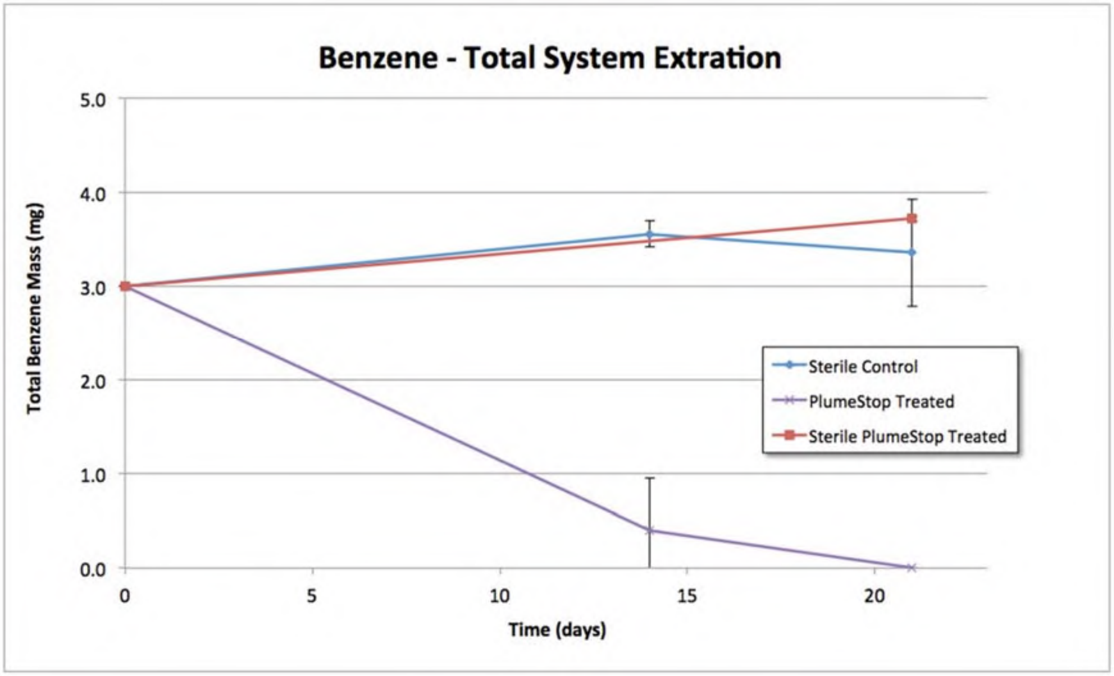


Figure 15. **Batch-Equilibrium Study – Total System Extracts**

In Figure 15, the total mass (soil + water) are compared over a 21-day period, with the objective of determining whether the on-going reduction in the PlumeStop system was related in some way to further sorption, or whether it was indeed a reflection of a separate destructive process.

4.5.4 Conclusion

The rapid and equal reduction in aqueous-phase concentration over the first sampling period in both the biotic and abiotic PlumeStop systems in contrast with the soil-only abiotic control may reasonably be attributed to abiotic sorption processes. That a reduction in concentration in the biotic PlumeStop system continues and indeed appears to follow a kinetically distinct (Figure 14) and broadly first-order approximation would be consistent with it being the result of biodegradation. This would clearly be the logical mechanism given that the system was biotic, differing only from the abiotic PlumeStop control in that it was not poisoned.

The destruction is further confirmed in the total mass extractions in Figure 15, in which the full initial mass of benzene was recovered from the abiotic PlumeStop control, confirming non-destructive abiotic sorption (and indeed a method validation of extractive recovery efficiency). In contrast, the mass-balance of benzene in the biotic PlumeStop system describes a destructive reduction, consistent with biodegradation.

Together, this provides confirmation that sorption of the contaminant by PlumeStop does not inhibit its subsequent biodegradation.

4.6 Test 4. Impact on Biodegradation Rate

4.6.1 Introduction

The final question related to proof-of-concept testing of the core PlumeStop technology hypothesis relates to the rate of post-sorption degradation, and whether the concentration of contaminants and microorganisms within the PlumeStop increases net biodegradation rate.

Q: Is net contaminant degradation rate enhanced, inhibited or unaffected by sorption into the biomatrix?

4.6.2 Test Outline

This test broadly follows the protocol of the preceding test, differing principally in that it includes a biotic soil-only control in addition to the biotic PlumeStop system. All systems were again reproduced in triplicate.

4.6.3 Test Results

Test results are presented in Figure 16. These illustrate total system extracts of benzene (soil + water) over the course of a 28-day study. Abiotic test systems with and without PlumeStop show similar mass recoveries and negligible losses. Reductions in the total mass of benzene recovered are evident for the two biotic systems, i.e. with and without PlumeStop. In the case of the PlumeStop system however, mass is reduced to below detection limit within the first sampling period (seven days).

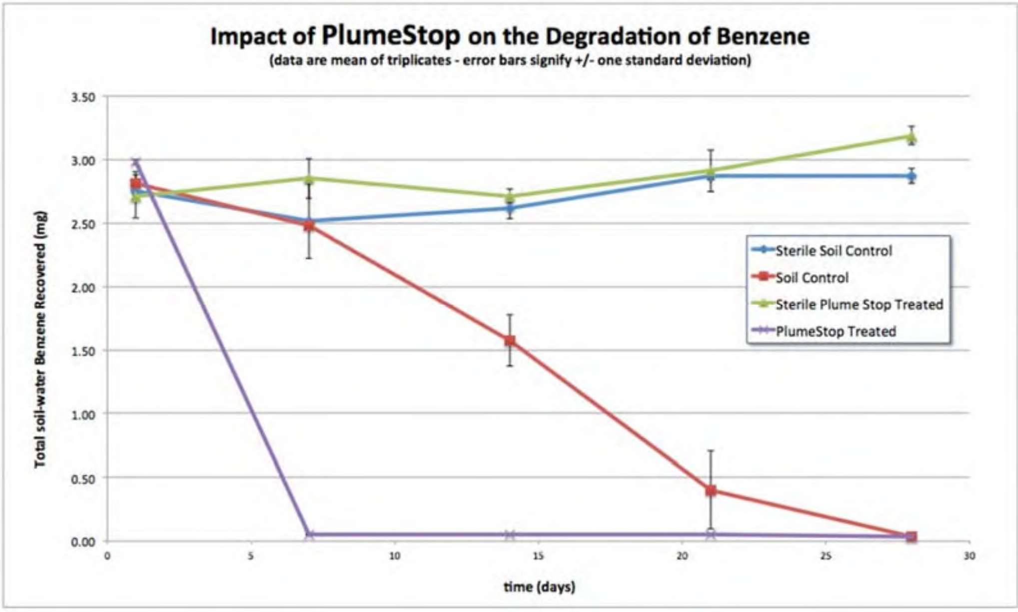


Figure 16. **Second Batch-Equilibrium Study – Total System Extracts (all treatments)**

4.6.4 Test Conclusions

The Benzene was fully degraded in the biotic PlumeStop system within first seven days of the test, in contrast with 12.5% degraded over same period in the biotic (soil-only) control. This approximates to a half-life of less than one day in the biotic PlumeStop system as compared to 10 days in the biotic control. This would represent a >10x rate increase based on the First Order approximation, over biotic aqueous rates, which are themselves consistent with published literature (*11*).

As with all laboratory tests, it would be unreasonable to extrapolate absolute rates such as these from lab to the field, however, the tests do serve to demonstrate a qualitative difference in the performance of the two systems. In so doing they support the hypothesis that **the contaminant degradation rate is enhanced by interaction with the PlumeStop**.

4.7 Satisfaction of Laboratory Test Objectives

The preceding sections of this paper describe laboratory-scale testing of the principles underpinning the core hypothesis of the PlumeStop technology. The following questions were sequentially addressed:

1. Can the PlumeStop biomatrix be effectively distributed through a saturated soil medium?
2. Does the treatment to secure distribution enhancement negatively affect sorption capacity?
3. Does biodegradation proceed within the biomatrix?
4. Is net contaminant degradation rate enhanced, inhibited or unaffected by sorption into the biomatrix?

The data presented are consistent with the core hypothesis, confirming that PlumeStop represents a dispersible, sorptive biomatrix that distributes easily through soil coating the particles without washing out, and is capable of capturing a significant flux of test hydrocarbon (*o*-xylene). Post-sorption biodegradation is shown to proceed, and occurs at an accelerated rate compared to biotic untreated systems.

5 Performance Testing – Field

5.1 Introduction

Laboratory testing can provide a valuable means of testing specific principles relating to environmental technologies, but cannot be considered a substitute for appropriate field performance testing. Although principles may be numerically elucidated in the laboratory, quantitative extrapolation of the result to the field cannot be technically supported. The following sections of this pater therefore extend the testing program of PlumeStop into field evaluation.

5.2 Field Test Objectives

The specific objectives of the field tests are to answer the following questions:

1. Can the performance shown in the lab be replicated in the field?
2. Can distribution be secured over field-practical distances?
3. Can significant field reductions in groundwater concentration be secured?
4. Can tentative indications of bio-destruction be identified?
5. Can the qualitative laboratory performance shown with hydrocarbons be replicated with chlorinated solvents?

Data addressing these are presented from two sites, one contaminated with hydrocarbons, and the other with chlorinated solvents. Both studies represent proof-of-concept evaluations rather than formal remediation endeavors.

5.3 Site Test 1 – Hydrocarbons

5.3.1 Introduction

The field impact of PlumeStop on hydrocarbon contamination was evaluated on a gasoline plume at a confidential site in the Midwest United States. The site was a former private high school campus; the contamination was historical (Figure 17). A leaking gasoline underground storage tank was identified as the source of the dissolved gasoline plume and subsequently removed. The site has some hydraulic control in the form of a building foundation dewatering/control system. This foundation dewatering/control system exerts a strong influence on groundwater flow direction as well as extent.

5.3.2 Test Arrangement

The PlumeStop was trialed in two areas of the plume; the original source (tank field) area (MW1) and in the plume body (MW2) approximately 14 m (46 feet) down-gradient from the source. Pre-application groundwater contamination levels were similar in each of the test areas (Table 2). The target/application interval in each case comprised saturated sandy silt with gravelly interbeds, underlain by a continuous hard silt layer. Depth to groundwater was approximately 2.5 m (7.5 – 8.0 ft). The building dewatering system imposes an artificial seepage velocity of approximately 200 – 280 m/yr (650-900 ft/yr) to the southwest (Figure 19).

Table 2. **Hydrocarbon Site – pre-treatment contamination levels**

	MW1 – Source Area	MW2 – Plume Area
Gasoline-Range Petroleum Hydrocarbons (TPH-g)	16,000 µg/L	14,000 µg/L
Benzene, Toluene, Ethyl-Benzene and Xylenes (BTEX)	7,000 µg/L	9,000 µg/L

PlumeStop was applied via direct-push injection (Figure 18) in a grid array. Eleven injection points were advanced in the area of MW1, and eight injection points were advanced around MW2, each at an approximate spacing of 1.5 m (5 feet) (Figure 20). The controlled release electron acceptor, ORC-Advanced® (REGENESIS, San Clemente, CA USA), was applied up-gradient and between points to support aerobic conditions appropriate for microbial colonization and activity.

Soil cores were taken before and after the PlumeStop application to provide local detail of the aquifer formation visual evaluation of the reagent's distribution.

Figure 17. **Hydrocarbon Site – Fieldwork**

Figure 18. **Hydrocarbon Site – Injection**

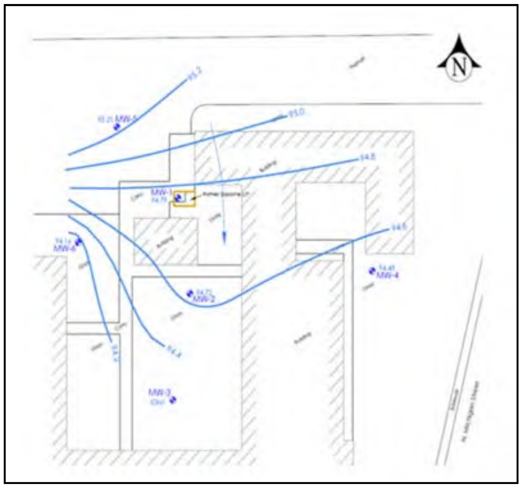


Figure 19. **Hydrocarbon Site – Groundwater Contours**

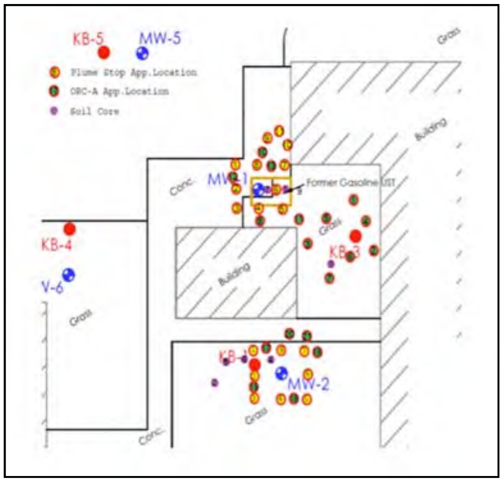


Figure 20. **Hydrocarbon Site – Injection Arrangement**

5.3.3 Test Results – first three months

Pre-application soil core data revealed significant contamination at the vadose/saturated zone interface, centered within a gravelly stratum (Figure 21). Post-application distribution of PlumeStop through the target zone was visually apparent (Figure 22). PlumeStop distribution extended throughout the entire lateral range evaluated using soil cores (1-2 meters from the closest application point). Close inspection of these soil cores revealed good evidence of an even dispersion of the PlumeStop through the permeable strata (Figure 23).

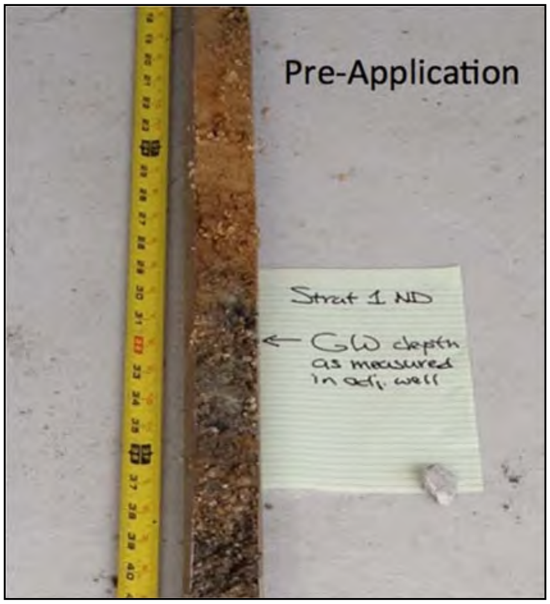


Figure 21. **Pre-Application Soil Core**

Figure 22. **Post-Application Soil Core**

Figure 23. **PlumeStop Dispersed through Permeable Stratum**

Hydrocarbon analysis of the groundwater revealed removal of contamination to below detection limits within the first sampling period (16 days). This represented a reduction of over three orders of magnitude (>99.9%) from original concentrations of 14,000 – 16,000 µg/L to < 100 µg/L. Data are presented in Figure 24. Groundwater concentrations remained below detection limits through the next sampling event, but then at 58 days rebounded to approximately 10% of their pre-treatment levels. Thereafter, the concentration in the plume well (MW2) reduced once more to below detection limits but remained largely unchanged in the source area well (MW1) at 10% of the baseline condition.

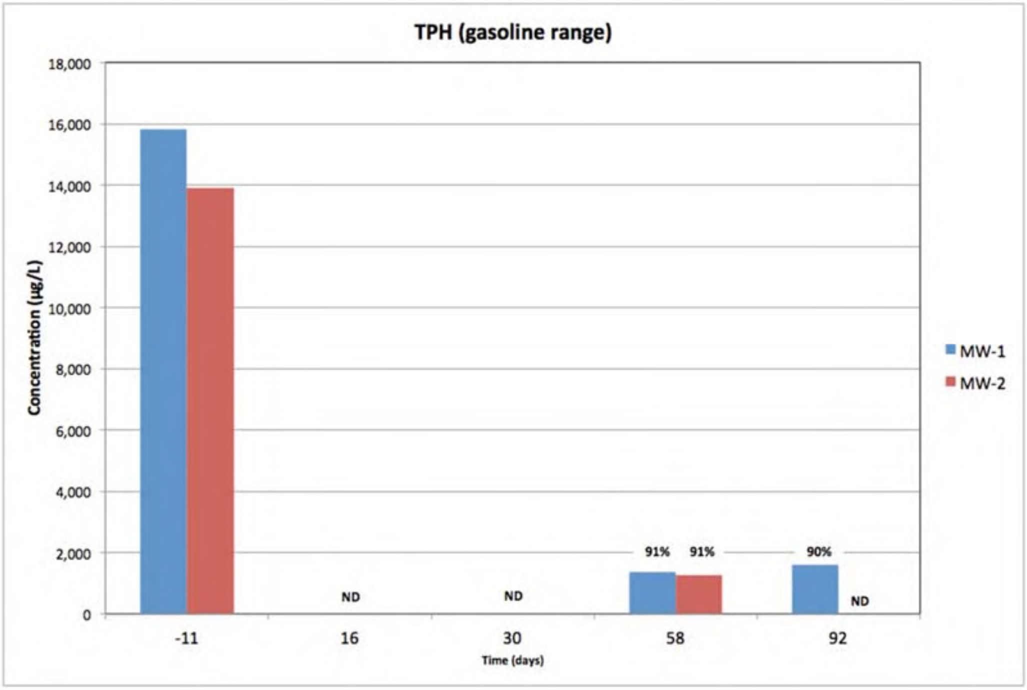


Figure 24. **Hydrocarbon Site – Field Results**

5.3.4 Test Conclusions

The field study confirms the ability of PlumeStop to be applied and dispersed through an aquifer formation using simple direct-push injection. Distribution through the maximum tested radius of 2.0 m (6.5 feet) was observed, suggesting the actual distribution may have been greater. A relatively even distribution of the reagent was observed within permeable strata, consistent with an anticipated performance of good dispersion throughout the mobile porosity suggested by the preceding laboratory studies.

The striking reduction in groundwater hydrocarbon concentrations immediately following application is consistent with the hypothesized sorption of contamination by the PlumeStop. (Displacement would not account for this as the total fluid injection was significantly less than one pore-volume, and indeed would be unlikely to result in an absolute a decline.)

The modest rebound in groundwater concentration at 58 days observed in both systems is believed to be due to the saturation ('over-topping') of the sorptive capacity of the PlumeStop owing to the entry of additional contaminant mass into the groundwater. This may either be from soil-sorbed, NAPL or immobile porosity mass within the test area partitioning / back-diffusing into the groundwater as a result of the initial groundwater concentration reduction.

Such mass would presumably be captured directly by the PlumeStop in like manner to that originally present in the bulk-porosity, resulting in little or no observable impact on groundwater concentration. However, upon saturation of the PlumeStop, concentrations in groundwater would be expected to rise, although this rate at which this occurs would be the balance of the rate of soil-contaminant desorption / back-diffusion and the rate of biodegradation within the PlumeStop biomatrix, given that this would be expected to free-up sorption sites (in an analogous manner to bio-GAC (*28*, *30*). From this it would follow that any such rebound would similarly decline as desorption / back-diffusion slows as secondary source-mass is depleted and the rate of biodegradation increases and becomes established. This is possibly what has occurred at the 92-day point in the plume area (MW2) well, where secondary source mass was presumably less than that in the original source area (MW1).

5.4 Site Test 2 – Chlorinated Solvents

5.4.1 Introduction

The field impact of PlumeStop on chlorinated solvent contamination ('chlorinated volatile organic compounds' – CVOCs) was evaluated on a mixed trichloroethene (TCE) and trichlorethane (TCA) plume at a former electronics facility in the Midwest United States. These solvents had been used at the site through to the end of the 1980s. Multiple source areas were evident.

5.4.2 Test Arrangement

The PlumeStop was trialed in a single test area located down gradient from the known sources, in an area of the plume believed to comprise dissolved and sorbed-phase contamination only, i.e. without residual non-aqueous-phase liquid (NAPL) present (Figure 25). Pre-test concentrations of TCA and TCE were 3,500 µg/L and 1,400 µg/L respectively. The aquifer soil type was sand to silty-sand, with groundwater located between 3 and 4 m from surface (10 – 13 feet). Groundwater seepage velocity was approximately 3.7 m/yr (12 ft/yr) to the southwest (Figure 26).

Figure 25. **Solvent Site – Test Location**

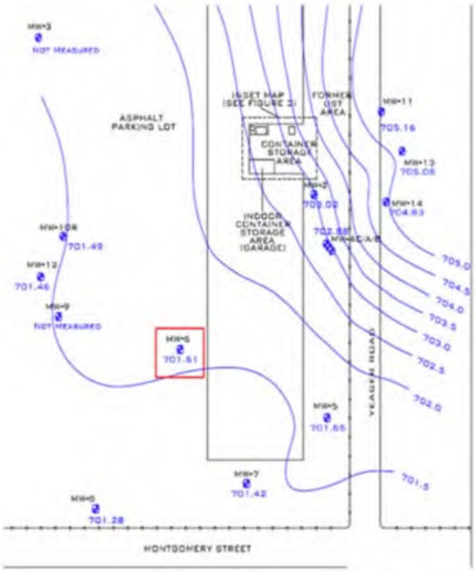
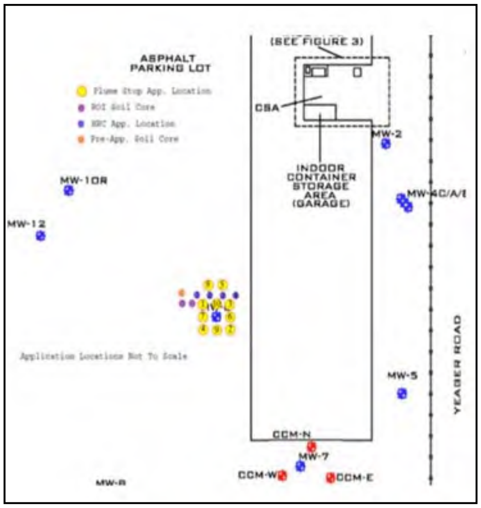


Figure 26. **Solvent Site – Groundwater Contours**

PlumeStop was applied by direct-push injection in a grid array of 10 injection points around the test well, spaced at a distance of 1.5 – 2.0 m (5 – 6.5 feet) (Figure 27 and Figure 28). The target application interval was across a depth of 2.75 – 6.5 m (9 – 21 feet) below ground surface. The controlled release electron donor HRC® (REGENESIS, San Clemente, CA USA) was applied in a linear array of four points immediately up-gradient of the test zone to establish and maintain anaerobic conditions appropriate for microbial colonization and activity (Figure 28).

Soil cores were taken before and after the PlumeStop application to provide local detail of the aquifer formation visual evaluation of the reagent's distribution.



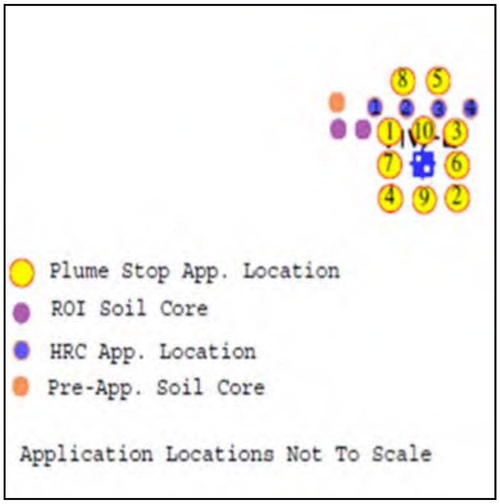


Figure 27. **Solvent Site – Injection Arrangement**

Figure 28. **Solvent Site – Inj. Arrangement (detail)**

5.4.3 Test Results – first two months

Post-application soil core data revealed good dispersion of the PlumeStop throughout the radius tested (2 m; 6.5 feet). Groundwater analysis revealed total CVOC concentration had dropped from 5,718 µg/L to 467 µg/L (92% decrease) by the time of the first monitoring event, two weeks after application (**Table 3**). Subsequent monitoring rounds showed a consistent decline in concentration, to 113 µg/L at one month and 12.9 µg/L at two months, representing concentration reductions from pre-treatment baseline of 98% and >99% respectively.

Data are presented graphically in Figure 29.

Table 3. Chlorinated Solvent Site – Field Results

Sampling Event (time post treatment)	**TCA (µg/L)**	**TCA (% Red.)**	**TCE (µg/L)**	**TCE (% Red.)**
Baseline (0 days)	3,550	0%	1,390	0%
Two weeks (17 days)	238	92%	201	86%
One Month (31 days)	89.4	98%	23.1	98%
Two Months (70 days)	12.9	99.8%	< 5	99.9%

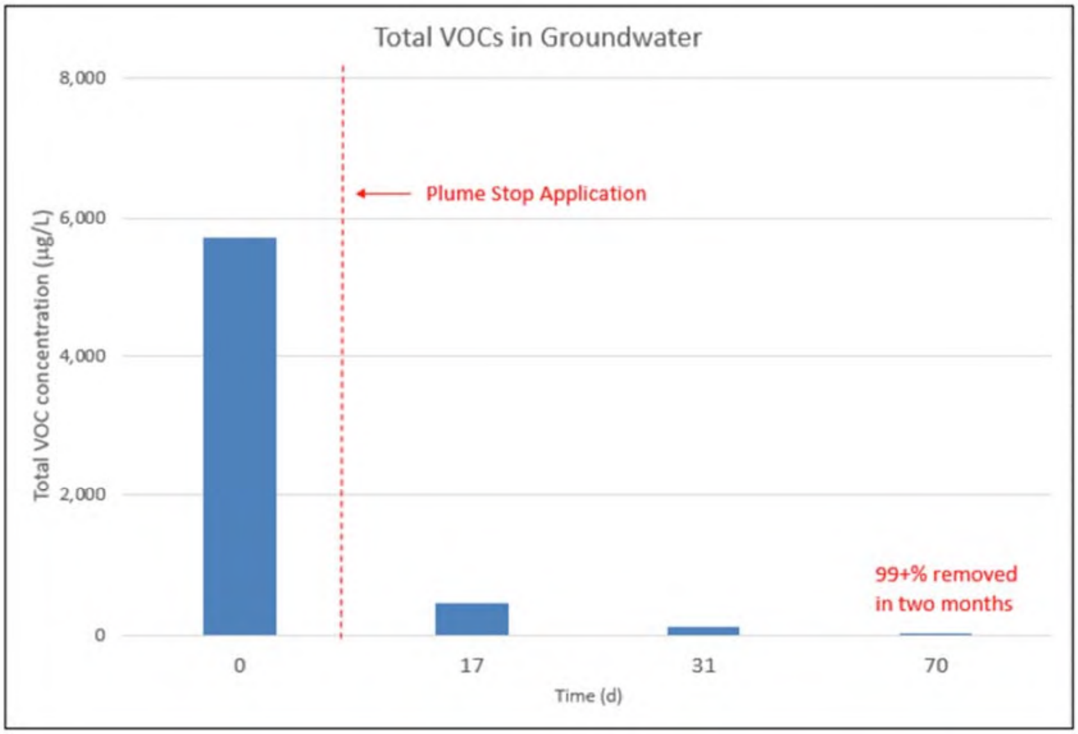


Figure 29. **Solvent Site – Field Results**

Geochemical changes observed in the groundwater included the establishment of reducing conditions between 17 and 31 days and a rise in dissolved iron from zero to 2,000 µg/L over the first 70 days. pH remained unchanged at 6.6 throughout the test period.

5.4.4 Test Conclusions

Examination of soil cores collected outside the PlumeStop application area indicate that PlumeStop was transported at least 2 m (6.5 feet) – the maximum interval measured – by the injection process used in this pilot testing program. The actual radius of dispersion was not determined beyond this, but may reasonably be presumed to have been greater.

The sharp, order of magnitude reduction in groundwater CVOC concentrations immediately following application is consistent with the hypothesized sorption of contamination by the PlumeStop. The on-going reduction following the initial step-change may be due to plume-equilibration and on-going partitioning of contaminant mass into the PlumeStop, biodegradation, or a combination of these processes. The timing however would suggest sorption to be the most likely and/or principal of these phenomena in the present case, given that conditions conducive to anaerobic biodegradation were only recently becoming established, and degradation daughter products were not observed.

5.5 Satisfaction of Field Test Objectives

The preceding sections of this paper describe the testing of PlumeStop performance in the field, for the treatment of hydrocarbons and chlorinated solvents respectively. The following questions were addressed:

1. Can the performance shown in the lab be replicated in the field?
2. Can distribution be secured over field-practical distances?

3. Can significant field reductions in groundwater concentration be secured?
4. Can tentative indications of bio-destruction be identified?
5. Can the qualitative laboratory performance shown with hydrocarbons be replicated with chlorinated solvents?

The field test data suggest the answer each of these questions would be in the affirmative.

Specifically, PlumeStop has been shown to distribute easily through soil over field-practical distances at least 2.0 m (6.5 ft) (the maximum tested interval), rapidly securing groundwater contaminant concentration reductions of one to two orders of magnitude and greater for both hydrocarbon and chlorinated solvent contamination alike. Field data suggest that biodegradation post-sorption is occurring, and as such, are consistent with the laboratory study data presented in the earlier part of this paper.

6 Discussion

6.1 Technology Implications – Key Features

The development of an injectable, dispersible, sorptive biomatrix has the potential to directly address a number of widespread challenges in the groundwater clean-up sector. Specifically, the principal features of technology are its ability to:

- Widely-distribute throughout the subsurface to impact a significant area;
- Adsorb contaminants and rapidly reduce associated groundwater concentrations;
- Inhibit transport of contaminants in the aquifer;
- Provide a "biomatrix" for microorganisms and contaminants;
- Enhance contaminant biodegradation, resulting in remediation of the site; and,
- Address matrix back-diffusion, where applicable.

6.2 Technology Implications – Selected Usage Scenarios

Among the selected usage indicators postulated for PlumeStop are the following:

1. **When time is critical** – PlumeStop arguably represents the fastest groundwater risk-reduction/remediation technology presently available[3]. Immediate risk-reduction is secured through sorption, quickly removing the contaminants from the groundwater; long-term destruction is then secured through in-matrix biodegradation.

2. As a long-term control of **migrating diffuse pollution** (or migrating pollution *per se*). PlumeStop can be used in barrier formation to capture diffuse contaminants, concentrating them within its biomatrix for locally intensive treatment. (This would provide a tighter capture-zone than bio-barriers alone (valuable where space is limited and/or groundwater is fast-flowing), faster destruction rates, and greater timing tolerance between (bio) amendment applications.)

3. As a means of treating **low-concentration plumes**. Bioremediation of/to low concentrations (e.g. low µg/L range) is often challenging owing to the concentrations being insufficient to support microbial activity. PlumeStop overcomes this limitation by accumulating low-level contaminants into the biomatrix until concentrations become sufficient within the matrix to support an active microflora while keeping the contaminants out of the groundwater.

4. As a means of addressing **Matrix Back-Diffusion**. Injection of PlumeStop into groundwater results in a rapid drop of contaminant groundwater concentration, typically of one to two orders of magnitude. This drop reverses the concentration gradient between the immobile porosity and the bulk solution (or increases the gradient out of the matrix if the bulk solution concentration has previously been reduced by other means). On entering the bulk solution, the back-diffused contaminants are in turn captured by the PlumeStop where they are biodegraded. The reverse gradient is therefore maintained and diffusion out of the immobile

---

[3] It is recognized that solid sorptive media may be introduced through other means such as fracture-emplacement, soil-mixing or tight-application grids, however, beyond the obvious cost and practicality benefits of dispersive colloidal liquid injection, the application fieldwork itself would be significantly faster.

porosity continues until such time as the back-diffusing mass is depleted. The PlumeStop is not consumed in this process, and will theoretically continue to function in this manner over decades, easily matching the timescales necessary to address back-diffusion, thus providing robust remedy-in-place protection from a one-time application.

7 PlumeStop® Colloidal Biomatrix – Product Summary

7.1.1 Overview

PlumeStop™ Colloidal Biomatrix is a new (patent pending) technology for groundwater treatment that allows for wide dispersion of a sorptive medium in the aqueous subsurface. The product has a dual function; it sorbs contaminants quickly removing them from the mobile phase ('PlumeStop'), and provides a high surface area matrix favorable for microbial colonization and growth ('Biomatrix'). Contaminant availability within a risk pathway is therefore reduced while at the same time contaminant destruction is accelerated. The product is very unique and offers attributes unlike any reagent on the market today.

7.1.2 Description

PlumeStop is an environmentally compatible, proprietary formulation of colloidal activated carbon combined with polymeric and molecular dispersion agents that allow the material to distribute widely throughout soil and groundwater without compromise to sorptive capacity. Once contaminants are embedded within PlumeStop's colloidal biomatrix structure, rapid biodegradation occurs. Intrinsic biodegradation processes can then be further enhanced with the proximal co-application of controlled-release electron acceptors or electron donors if desired.

7.1.3 Applicability

The PlumeStop technology is effective on most organic groundwater contaminants, including hydrocarbons, halogenated compounds, and a wide variety of volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). It can be applied to inhibit spreading of contaminant plumes, to protect sensitive receptors, or to prevent contaminant migration across property boundaries. PlumeStop is also a very effective tool for control and treatment of groundwater contamination associated with matrix back-diffusion, and for treating sites with very low contaminant concentrations (oligotrophic bio-limitation).

7.1.4 Performance

Laboratory and field studies with PlumeStop indicate that it has minimal impacts on groundwater quality, oxidation-reduction potential (redox), and geochemistry. PlumeStop, once injected into the subsurface, is expected to last on the order of decades, continually immobilizing and stimulating the biodegradation of contaminants. Field studies confirm wide-area dispersion, with order of magnitude (>90%) dissolved-phase concentration reductions secured at the test sites post-application sampling, increasing to two orders of magnitude (>99%) within two months for both chlorinated solvent and hydrocarbon species alike. Laboratory data provide confirmation of post-sorption degradation enhancement, describing a significant increase in the rate of contaminant destruction in biotic matrix systems compared to abiotic matrix and biotic non-matrix controls.

8 Further Information

PlumeStop™ Colloidal Biomatrix (PlumeStop™) has been developed by and is commercially available from REGENESIS, San Clemente, California, USA. U.S. and international patents pending. Further product information and a full listing of technical contact personnel are available at www.regenesis.com.

9 Literature Cited

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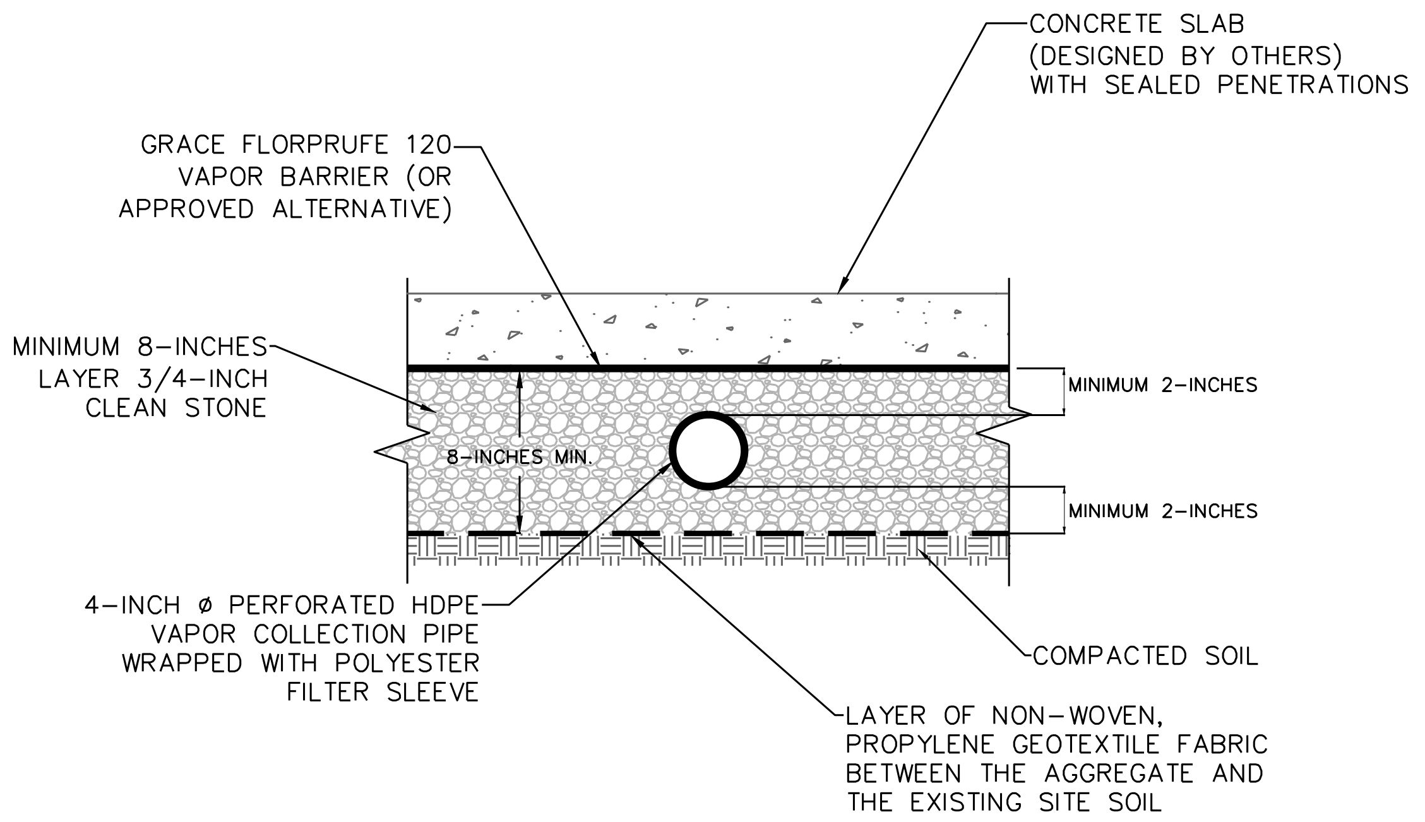
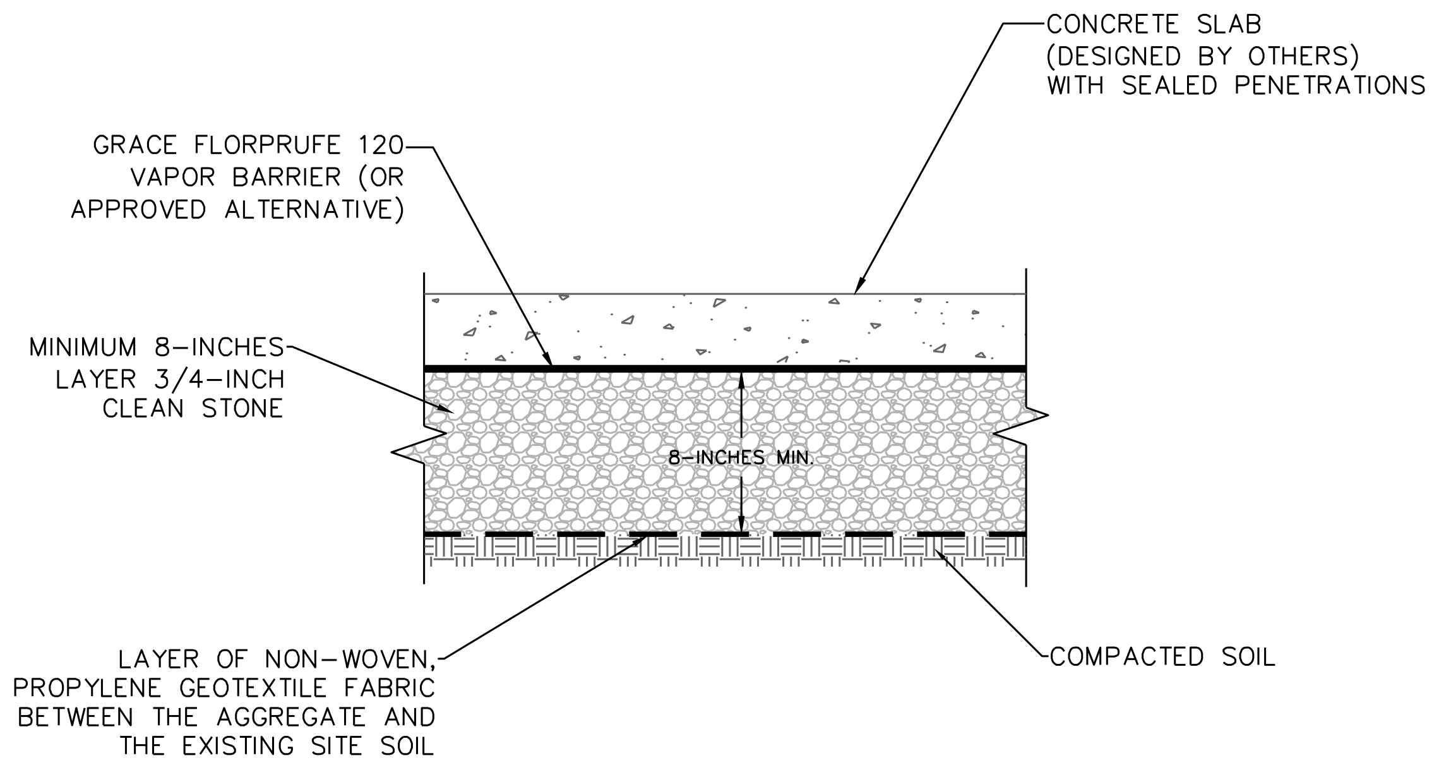
APPENDIX E
SMD SYSTEM DETAILS



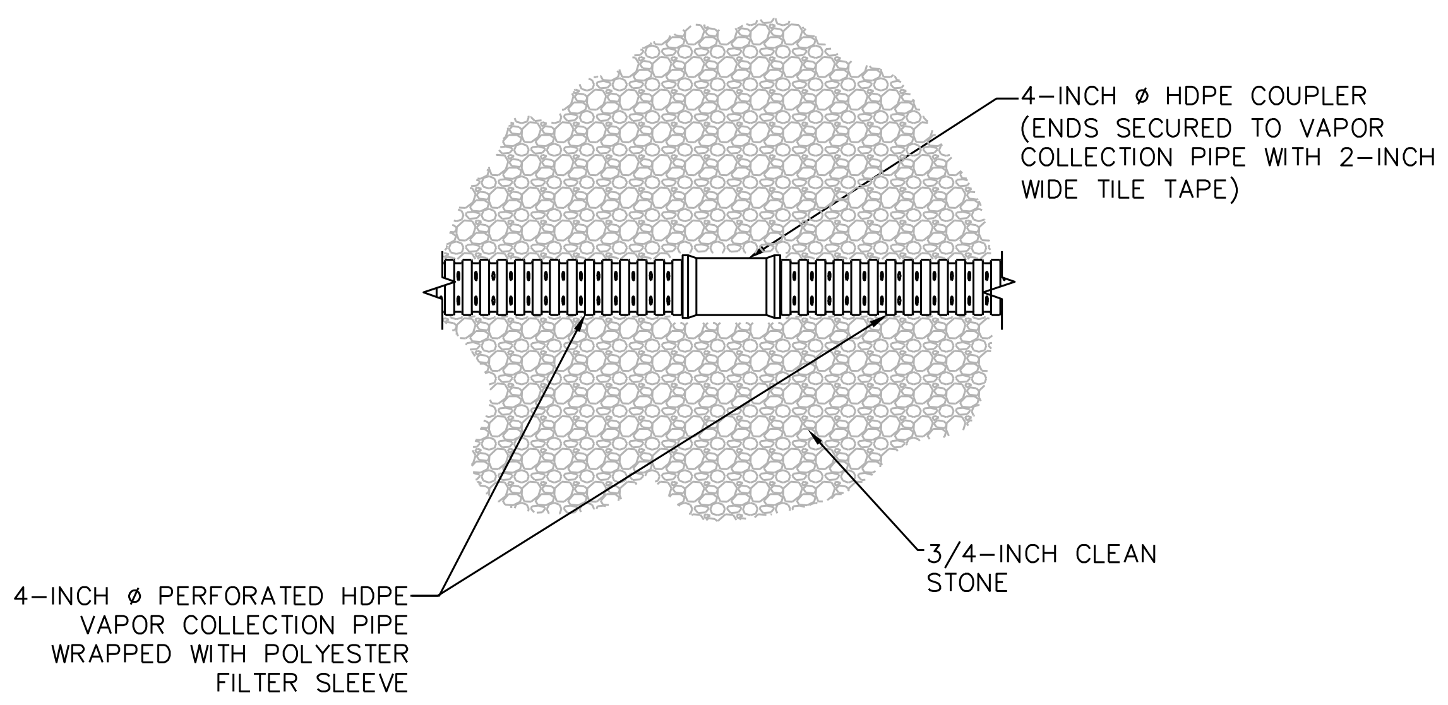
DETAIL 1: TYPICAL SECTION FOR VAPOR COLLECTION PIPE AND VAPOR BARRIER

NOT TO SCALE



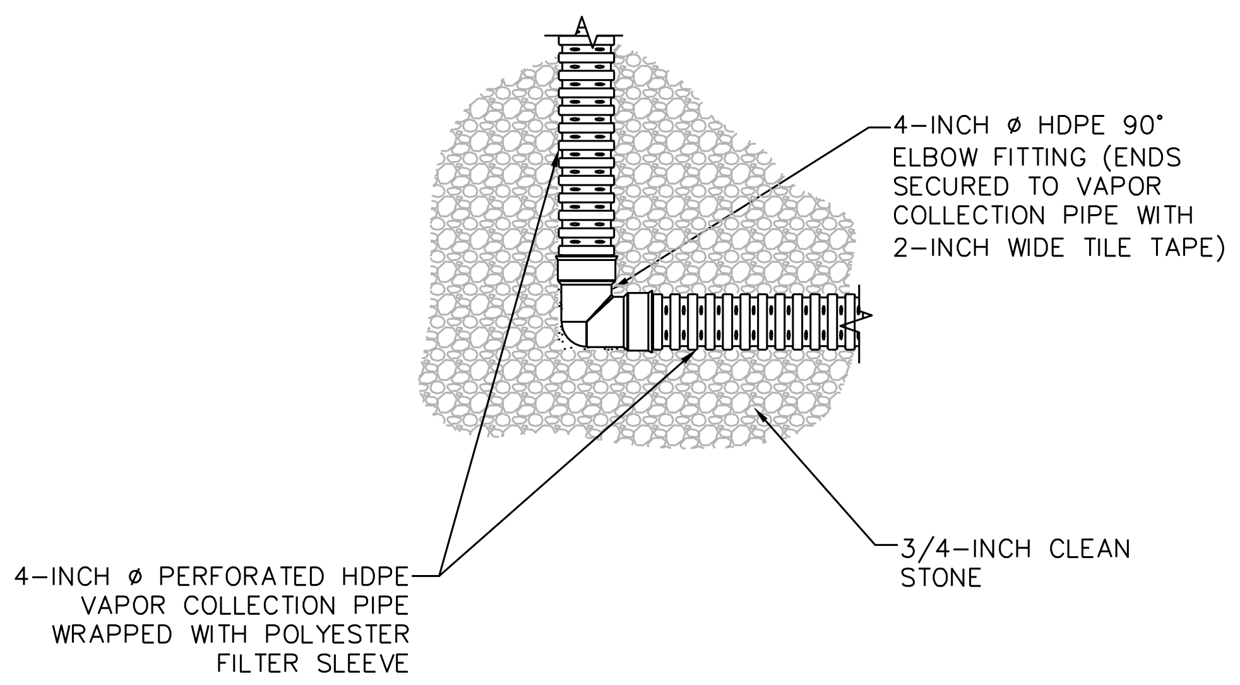
DETAIL 2: TYPICAL SECTION THROUGH SUB-SLAB

NOT TO SCALE



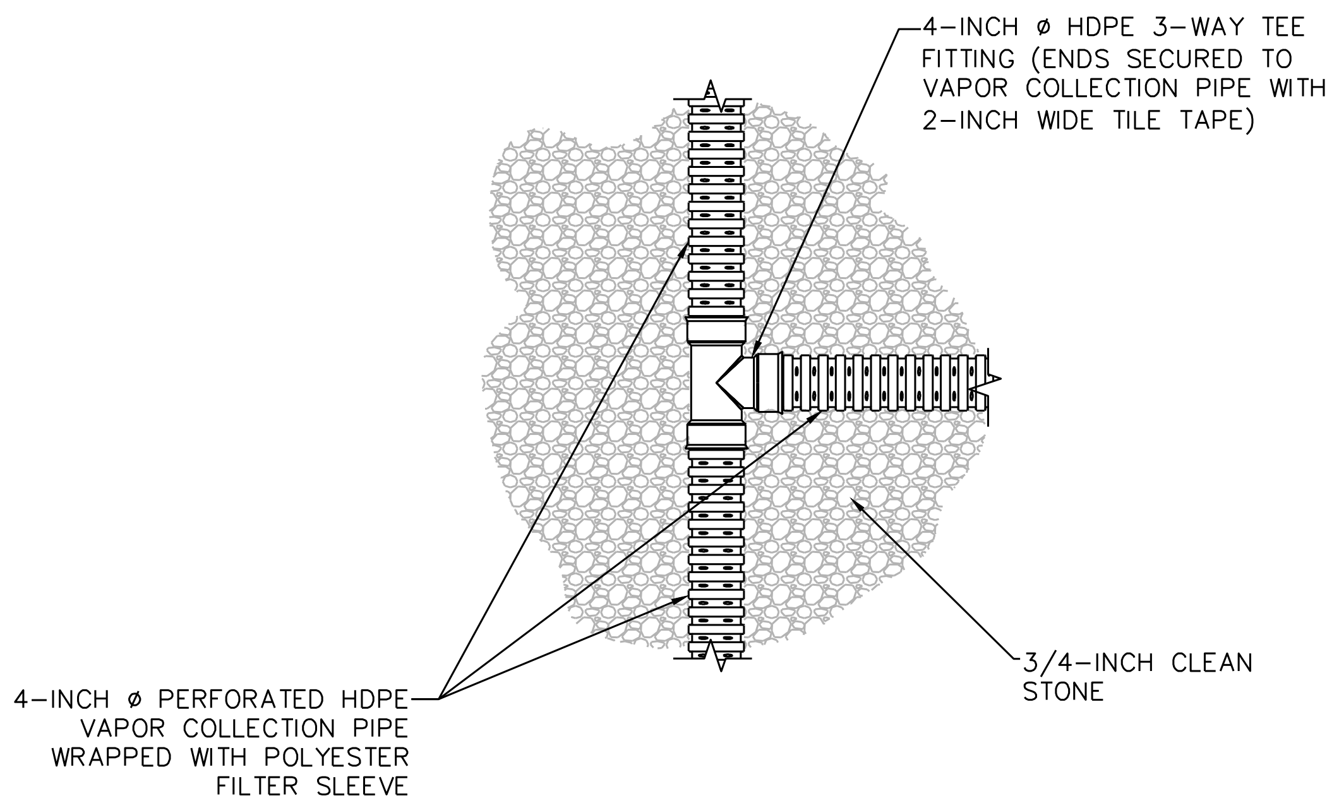
DETAIL 3: TYPICAL COUPLER CONNECTION FOR VAPOR COLLECTION PIPE (PLAN VIEW)

NOT TO SCALE



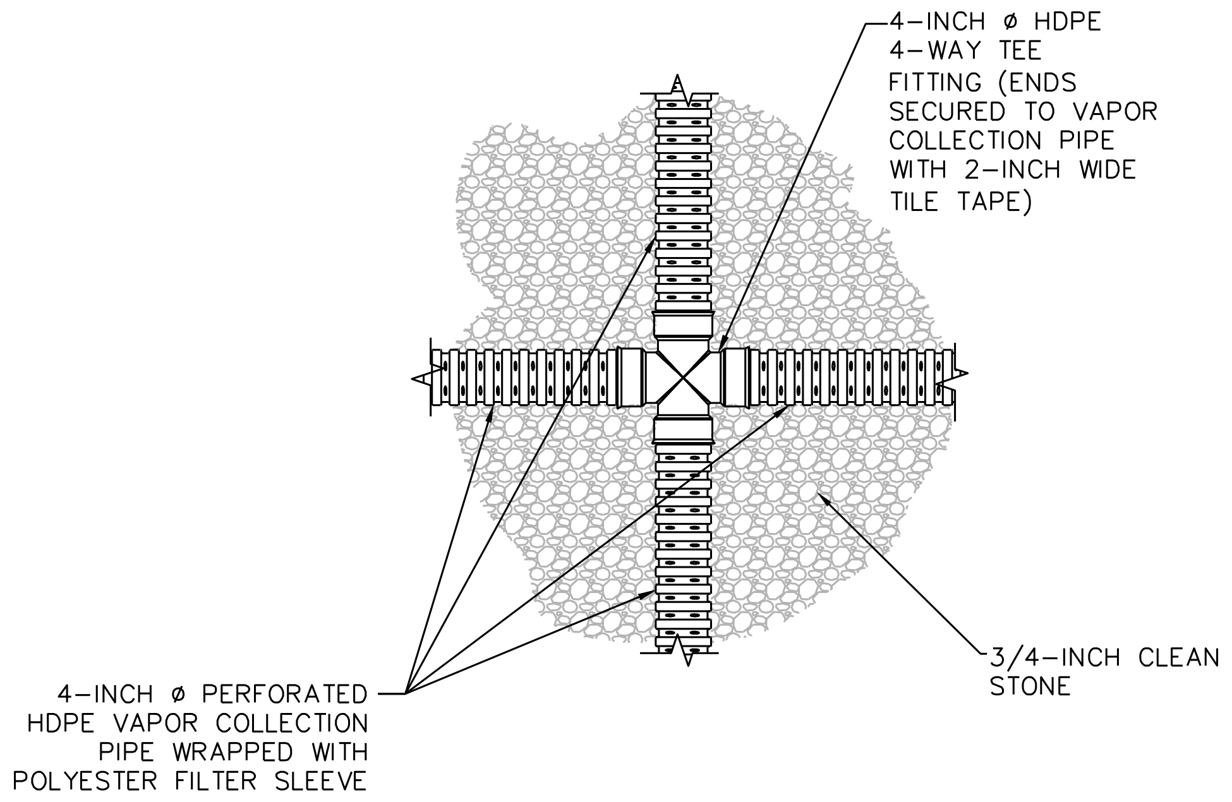
DETAIL 4: TYPICAL 90° ELBOW FITTING CONNECTION FOR VAPOR COLLECTION PIPE (PLAN VIEW)

NOT TO SCALE



DETAIL 5: TYPICAL 3-WAY TEE FITTING CONNECTION FOR VAPOR COLLECTION PIPE (PLAN VIEW)

NOT TO SCALE



DETAIL 6: TYPICAL 4-WAY TEE FITTING CONNECTION FOR VAPOR COLLECTION PIPE (PLAN VIEW)

NOT TO SCALE

GENERAL NOTES:

1. DESIGN DETAILS AND DRAWING ARE ADAPTED FROM EPA DOCUMENT EPA/625/R-92/016.
2. INSTALLATION OF THE SUBMEMBRANE COMPONENTS AND RISER PIPE MUST BE COORDINATED WITH THE INSTALLATION OF OTHER UTILITIES AND STRUCTURAL COMPONENTS.
3. PERFORATED VAPOR COLLECTION PIPE SHALL BE 4-INCH ø FLEXIBLE, CORRUGATED, SMOOTH INTERIOR, PERFORATED, HIGH DENSITY POLYETHYLENE (HDPE) PIPE WITH A MINIMUM PIPE STIFFNESS OF 35 POUNDS PER SQUARE INCH (PSI) AT 5% DEFLECTION. PERFORATIONS SHALL BE SLOT-TYPE. THERE SHALL BE, AT A MINIMUM, THREE EQUALLY SPACED PERFORATIONS PER GROOVE (I.E. DEPRESSED SECTION OF THE PIPE) OF THE CORRUGATED PIPE. PERFORATIONS ON ALTERNATING GROOVES SHALL BE OFF-SET.
4. TOP OF PERFORATED VAPOR COLLECTION PIPE SHALL BE 2 INCHES FROM THE BOTTOM OF SLAB. WHEN NECESSARY, PERFORATED VAPOR COLLECTION PIPE MAY BE ROUTED UNDERNEATH OTHER UTILITIES AND PIPING IN THE SUBSURFACE; TOP OF PERFORATED VAPOR COLLECTION PIPE SHOULD NOT EXCEED 12 INCHES FROM THE BOTTOM OF THE SLAB.
5. ALL FITTINGS AND CONNECTIONS FOR THE VAPOR COLLECTION PIPE SHALL BE 4-INCH ø HDPE FITTINGS, MADE BY THE SAME MANUFACTURER AS THE 4-INCH ø PIPE, AND OF THE TYPE RECOMMENDED BY THE MANUFACTURER FOR USE WITH THE 4-INCH ø PIPE. SECURE ALL FITTINGS AND CONNECTIONS WITH 2-INCH WIDE TILE TAPE.
6. POLYESTER FILTER SLEEVES SHALL HAVE A MINIMUM AIR PERMEABILITY OF 70 CUBIC FEET/SQUARE FEET/MINUTE.
7. RISER PIPE (DESIGNED BY OTHERS) SHALL BE 4-INCH ø METAL PIPE OR OTHER MATERIAL THAT COMPLIES WITH APPLICABLE BUILDING CODE.
8. RISER PIPE (DESIGNED BY OTHERS) SHALL BE EXTENDED TO THE ROOF WITH MINIMAL CHANGES IN DIRECTION AS SHOWN ON THE MECHANICAL AND PLUMBING DRAWINGS.
9. ALL PIPE AND CONDUIT PENETRATIONS THROUGH THE SLAB (INCLUDING MECHANICAL, ELECTRICAL, PLUMBING, OR OTHER) SHALL BE SEALED WITH A HIGH ADHESIVE SEALANT, UNLESS OTHERWISE SPECIFIED. PENETRATIONS SHALL BE AIR-TIGHT.
10. RISER PIPE MUST BE CLEARLY LABELED "CAUTION: DO NOT ALTER SUBSLAB VAPOR VENT PIPE" IN EACH ACCESSIBLE AREA (A MINIMUM OF EVERY 10 LINEAR FEET OF RISER PIPE RUN).
11. SYSTEM INSTALLATION SHALL ADHERE TO: FINAL GUIDANCE FOR EVALUATING SOIL VAPOR INTRUSION IN THE STATE OF NEW YORK PREPARED BY NEW YORK STATE DEPARTMENT OF HEALTH (NYSDOH), DATED OCTOBER 2006 AND 2008 NEW YORK CITY MECHANICAL CODE, CHAPTER 5, SECTION MC 512-SUBSLAB EXHAUST SYSTEMS. POINT OF EXHAUST (DESIGNED BY OTHERS) SHALL BE
    - ABOVE THE EAVE OF THE ROOF (PREFERABLY, ABOVE THE HIGHEST EAVE OF THE BUILDING AND 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, AND
    - 10 FEET FROM ANY ADJOINING OR ADJACENT BUILDINGS, OR HVAC INTAKES OR SUPPLY REGISTERS.

14. ALL EXTERNAL PIPES SHALL BE PAINTED WITH A CORROSION RESISTANT COATING, DEPENDING ON PIPE MATERIAL.

15. 3/4-INCH CLEAN STONE = IN-PLACE STONE SHALL BE CLEAN, COARSE, NATURAL, ANGULAR, WASHED 3/4-INCH AGGREGATE WITH THE FOLLOWING GRADATION:

SIEVE SIZE	% PASSING BY WEIGHT
1 1/2-INCH	100
1-INCH	90-100
1/2-INCH	0-5
#200	<1

16. CLEAN STONE LAYER ON TOP OF PIPE SHALL NOT BE COMPACTED.

17. CONTRACTOR SHALL PROVIDE AS-BUILT DRAWINGS (SIGNED AND SEALED BY A NYS-LICENSED PROFESSIONAL ENGINEER) OF COMPLETE SMD SYSTEM TO ENGINEERING FOLLOWING INSTALLATION.

VAPOR BARRIER NOTES:

1. VAPOR BARRIER SHALL BE INSTALLED IN ACCORDANCE WITH ALL APPLICABLE MANUFACTURER GUIDELINES AND DETAILS.
2. VAPOR BARRIER SHALL BE INSTALLED BY A MANUFACTURER-CERTIFIED INSTALLER.
3. VAPOR BARRIER SHALL BE INSPECTED IMMEDIATELY BEFORE CONCRETE IS PLACED. ALL PENETRATIONS, HOLES, OR TEARS SHALL BE SEALED BEFORE CONCRETE IS PLACED.

Date	Description	No.

REVISIONS

SIGNATURE DATE SIGNED

PROFESSIONAL JASON J. HAYES
STATE LIC. No. 089941

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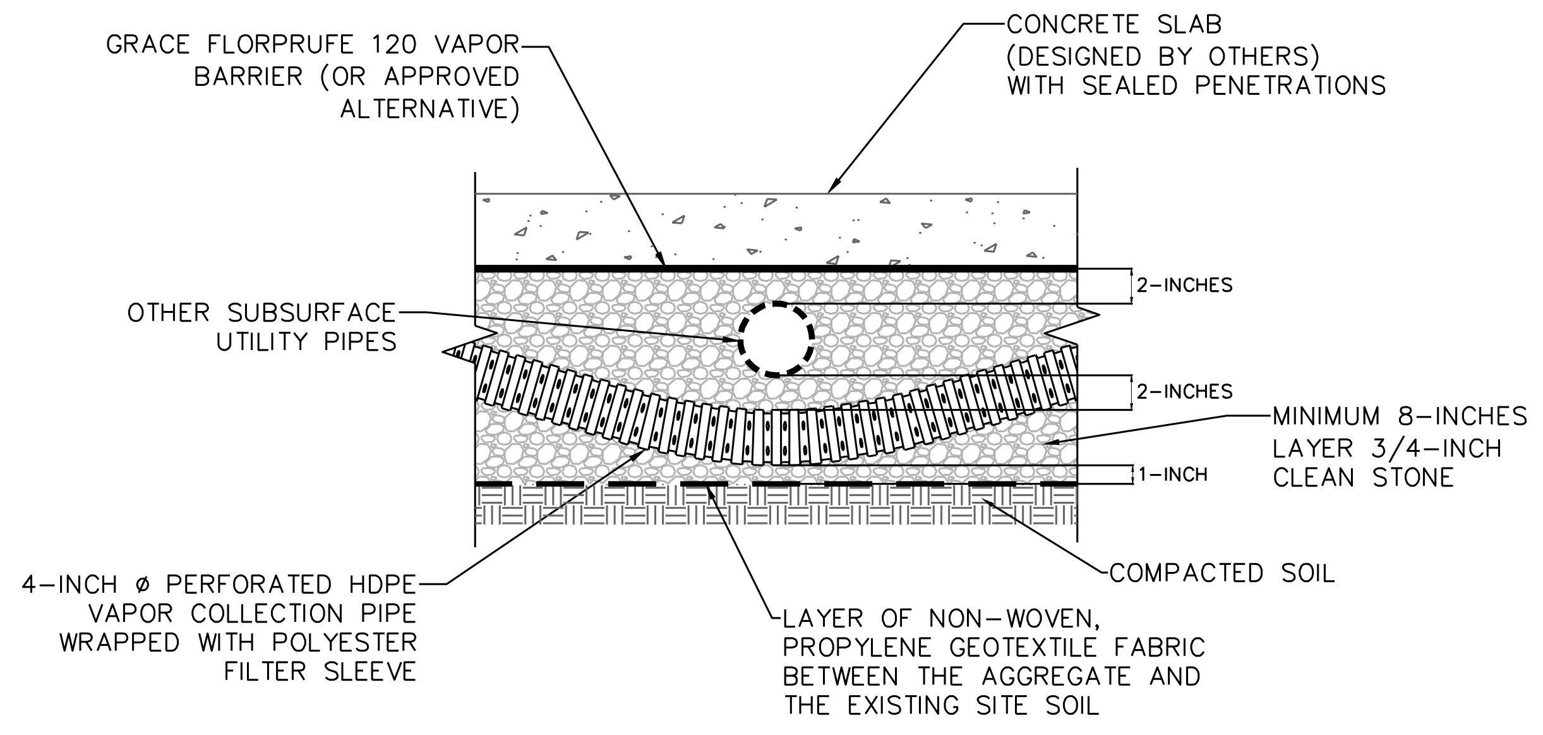
Langan International LLC
Collectively known as Langan

Project
23-10 QUEENS PLAZA SOUTH
BLOCK No. 425, LOT No. 5
LONG ISLAND CITY
QUEENS **NEW YORK**

Drawing Title
SUBMEMBRANE DEPRESSURIZATION SYSTEM DETAILS

Project No. **170244603**
Date **06/10/2015**
Scale **NTS**
Drawn By **PM**
Checked By
Submission Date
Drawing No. **E-1**
Sheet 1 of 2

NOTE: DETAIL 7 ONLY APPLIES WHERE 4-INCH HDPE VAPOR COLLECTION PIPE DOES NOT FIT ABOVE UTILITY PIPE.



DETAIL 7: TYPICAL DETAIL AT LOCATIONS OTHER SUBMEMBRANE UTILITY PIPE OVERLIES PERFORATED SUBSLAB PIPE
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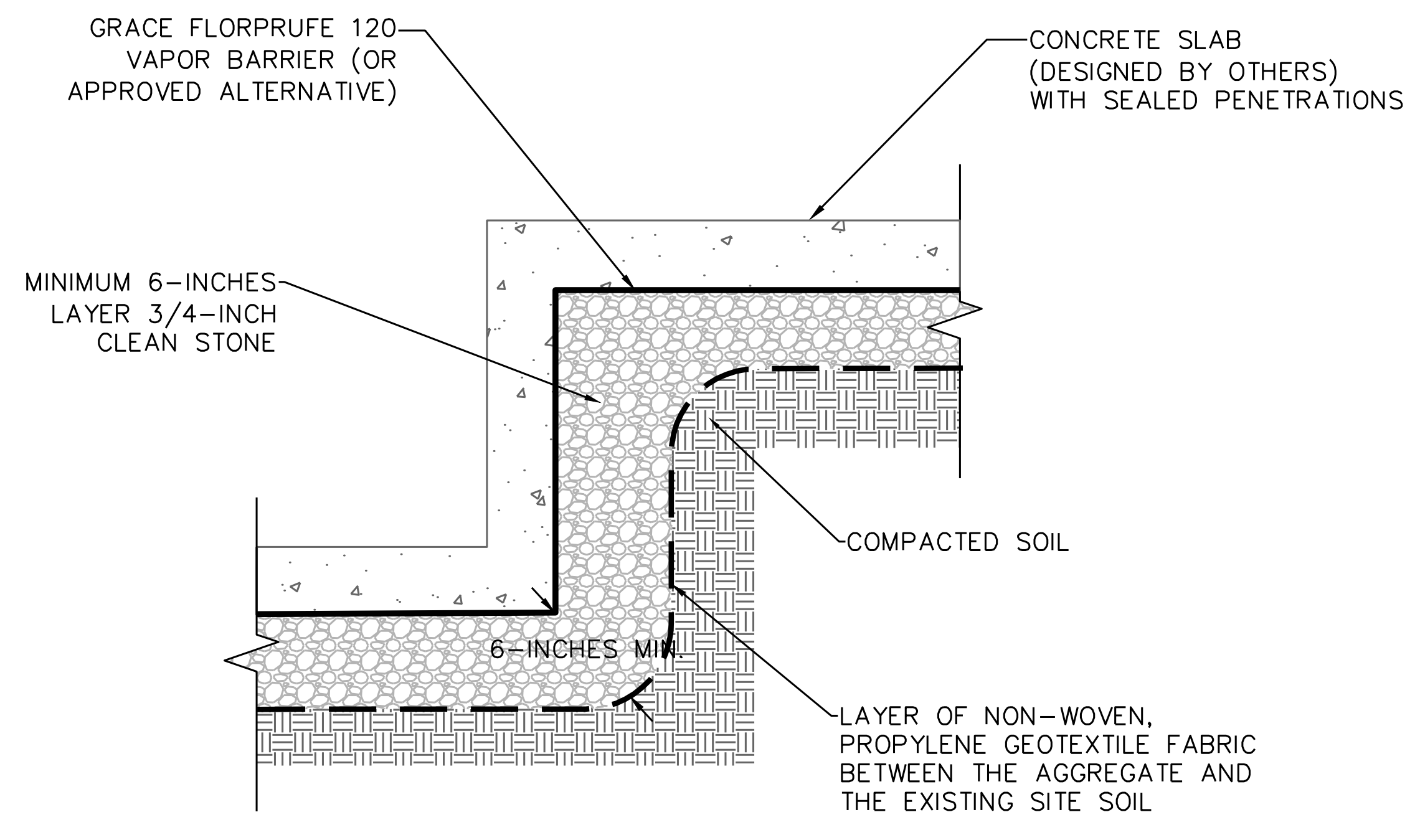

DETAIL 8: TYPICAL SECTION FOR ELEVATION CHANGE BETWEEN TWO SLABS
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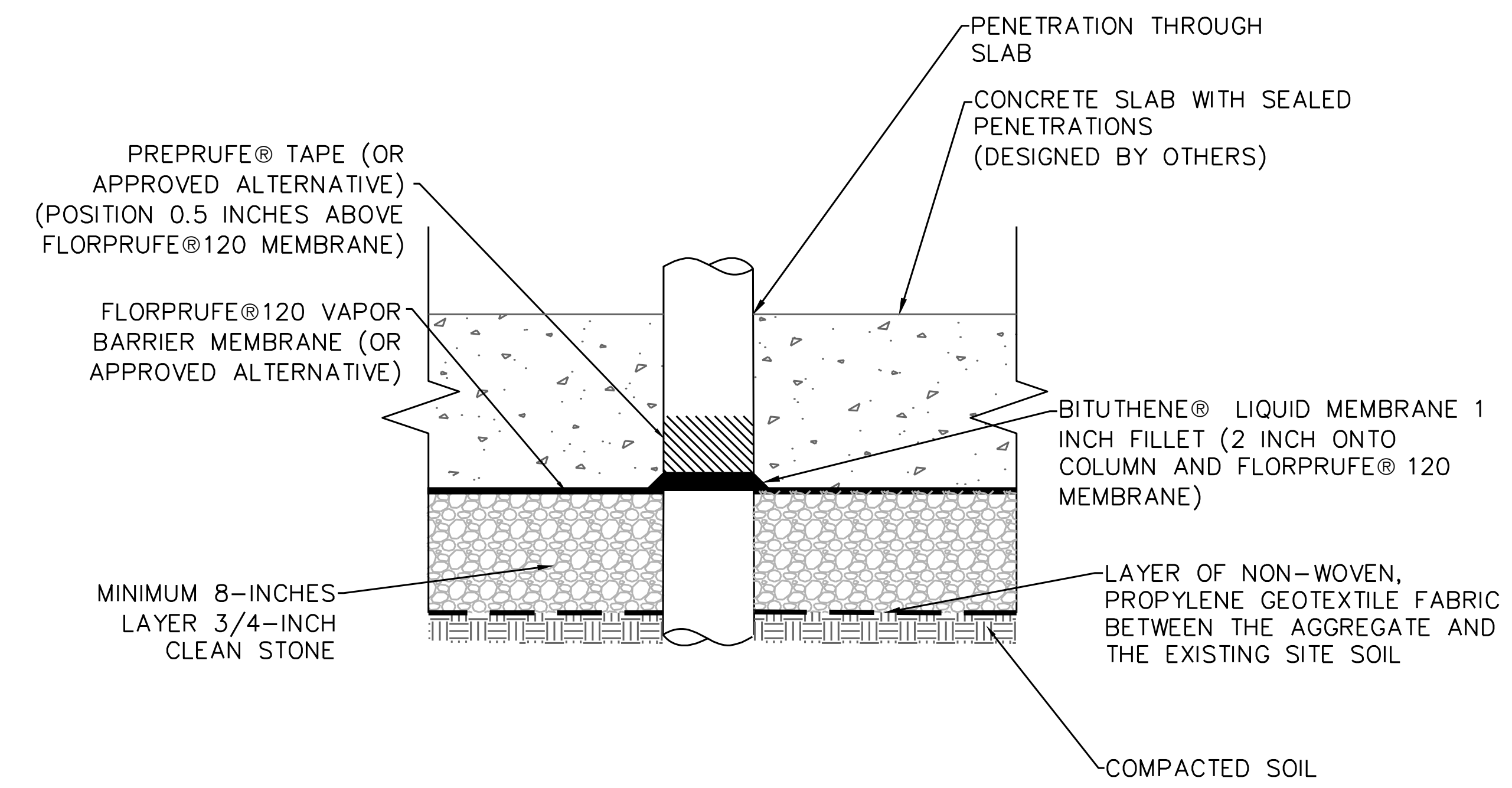

DETAIL 9: TYPICAL VAPOR BARRIER ASSEMBLY AT PENETRATION
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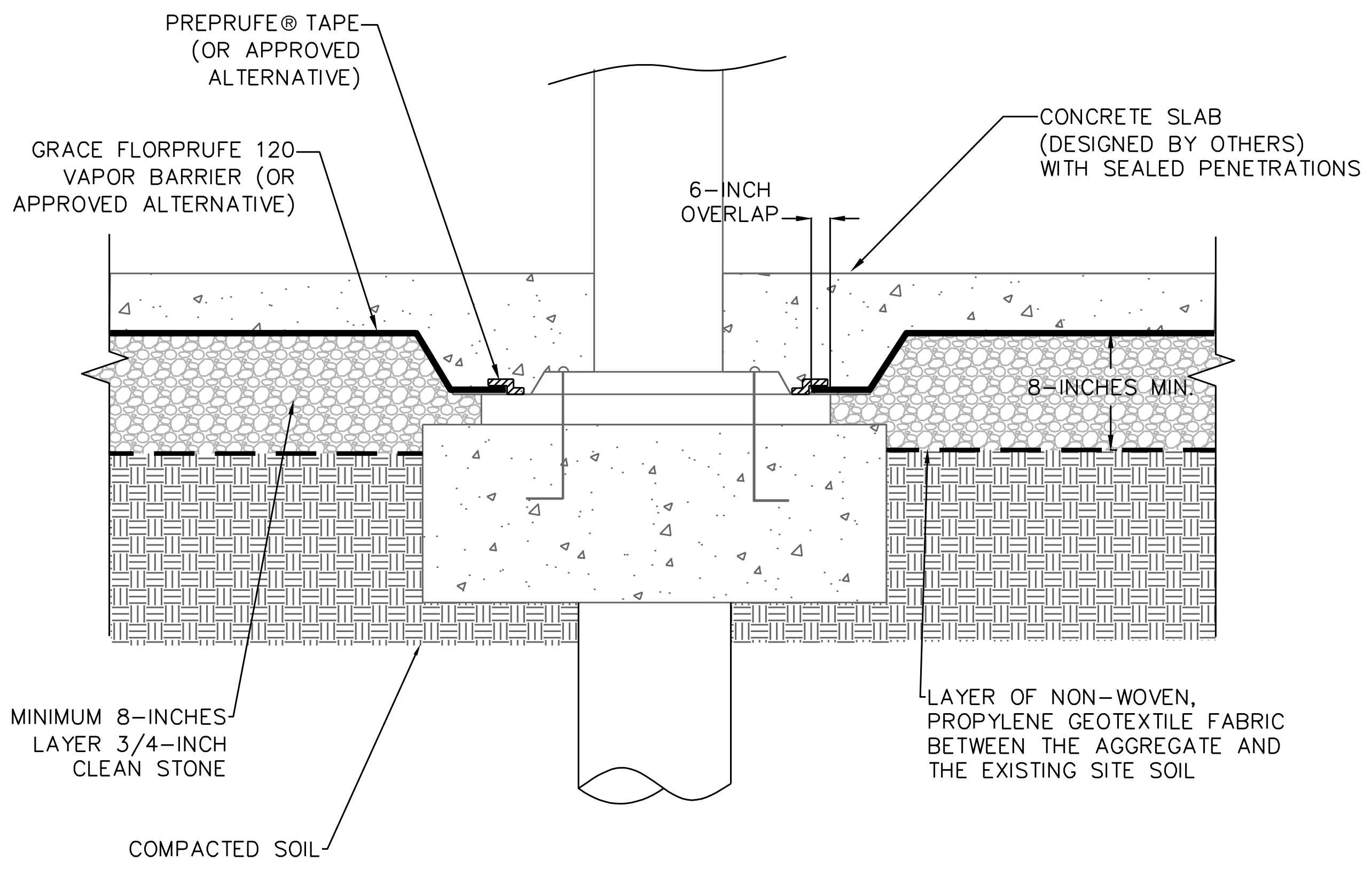

DETAIL 10: TYPICAL DETAIL FOR INTERIOR PILE CAP
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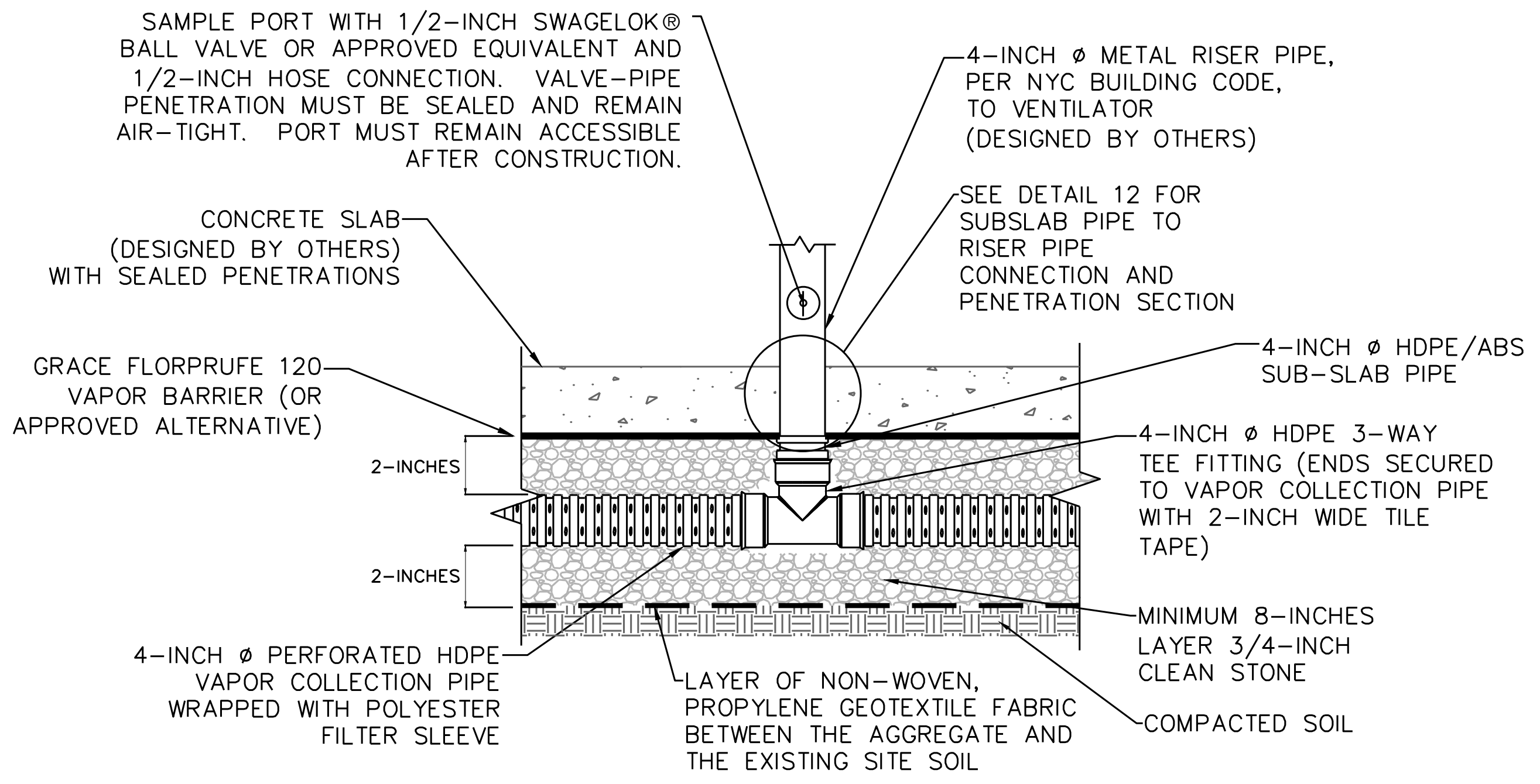
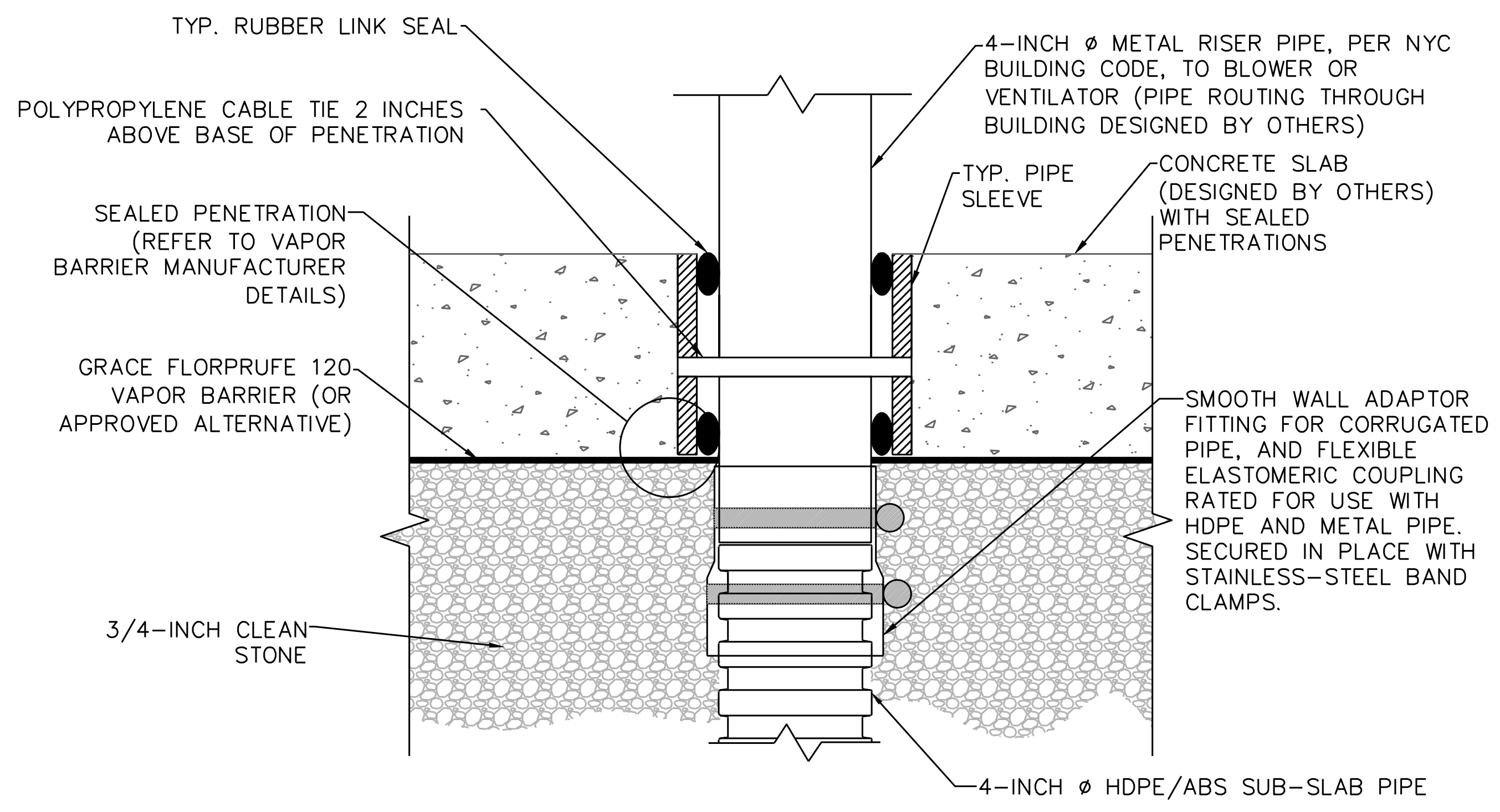


DETAIL 11: TYPICAL SECTION AT PERFORATED PIPE TO RISER PIPE
NOT TO SCALE



DETAIL 12: VAPOR COLLECTION PIPE TO RISER PIPE CONNECTION
NOT TO SCALE

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REVISIONS

SIGNATURE DATE SIGNED
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STATE LIC. No. 089941

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Langan Engineering and Environmental Services, Inc.
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Collectively known as Langan

Project
23-10 QUEENS PLAZA SOUTH
BLOCK No. 425, LOT No. 5
LONG ISLAND CITY
QUEENS NEW YORK

Drawing Title
SUBMEMBRANE DEPRESSURIZATION SYSTEM

Project No. 170244603
Date 06/10/2015
Scale NTS
Drawn By PM
Checked By
Submission Date
Drawing No. E-2
Sheet 2 of 2

APPENDIX F
COMMUNITY AIR MONITORING PLAN

Community Air Monitoring Plan

As described in the Interim Remedial Measure Work Plan (IRMWP), a four-story concrete building with a basement and partial sub-basement covers the entire Site footprint. Community air monitoring will be performed during the following activities:

- Decommissioning and removal of one registered, 10,000-gallon aboveground storage tank (AST);
- Installation of recovery wells/sumps in the southwestern portion of the building to recover light non-aqueous phase liquid (LNAPL) observed during previous investigations, and periodic LNAPL recovery using conventional LNAPL recovery technology;
- Demolition of the existing cellar slab and excavation to about 2.5 feet below slab grade (bsg) to allow for installation of a submembrane depressurization piping and site cap;
- Decommissioning and removal of four unregistered, 550-gallon underground storage tanks (USTs) and any unknown USTs;
- Additional excavation to the extent practical to remove any grossly-impacted media; and
- Backfilling of excavations, as necessary.

The Site is currently vacant, except for a portion of the first floor used as field offices for a construction site on the southern adjoining lot. During IRMWP implementation activities, all work will be performed on the basement level and access to the building will be restricted to authorized personnel.

Community air monitoring will be conducted in compliance with the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan (CAMP). The CAMP program is outlined below.

Monitoring for dust and odors will be conducted during all ground intrusive activities by the Remediation Engineer's field inspector. Continuous monitoring on the perimeter of the work zones for odor, VOCs, and dust will be required for all ground intrusive activities such as UST removal, and soil excavation and handling activities. The work zone is defined as the general area in which machinery is operating in support of remediation activities. A portable PID will be used to monitor the work zone and for periodic monitoring for VOCs during activities such as soil and groundwater sampling. The site perimeter will be monitored for fugitive dust emissions by visual observations as well as instrumentation measurements. Particulate or dust will be monitored continuously with real-time field instrumentation that will meet, at a minimum, the performance standards from DER-10 Appendix 1B.

The following actions will be taken based on VOC levels measured:

If total VOC levels exceed 5 ppm above background for the 15-minute average at the perimeter, work activities will be temporarily halted and monitoring continued. If levels readily decrease (per instantaneous readings) below 5 ppm above background, work activities will resume with continued monitoring.

If total VOC levels at the downwind perimeter of the hot zone persist at levels in excess of 5 ppm above background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level 200 feet downwind of the hot zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less – but in no case less than 20 feet, is below 5 ppm above background for the 15-minute average.

If the total VOC level is above 25 ppm at the perimeter of the hot zone, activities will be shut down.

The following actions will be taken based on visual observations and measured dust levels using a quantitative meter following minimum performance standards from DER-10 Appendix 1B:

If the downwind particulate level is 100 micrograms per cubic meter ($\mu g/m^3$) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression must be employed. Work may continue with dust suppression techniques provided that downwind PM10 levels do not exceed 150 $\mu g/m^3$ above the background level, and provided that no visible dust is migrating from the work area.

If, after implementation of dust suppression techniques, downwind PM10 levels are greater than 150 $\mu g/m^3$ 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 downwind PM10 concentration to within 150 $\mu g/m^3$ of the upwind level and in preventing visible dust migration.