Former Arkansas Chemical Co., Inc. Site

KINGS COUNTY, NEW YORK

Site Management Plan

NYSDEC Site Number: C224172

Prepared for:

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Revisions to Final Approved Site Management Plan:

Revision #	Submitted Date	Summary of Revision	DEC Approval Date

DECEMBER 2014

CERTIFICATION

I, Paul K. Boyce, am currently a New York State registered professional engineer as defined in 6 NYCRR Part 375 and that this Site Management 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) and that all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

Paul Boyce, P.E.
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Signature

12.09.14
Date

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1.0 INTRODUCTION AND DESCRIPTION OF REMEDIAL PROGRAM

1.1 INTRODUCTION

This document is required as an element of the remedial program at 74 Wallabout Street in Brooklyn, Kings County, New York (hereinafter referred to as the "Site") under the New York State (NYS) Brownfield Cleanup Program (BCP) administered by New York State Department of Environmental Conservation (NYSDEC). The site was remediated in accordance with Brownfield Cleanup Agreement (BCA) Index C224172-04-13, Site #C224172 which was executed on May 17, 2013 and amended November 2014 to include Northland LLC and Starwood LLC as owners.

1.1.1 General

74 Wallabout, LLC, Northland LLC, and Starwood LLC entered into a BCA with the NYSDEC to remediate a 0.89-acre property located in Brooklyn, Kings County, New York. This BCA required the Remedial Party, 74 Wallabout, LLC to investigate and remediate contaminated media at the site. A figure showing the site location and boundaries of this 0.89-acre site is provided in **Figure 1**. The boundaries of the site are more fully described in the metes and bounds site description that is part of the Environmental Easement.

After completion of the remedial work described in the Interim Remedial Measure Work Plan (IRMWP) and the Remedial Alternatives Analysis (RAA) / Remedial Work Plan (RWP), some contamination was left in the subsurface at this site, which is hereafter referred to as 'remaining contamination." This Site Management Plan (SMP) was prepared to manage remaining contamination at the site until the Environmental Easement is extinguished in accordance with NYS Environmental

Conservation Law (ECL) Article 71, Title 36. Reports associated with the site can be viewed by contacting the NYSDEC or its successor agency managing environmental issues in NYS.

This SMP was prepared by P.W. Grosser Engineering & Hydrogeologists, PC (PWGC) on behalf of 74 Wallabout, LLC, in accordance with the requirements in NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10), dated May 3, 2010, and the guidelines provided by NYSDEC. This SMP addresses the means for implementing the Institutional Controls (ICs) and Engineering Controls (ECs) that are required by the Environmental Easement for the site.

1.1.2 Purpose

The site contains contamination left after completion of the remedial action. ECs have been incorporated into the site remedy to control exposure to remaining contamination during the use of the site to ensure protection of public health and the environment. An Environmental Easement granted to the NYSDEC, and recorded with the Kings County Clerk, will require compliance with this SMP and the ECs and ICs placed on the site. The ICs place restrictions on site use, and mandate operation, maintenance, monitoring and reporting measures for the ECs and ICs. This SMP specifies the methods necessary to ensure compliance with the ECs and ICs required by the Environmental Easement for contamination that remains at the site. This plan has been approved by the NYSDEC, and compliance with this plan is required by the grantor of the Environmental Easement and the grantor's successors and assigns. This SMP may only be revised with the approval of the NYSDEC.

This SMP provides a detailed description of the procedures required to manage remaining contamination at the site after completion of the Remedial Action, including: (1) implementation and management of ECs and ICs and (2) performance of periodic inspections, certification of results, and submittal of Periodic Review Reports. To address these needs, this SMP includes two plans: (1) an EC and IC Plan for

implementation and management of EC/ICs and (2) a Monitoring Plan for implementation of Site Monitoring.

This plan also includes a description of Periodic Review Reports for the periodic submittal of data, information, recommendations, and certifications to NYSDEC.

It is important to note that:

- This SMP details the site-specific implementation procedures that are required by the Environmental Easement. Failure to properly implement the SMP is a violation of the environmental easement, which is grounds for revocation of the Certificate of Completion (COC);
- Failure to comply with this SMP is also a violation of ECL, 6 New York Codes, Rules and Regulations (NYCRR) Part 375 and the BCA (Index #C224172-04-13 Site #C224172) for the site, and thereby subject to applicable penalties.

1.1.3 Revisions

Revisions to this plan will be proposed in writing to the NYSDEC's project manager. In accordance with the Environmental Easement for the site, the NYSDEC will provide a notice of any approved changes to the SMP, and append these notices to the SMP that is retained in its files.

1.2 SITE BACKGROUND

1.2.1 Site Location and Description

The site is located in New York City, County of Kings, New York and is identified as Block 2261 and Lot 1 on the New York City Tax Map. The site is an approximately 0.89-acre area bounded by Wallabout Street to the north, Flushing Avenue to the south, a hotel and school properties to the east, and Kent Avenue to the west (see **Figure 2**). The boundaries of the site are more fully described in **Appendix A** – Metes and Bounds.

1.2.2 Site History

Combinations of residential, mixed and commercial buildings were demolished and several commercial buildings and a portion of the recently demolished commercial building were constructed at the subject site in 1926 and 1927. A commercial building was demolished prior to 1950 and the southern asphalt parking area was constructed at the subject site. A commercial building was demolished and the remaining portion of the current commercial building was constructed at the subject site in 1945. A commercial building was demolished prior to 1965 and the northern asphalt parking area was constructed at the subject site.

A review of available New York Telephone Address Directories, New York City Department of Buildings (NYCDOB) Certificates of Occupancy, and available Sanborn Fire Insurance Maps indicated the subject site was utilized in the past by a chemical manufacturer, furniture manufacturer, shelving company, paint and varnish manufacturer, lumber company, cable and rope company, packaging company, plastic processing company, a cleaner industries company and a housewares and household chemicals distributing company. No determination regarding the usage, storage or disposal of hazardous wastes while these facilities were in operation could be made.

1.2.3 Geologic Conditions

The subject property is located over the Long Island aquifer system, which underlies all of Nassau, Suffolk, Kings (Brooklyn), and Queens Counties. The unconsolidated aquifer formations form a southward-dipping wedge that attains a maximum thickness in Kings County of approximately eight-hundred (800) feet in southeast area of Brooklyn. Overlying bedrock in the area is the Lloyd, Magothy, Jameco, and Upper Glacial aquifer systems. The Upper Glacial aquifer overlies all underlying units and is found at the surface in nearly all of Kings and Queens Counties.

The site overlies an interconnected aquifer system consisting of the upper glacial deposits and the underlying Magothy Formation. Depth to groundwater in the underlying glacial aquifer is approximately 5 to 9 feet below ground surface (bgs). The lithologic

description of the sediments from soil borings installed during previous investigations at the site identifies the materials as fill material to approximately 8 feet bgs underlain by layers of fine to medium silty sands and silt.

Regional groundwater flow direction is east-southeast to west-northwest. Municipal water supply is provided by the New York City Department of Environmental Protection (NYCDEP).

The site is located approximately 15 feet above mean sea level. The topography of the site and general area is relatively flat with a slight downward slope to the northwest.

No erosion of surface areas was noted. Precipitation discharges into the municipal sewer/storm water system with no evidence of overland flow away from the site towards surface-water bodies.

The nearest surface-water body is the Wallabout Channel located approximately ½ mile to the northwest. Based upon site topography, overland flow to this surface-water body is unlikely.

A geologic section is shown in **Figure 3**.

A groundwater flow figure is shown in **Figure 4**.

1.3 SUMMARY OF REMEDIAL INVESTIGATION FINDINGS

Several past assessments and investigations were completed at the subject property. A Remedial Investigation (RI) was performed to characterize the nature and extent of contamination at the site. The results of the RI are described in detail in the following reports:

Phase I Environmental Site Assessment (ESA) (2006)

Middleton Environmental, Inc. (MEI) conducted a Phase I ESA for the site in October 2006. The Phase I ESA identified several historical uses of environmental concern including, a chemical company (Arkansas Chemical Co., Inc.), a paint and

varnish manufacturing company, a rope manufacturing company, a plastic processing company, a cleaner industries company, a soap company, a wood working company, a lumber company, a shelving company, and a houseware and household chemicals distributing company (Lee Distributors). No specific determination regarding the usage, storage or disposal of hazardous wastes/materials while these businesses were in operation could be made, however a 1948 Certificate of Occupancy identified permissible use at the site as the manufacture and storage of paints and varnishes. The Phase I ESA also identified suspect underground storage tanks (USTs), storm water drywells and several metal floor plates of unknown usage at the site.

Phase II ESA (2007)

PWGC conducted a Phase II ESA for the site in January 2007. The purpose of the Phase II ESA was to address the recognized environmental conditions specified in the MEI Phase I ESA Report. Due to access limitations, the Phase II ESA was limited to the northern half of the site. No investigation was conducted on the southern half of the property. The Phase II ESA included a geophysical survey of accessible areas and a subsurface investigation consisting of the installation of 8 soil borings to depths between 4.5-16 feet bgs.

A geophysical survey was performed on December 22, 2006. Due to access limitations, the geophysical was limited to the northern half of the site. Due to the nature of the existing reinforced concrete slab, a magnetometer survey was not performed. NOVA Geophysical and Environmental Services (NOVA) of Douglaston, New York performed a Ground Penetrating Radar (GPR) and Noggin's Concrete Imaging survey to locate anomalies indicative of buried USTs at the site. GPR profiles collected within the northeast corner of the existing building appeared to be consistent with the size and shape of six (6) 550-gallon USTs. Additionally, six vent lines (connected to the suspected USTs) were located on the northeast corner of the building. Additional anomalies suspected to be scrap metal or concrete rubble were also identified across the site.

Four borings were installed around the identified anomaly located at the northeast corner of the site and the remaining four borings were spread across the site. Three

groundwater samples were collected from the borings advanced near the USTs. Groundwater was encountered at approximately 12 feet bgs. The Phase II ESA included analysis of soil and groundwater samples for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs).

While the subsurface conditions around the USTs did not indicate evidence of a release, the Phase II ESA did identify an area beneath the paved portion of the site with elevated SVOC concentrations that exceed what would typically be associated with historic fill.

Visual/olfactory evidence of impact and/or elevated photo-ionization detector (PID) readings were reported at several boring locations. A total of six soil samples and three groundwater samples were submitted for analysis.

Acetone was detected above NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives (UUSCOs) in one of the six soil samples analyzed. Acetone is a common laboratory contaminant. Several SVOCs were detected in each of the samples above NYSDEC Part 375 UUSCOs and one sample collected contained SVOCs concentrations above NYSDEC Part 375 Industrial Use SCOs. Based upon these findings and the historic use of the site, the Phase II ESA recommended additional investigation which would include the entire site as well as analysis for a wider range of potential contaminants of concern that better reflect the past site uses (e.g. pesticides, polychlorinated biphenyls (PCBs) and heavy metals).

Acetone was detected in the three groundwater samples submitted for analysis; one sample contained acetone concentrations above its respective NYSDEC groundwater guidance value. Acetone is a common laboratory contaminant. Several SVOCs were detected in each of the three samples at concentrations exceeding NYSDEC groundwater standards.

Supplemental Phase II ESA (2012)

Prior to being accepted into the NYSDEC BCP, PWGC conducted a Supplemental Phase II ESA in December 2012 to characterize the southern half of the

site and to further delineate the extent of elevated SVOCs identified during the January 2007 Phase II ESA. The Supplemental Phase II ESA included a subsurface investigation consisting of the installation of eight soil borings to a depth of 20 feet bgs, three groundwater monitoring wells, and three temporary soil vapor sampling ports.

One VOC, 2-butanone, was detected above NYSDEC Part 375 UUSCOs in one of the eight soil samples analyzed. Several SVOCs were detected in four of the ten collected samples above NYSDEC Part 375 UUSCOs. The concentrations in one (SB013) of the four elevated samples was comparable to the concentrations seen in SB-8 during the Phase II ESA performed in 2007. Pesticides were detected in four of the ten soil samples above NYSDEC Part 375 UUSCOs. Metals were detected in twelve of the thirteen samples above NYSDEC Part 375 UUSCOs and mercury exceeded the NYSDEC Part 375 Industrial Use SCO in four of the soil samples.

Three groundwater monitoring wells were installed at the site to determine groundwater quality. Light non-aqueous phase liquid (LNAPL) was observed in one of the three newly installed groundwater monitoring wells (MW002). Groundwater samples were collected from the two groundwater monitoring wells not containing LNAPL and from two temporary groundwater points to determine groundwater quality. In addition, an LNAPL sample was collected for identification.

One VOC, naphthalene, was detected in one of the groundwater samples above its respective NYSDEC guidance value. Several SVOCs were detected in each of the four groundwater samples above NYSDEC Ambient Water Quality Standards (AWQS). Several metals were detected in both the total and dissolved groundwater samples above NYSDEC AWQS; however mercury was not detected above the AWQS in the dissolved groundwater samples. The LNAPL was determined to most closely match No 4 or No 6 fuel oil.

Three temporary soil vapor samples were collected at the site to determine soil vapor concentrations. Several VOCs were detected in each of the three samples. None

of the compounds associated with the New York State Department of Health (NYSDOH) decision matrices were detected.

Remedial Investigation (2013)

An RI was performed at the site in 2013 by PWGC. The scope of work for the RI was detailed in a RI Work Plan dated June 2013, and a RI Work Plan Addendum dated July 1, 2013. Field work for the RI was completed between July and August 2013, and is documented in a draft RI Report dated September 2013. The final RI Report was submitted on April 30, 2014. The scope of work for the RI consisted of:

- Geophysical Investigation.
- Characterization of pits and concrete vault.
    - Removal and proper disposal of liquids and sediment.
    - Installation of two shallow soil samples beneath two structures found to have earthen bottoms.
- Installation of seven soil borings.
    - Collection and analysis of soil samples from 0-2 feet, 6-8 feet, and 10-12 feet.
- Installation of three temporary groundwater sampling points.
- Installation of four observation wells and two groundwater monitoring wells.
    - Monitoring of all site wells.
    - Sampling of new wells not containing LNAPL.
- Installation of four soil vapor points.

The geophysical investigation identified one additional anomaly at the site which shows similar characteristics of a 550-gallon UST located in the northwest parking area of the site. No additional new anomalies were identified. An additional UST was identified during removal of the concrete slab in the southwest portion of the site.

One large concrete vault and fifteen pits were located within the building slab at the site. Sediment within the structures was found to contain elevated levels of VOCs, SVOCs, metals, and pesticides. Liquids and sediment were removed from each structure

so that a visual inspection could be performed on the base of each structure. All but two structures were found to have solid concrete bottoms and be in sound condition. Shallow soil samples were collected beneath the structures in contact with the subsurface.

Seven soil borings were conducted throughout the site to a depth of 12 to 14 feet bgs, soil samples were collected, characterized, and analyzed. Analytical results indicated that soils across the entire site contained elevated concentrations of VOCs, SVOCs, pesticides, and metals to a depth of ten feet bgs. SVOCs and metals were elevated at a depth greater than eight feet. The concentrations were fairly uniform with the exception of significantly higher SVOCs and metals in the center of the property and in the northwest corner of the property.

Two groundwater monitoring wells, four observation wells and three temporary groundwater sampling points were installed at the site. The newly installed groundwater monitoring wells were developed within 48 hours of installation. The newly installed monitoring wells and observation wells were monitored along with the existing groundwater monitoring wells at the subject site. LNAPL was identified in two groundwater monitoring wells (MW002 and MW005) and three observation wells (OB001, OB002, and OB004). Groundwater samples were collected from groundwater monitoring wells and observation wells not containing LNAPL and the three temporary groundwater sampling points. Analytical results identified minor petroleum impacts in the vicinity of the LNAPL plume, SVOC and metals impacts across the site. Impacts were relatively minor with the exception of metals at the SB022 location which contained elevated levels of lead and mercury within the dissolved groundwater sample.

Four soil vapor points were installed onsite, sampled, and analyzed. Several VOCs were detected in each of the four samples. One VOC, trichloroethene (TCE), was detected above the NYSDOH decision matrices level of 50 $\mu g/m^3$.

Generally, the RI determined that:

- The static water table elevation at the site is between 5 feet in the northwest portion of the property were the elevation of the site is significantly lower to 9

feet bgs. Recent work has shown that groundwater has been measured at approximately 7 feet bgs in off-site monitoring wells.

- Groundwater beneath the site flows toward the west-northwest.
- An LNAPL plume is present in the southwestern portion of the property. The LNAPL was identified as petroleum-based in nature from laboratory analysis. The LNAPL was thickest at the MW005 location (4.95 feet). The source of LNAPL was attributed to the UST in the southwest portion of the property. Further observations subsequent to the RI have identified the oil as either #4 or #6 fuel oil.
- Soil across the site contains VOCs, SVOCs, pesticides, and/or metals above UUSCOs. Two hot spot areas were identified in the center of the property and the northwest corner which contained significantly higher concentrations of SVOCs and metals. Contaminants are likely inherent in the fill material beneath the subject property. Soil contamination generally decreased with depth and only SVOCs and metals were detected above UUSCOs in the soils below ten feet bgs.
- Groundwater at the site has minor detections of VOCs, SVOCs, and/or dissolved metals above Guidance Values or AWQS. The compounds detected were also detected in the soils beneath the site and are likely migrating from the soil into the groundwater. There does not appear to be significant groundwater impact migrating off the site with the exception of the LNAPL plume in the southwest portion of the property.
- The fate and transport of contaminants identified is a function of the properties of the individual contaminants, the geology and hydrogeology of the site, and available pathways for the contaminants to migrate. The following factors were considered when determining the fate and transport of the contaminants identified on-site: the relatively small size of the Site, the concentrations and locations of soil, groundwater, and soil vapor impact within the Site, and the measured groundwater flow direction towards the northwest. Based upon these factors, the LNAPL plume has likely migrated beneath Kent Avenue and there is potential for off-site soil vapor impact from the LNAPL plume.

- The possible on-site exposure pathways are by ingestion, inhalation, or dermal exposure to workers during construction activities or to site trespassers. Off-site exposure scenarios include inhalation of particulates during construction and possible off-site LNAPL migration. These exposures would likely not be extensive given the intermittent nature and duration or the site construction activities. There is no plausible off-site ingestion or dermal exposure pathway. Vapor migration into the on-site buildings and vapor exposure to future residences is a possible exposure pathway dependent on the extent of LNAPL.
- Because of the relatively small size of the Site and the observed levels of onsite impact in soil, groundwater and soil vapor, future onsite populations are potential receptors if appropriate Institutional Controls / Engineering Controls (ICs/ECs) are not properly implemented.

Below is a summary of site conditions when the RI was performed in 2006-2013:

Soil

The following was utilized for the evaluation of contamination in soil:

1. Subsurface soil samples were collected from the two foot interval above refusal depth (4-6 feet) or the water table (9-11 feet) during the Phase II Investigation (December 2006). Subsurface soil samples were analyzed for the presence of VOCs and SVOCs.

2. Subsurface soil samples were collected from varying depths and at least one interval from each boring during the Supplemental Phase II Investigation (December 2012). Subsurface soil samples were analyzed for the presence of VOCs, SVOCs, pesticides, PCBs, and metals.

3. Subsurface soil samples were collected at three depths during the RI; 0-2 feet bgs, 6-8 feet bgs, and 10-12 feet bgs and from beneath two pits found to have contact with the subsurface. Subsurface soil samples were analyzed for the presence of VOCs, SVOCs, pesticides, PCBs, and metals.

Analytical results identified the presence of:

- Several VOCs were detected above UUSCOs including acetone in SB-1, SB-2, SB-3, SB-4, SB-6, SB-8, SB019, SB022, and SB023, benzene in SB022, p/m-xylene in SB021 and SB022, and trichloroethene in SB022. Contamination was limited to the shallow intervals (0-2 feet and 6-8 feet).

- Several SVOCs were detected above UUSCOs in several soil borings including acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, dibenzofuran, fluorine, ideno(a,2,3-cd)pyrene, naphthalene, phenanthrene, and/or pyrene. SVOCs were significantly higher in the 4-6 foot interval from SB-8, the 6-8 foot interval from SB013, SB018, and SB021 when compared to the rest of the samples.

- Several metals were detected above UUSCOs in several of the borings including arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel and zinc. In general, concentrations were highest in the shallow soil intervals and decreased in the deeper intervals.

- Pesticides, Alpha-BHC, 4,4'-DDD and/or 4,4'-DDT, were detected above UUSCOs in several of the samples. The detections were limited to the shallow soil intervals and were not detected in the deepest soil interval (10-12 feet).

The presence of SVOCs, pesticides, and metals is likely attributed to fill material at the site. The highest concentrations were observed between four and eight feet below grade. Spread or migration of contaminants is likely a result of physical processes and should be limited to the soils immediately beneath the site and localized groundwater.

Site-Related Groundwater

The following was utilized for the evaluation of contamination in groundwater:

1. Three groundwater samples collected adjacent to the UST during the Phase II Investigation (December 2006). Groundwater samples were analyzed for VOCs and SVOCs.

2. Three permanent and two temporary groundwater monitoring wells were installed during the Supplemental Phase II Investigation (December 2012). Groundwater samples were collected from four of the five wells and analyzed for the presence of VOCs, SVOCs, pesticides, PCBs, and metals. LNAPL was observed in one well and not sampled.

3. Two groundwater monitoring wells, four observation wells and three temporary groundwater sampling points were installed during the RI (July and August 2013). Groundwater samples were analyzed for the presence of VOCs, SVOCs, pesticides, PCBs, and metals. LNAPL was observed in two wells and not sampled.

Groundwater analytical results identified the presence of:

- LNAPL was observed in three monitoring wells. The LNAPL was determined to most closely match No 4 or No 6 fuel oil.

- Several VOCs were detected above guidance values or AWQS. Acetone was detected above its guidance value in GW-2, naphthalene was detected above its guidance value in GW013, and benzene was detected above AWQS in OB003. Acetone is a common laboratory contaminant. No other VOCs were detected above guidance values or AWQS.

- Several SVOCs were detected above AWQS in multiple groundwater samples (GW-1, GW-2, GW-3, GW011, GW013, MW001, MW005, SB020(GW) and SB021(GW)) including acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, ideno(a,2,3-cd)pyrene, fluorine, naphthalene, phenanthrene, and pyrene. The detections were relatively low and are not indicative of a release condition with the exception of MW005 which contained LNAPL.

- Several metals were detected above AWQS in each of the dissolved groundwater samples including antimony, iron, lead, manganese, mercury, and sodium. Lead

and mercury were limited to one sample (SB022). The other metals detected are relatively common in groundwater and are likely naturally occurring due to the composition of soils in the aquifer.

The presence of VOCs in groundwater at the site is likely related to the LNAPL plume; SVOC and metals impact is likely related to the presence of historic urban fill material beneath the site. The spread or migration of contaminants is likely to be localized and dependent on groundwater flow direction and velocity.

Site-Related Soil Vapor Intrusion

During the Supplemental Phase II ESA completed in 2012, three temporary soil vapor samples were collected at the site to determine soil vapor concentrations. Several VOCs were detected in each of the three samples. None of the compounds associated with the NYSDOH decision matrices were detected.

During the RI completed in 2013, four soil vapor points were installed onsite, sampled, and analyzed. Several VOCs were detected in each of the four samples. One VOC, TCE, was detected above the NYSDOH decision matrices level of 50 $\mu g/m^3$.

Underground Storage Tanks

UST closure activities were performed in accordance with NYSDEC DER-10 and the IRMWP dated October 10, 2013.

74 Wallabout, LLC retained the services of All Boro Tank Testing (ABTT) to perform UST closure activities at the site. PWGC provided coordination, oversight and documentation of UST closure activities.

NYSDEC Notification

Prior to performing UST closure activities, the NYSDEC was notified via email. During a January 8, 2014 conference call, the NYSDEC approved the start of UST closure activities and requested that samples collected from the excavation bottoms be analyzed for metals, pesticides, and PCBs in addition to VOCs and SVOCs.

Underground Storage Tank Registration

Upon determination of the number, size, and composition of the USTs at the subject site, PWGC completed the Petroleum Bulk Storage (PBS) registration form, required by 6 NYCRR 612.2(d), which was submitted to the NYSDEC by the property owner. It was determined that there were a total of nine USTs at the subject site which were characterized as follows:

Tank Number	Capacity (Gallons)	Product Stored	Tank Type
1	1,000	Diesel	Steel
2	1,000	Diesel	Steel
3	1,000	Diesel	Steel
4	1,000	Diesel	Steel
5	1,000	Diesel	Steel
6	1,000	Diesel	Steel
7	1,000	Diesel	Steel
8	550	Gasoline	Steel tank in Concrete
9	3,000	#2 Fuel Oil	Steel

The location and orientation of the USTs and copy of the PBS registration form will be included in the Final Engineering Report (FER).

Underground Storage Tank Removal

UST removal activities began on January 8, 2014. An excavator was utilized to expose the top of each UST. Prior to removal from the subsurface, remaining liquids and sludge were pumped out utilizing a vacuum powered pump truck. A total of 3,060 gallons of liquids were removed and properly disposed of at Cycle Chem Inc. in Elizabeth, New Jersey. Liquid waste manifests are included in **Appendix D**. Seven USTs (Tank 1 through 7) were identified within a subsurface concrete encasement in the northeast corner of the property. Tank # 8 was located in the northwest corner of the property and found to be encased in concrete. Tank # 9 was located in the southwest corner of the property.

Following removal of liquids, the USTs were cut open, cleaned, removed from the ground utilizing the excavator including associated piping, and placed on plastic

sheeting for inspection. The USTs were found to be in poor condition with corrosion holes visually observed in Tanks Number 4, 6, and 9 ranging in size up to ½ inch in diameter. Groundwater was encountered beneath Tank # 8 and 9 and LNAPL was visually observed on the water table. There were no signs of petroleum impact beneath the northeast tanks.

Following the removal of the USTs, the base of each tank excavation was inspected and screened with a PID for the evidence of petroleum impact. Petroleum impacted soils were identified beneath Tank #8 and 9.

Underground Storage Tank Soil Characterization Sampling Protocol

In order to characterize subsurface conditions in the vicinity of the removed USTs, subsurface soil samples were collected in accordance with Section 5.5 of NYSDEC DER-10 and the January 8, 2014 correspondence with the NYSDEC.

Since there was no evidence of a discharge and there was no groundwater beneath the USTs in the northeast corner of the property (Tank # 1 through 7), discrete center line soil samples were collected from beneath the former location of the USTs at a frequency equal to the total length of the tank in feet divided by five. A total of three bottom samples were collected from the former location of each UST (EP001 through EP021). Since there was evidence of a discharge and groundwater was encountered beneath Tank # 8 and 9, sidewall samples were collected per every fifteen feet of linear sidewall of each former UST location (SW001 through SW008). Soil/sediment samples were retrieved from each location utilizing a stainless steel hand auger. Prior to sampling, equipment was decontaminated using a laboratory-grade detergent and tap water scrub to remove visual contamination; generous tap water rinse; followed by a distilled water rinse. Three grab samples were retrieved from each location. VOCs are sensitive and compositing the samples often releases some of the organics as vapor, therefore grab samples were collected for field screening and laboratory analysis of VOCs. Grab samples were screened with a PID to detect the presence of volatile organic vapors associated with petroleum products and industrial solvents. Volatile organic vapors were detected above background in SW001 through SW008 ranging from 32 ppm to 320 ppm.

Volatile organic vapors above background were not detected in the bottom samples from the northeast tank location. A VOC sample was collected from the highest PID reading or from one of the grab samples at random where there was no PID response and jarred separately. The remaining samples were transferred to a stainless steel bowl,homogenized, and collected for laboratory analysis of SVOCs, pesticides, PCBs, and metals as a composite sample.

Samples were collected in pre-cleaned laboratory supplied glassware and stored in a cooler on ice for transport to Alpha Analytical Laboratories (AAL) for analysis. Samples were analyzed for:

- TCL/PP VOCs by United States Environmental Protection Agency (USEPA) Method 8260
- TCL/PP SVOCs by USEPA Method 8270

The NYSDEC also requested that bottom samples be analyzed for the following:

- TCL Organochlorine Pesticides & PCBs by USEPA Methods 8081/8082
- TAL Metals by USEPA Methods 6010/7471

Underground Storage Tank Soil Characterization Analytical Results

Soil analytical results were compared to the cleanup objectives established in the IRMWP dated October 10, 2013.

One or more VOCs were detected above laboratory method detection limits (MDLs) in each of the UST characterization samples. The detections were relatively low and none exceed their respective NYSDEC UUSCO.

One or more SVOCs were detected above laboratory MDLs in each of the UST characterization samples. The detections exceeded the NYSDEC Protection of Groundwater SCOs (POGSCOs) in twenty-six of the twenty-nine UST characterization samples. Compounds detected above SCOs included Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dibenzofuran, and Ideno(1,2,3-

cd)pyrene. In general these compounds have been detected throughout the site at varying concentrations and the concentrations observed are consistent with concentrations observed across the site. It does not appear that the USTs have added to existing SVOC concentrations.

One or more metals were detected above laboratory MDLs in each of the UST characterization samples. Several metals were detected above NYSDEC Restricted Residential Use SCOs (RRSCOs) or the Site Specific SCO including lead in each sample and barium (EP006), copper (EP001, EP006, and EP007) and mercury (EP007 and EP015). In general these compounds have been detected throughout the site at varying concentrations and the concentrations observed are consistent with concentrations observed across the site. It does not appear that the USTs have added to existing metal concentrations.

One or more Pesticides and/or PCBs were detected above laboratory MDLs in seven of the twenty-one UST characterization samples. One Pesticide (4,4'-DDD) was detected above its respective NYSDEC UUSCO in EP001.

1.4 SUMMARY OF REMEDIAL ACTIONS

The site was remediated in accordance with the NYSDEC-approved IRMWP dated October 10, 2013 and the draft Remedial Alternatives Analysis and Remedial Action Work Plan dated July 2014.

The following is a summary of the Remedial Actions performed at the site:

1. Excavation of soil/fill exceeding the following site specific SCOs as approved in the IRMWP and subsequent approvals during the IRM implementation:

    - UUSCOs for VOCs (less acetone), Pesticides, and PCBs,
    - Protection of groundwater SCOs for SVOCs,
    - Restricted residential SCOs for acetone and all metals except arsenic and mercury,

- Arsenic SCO of 40 milligrams per kilogram (mg/kg),
- Mercury SCO of 5.7 mg/kg.

Within the footprint of the proposed building, soils were excavated to a minimum depth of ten feet bgs. Several grids were excavated deper for either construction purposes or for attainment of SCOs. In the portion of the site to be used for the future school expansion, soils were excavated to eight feet bgs. The excavation completion information will be provided in the FER.

2. Removal of LNAPL through dewatering and vacuum enhanced fluid recovery (VEFR) events;
3. LNAPL migration mitigation through the use of the steel sheeting installed at the property's perimeter;
4. Installation of a vapor barrier/water proofing membrane under the building's foundation;
5. Backfill the portion of the site to be used for future school expansion with clean fill;
6. Construction and maintenance of a composite cover system consisting of the footprint of the building and two-foot depth ground cover in areas that are not developed with a structure to prevent human exposure to remaining contaminated soil/fill remaining at the site;
7. Execution and recording of an Environmental Easement to restrict land use and prevent future exposure to any contamination remaining at the site.
8. Development and implementation of a SMP for long term management of remaining contamination as required by the Environmental Easement, which includes plans for: (1) ICs and ECs, (2) monitoring, (3) operation and maintenance and (4) reporting;

Remedial activities are anticipated to be completed by December 2014.

1.4.1 Removal of Contaminated Materials from the Site

The SCOs for the primary contaminants of concern and applicable land use for this site are:

- UUSCOs for VOCs (less acetone), Pesticides, and PCBs,
- Protection of groundwater SCOs for SVOCs,
- Restricted residential SCOs for acetone and all metals except arsenic and mercury,
- Arsenic SCO of 40 milligrams per kilogram (mg/kg),
- Mercury SCO of 5.7 mg/kg.

Soils were disposed at the following facilities:

- Clean Earth of Carteret – 10,053.96 tons
- Clean Earth of Carteret (Canal) – 2,286.31 tons
- Clean Earth of New Castle – 4,805.16 tons
- Clean Earth of Southeast Pennsylvania – 2,859.45 tons
- Atlantic County Utilities Authority Landfill – 641.06 tons
- Bellmawr Waterfront Redevelopment Site – 6,713.05 tons
- American Landfill – 14 drums

A figure showing areas where excavation was performed will be included in the FER.

Liquids were disposed at the following facilities:

- Cycle Chem Inc – 2,700 gallons
- Clean Water of New York – 17,300 gallons

1.4.2 Site-Related Treatment Systems

No long-term treatment systems were installed as part of the site remedy.

1.4.3 Remaining Contamination

Soil remaining meets the site specific SCOs.

VOCs

Soil remaining meets UUSCOs for VOCs with the exception of acetone which remains in soil above UUSCOs, but below RRSCOs.

SVOCs

The following compounds remain in soil above UUSCOs, but below POGSCOs:

- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Indeno(1,2,3-cd)pyrene

Pesticides

Soil remaining meets UUSCOs for pesticides.

PCBs

Soil remaining meets UUSCOs for PCBs.

Metals

The following metals remain soil above UUSCOs, but below RRSCOs:

- Copper
- Lead
- Silver
- Zinc

Arsenic and mercury are present in soil below the site specific SCOs of 40 mg/kg and 5.7 mg/kg, respectively. **Figure 5** summarizes the results of soil remaining after completion of Remedial Action that exceed the Track 1 (unrestricted) SCOs.

A demarcation layer consisting of RCA was installed between the final excavation depth and the vapor barrier within the footprint of the proposed building. An orange plastic snow fencing material was used as a demarcation layer in the proposed future school expansion.

2.0 ENGINEERING AND INSTITUTIONAL CONTROL PLAN

2.1 INTRODUCTION

2.1.1 General

Since remaining contaminated soil, exists beneath the site, EC/ICs are required to protect human health and the environment. This EC/IC Plan describes the procedures for the implementation and management of EC/ICs at the site. The EC/IC Plan is one component of the SMP and is subject to revision by NYSDEC.

2.1.2 Purpose

This plan provides:

- A description of EC/ICs on the site;
- The basic implementation and intended role of each EC/IC;
- A description of the key components of the ICs set forth in the Environmental Easement;
- A description of the features to be evaluated during each required inspection and periodic review;
- A description of plans and procedures to be followed for implementation of EC/ICs, such as the implementation of the Excavation Work Plan for the proper handling of remaining contamination that may be disturbed during maintenance or redevelopment work on the site; and
- Any other provisions necessary to identify or establish methods for implementing the EC/ICs required by the site remedy, as determined by the NYSDEC.

2.2 ENGINEERING CONTROLS

2.2.1 Engineering Control Systems

2.2.1.1 Composite Cover

Exposure to remaining contamination in soil/fill at the site is prevented by a composite cover system placed over the site. The cover system within the footprint of the proposed building is comprised of concrete-covered sidewalks, and concrete building slabs with a vapor barrier installed beneath. The cover system for the proposed future school expansion area is comprised of a minimum of 24 inches of RCA. A composite cover plan is shown on **Figure 6**. The Excavation Work Plan (EWP) that appears in **Appendix B** outlines the procedures required to be implemented in the event the cover system is breached, penetrated or temporarily removed, and any underlying remaining contamination is disturbed. Procedures for the inspection and maintenance of this cover are provided in the Monitoring Plan included in Section 4 of this SMP.

2.2.2 Criteria for Completion of Remediation/Termination of Remedial Systems

Generally, remedial processes are considered completed when effectiveness monitoring indicates that the remedy has achieved the remedial action objectives identified by the decision document. The framework for determining when remedial processes are complete is provided in Section 6.6 of NYSDEC DER-10.

2.2.2.1 Composite Cover System

The composite cover system is a permanent control and the quality and integrity of this system will be inspected at defined, regular intervals in perpetuity.

2.3 INSTITUTIONAL CONTROLS

A series of ICs is required by the RWP to: (1) implement, maintain and monitor EC systems; (2) prevent future exposure to remaining contamination by controlling disturbances of the subsurface contamination; and, (3) limit the use and development of

the site to restricted residential uses only. Adherence to these ICs on the site is required by the Environmental Easement and will be implemented under this SMP. These ICs are:

- Compliance with the Environmental Easement and this SMP by the Grantor and the Grantor's successors and assigns;
- All ECs must be operated and maintained as specified in this SMP;
- All ECs on the Controlled Property must be inspected at a frequency and in a manner defined in the SMP.
- Soil vapor and other environmental or public health monitoring must be performed as defined in this SMP;
- Data and information pertinent to Site Management of the Controlled Property must be reported at the frequency and in a manner defined in this SMP;

ICs identified in the Environmental Easement may not be discontinued without an amendment to or extinguishment of the Environmental Easement.

The site has a series of ICs in the form of site restrictions. Adherence to these ICs is required by the Environmental Easement. Site restrictions that apply to the Controlled Property are:

- The property may only be used for restricted residential, commercial, or industrial use provided that the long-term ECs and ICs included in this SMP are employed.
- The property may not be used for a higher level of use, such as unrestricted use without additional remediation and amendment of the Environmental Easement, as approved by the NYSDEC;
- All future activities on the property that will disturb remaining contaminated material must be conducted in accordance with this SMP;

- The use of the groundwater underlying the property is prohibited without treatment rendering it safe for intended use;
- The potential for vapor intrusion must be evaluated for any buildings developed on the property and any potential impacts that are identified must be monitored or mitigated;
- Vegetable gardens and farming on the property are prohibited;
- The site owner or remedial party will submit to NYSDEC a written statement that certifies, under penalty of perjury, that: (1) controls employed at the Controlled Property are unchanged from the previous certification or that any changes to the controls were approved by the NYSDEC; and, (2) nothing has occurred that impairs the ability of the controls to protect public health and environment or that constitute a violation or failure to comply with the SMP. NYSDEC retains the right to access such Controlled Property at any time in order to evaluate the continued maintenance of any and all controls. This certification shall be submitted annually, or an alternate period of time that NYSDEC may allow and will be made by an expert that the NYSDEC finds acceptable.

2.3.1 Excavation Work Plan

The site will be remediated for restricted residential use. Any future intrusive work that will penetrate the soil cover or cap, or encounter or disturb the remaining contamination, including any modifications or repairs to the existing cover system will be performed in compliance with the EWP that is attached as **Appendix B** to this SMP. Any work conducted pursuant to the EWP must also be conducted in accordance with the procedures defined in a Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP) prepared for the site. A sample HASP is attached as **Appendix C** to this SMP that is in current compliance with DER-10, and 29 Code of Federal Regulations (CFR) 1910, 29 CFR 1926, and all other applicable Federal, State and local regulations. Based on future changes to State and federal health and safety requirements, and specific

methods employed by future contractors, the HASP and CAMP will be updated and re-submitted with the notification provided in Section A-1 of the EWP. Any intrusive construction work will be performed in compliance with the EWP, HASP and CAMP, and will be included in the periodic inspection and certification reports submitted under the Site Management Reporting Plan (See Section 5).

The site owner and associated parties preparing the remedial documents submitted to the State, and parties performing this work, are completely responsible for the safe performance of all intrusive work, the structural integrity of excavations, proper disposal of excavation de-water, control of runoff from open excavations into remaining contamination, and for structures that may be affected by excavations (such as building foundations and bridge footings). The site owner will ensure that site development activities will not interfere with, or otherwise impair or compromise, the ECs described in this SMP.

2.3.2 Soil Vapor Intrusion Evaluation

Prior to the construction of any enclosed structures located over areas that contain remaining contamination and the potential for soil vapor intrusion (SVI) has been identified, an SVI evaluation will be performed to determine whether any mitigation measures are necessary to eliminate potential exposure to vapors in the proposed structure. Alternatively, an SVI mitigation system may be installed as an element of the building foundation without first conducting an investigation. This mitigation system will include a vapor barrier and passive sub-slab depressurization system that is capable of being converted to an active system.

Prior to conducting an SVI investigation or installing a mitigation system, a work plan will be developed and submitted to the NYSDEC and NYSDOH for approval. This work plan will be developed in accordance with the most recent NYSDOH "Guidance for Evaluating Vapor Intrusion in the State of New York". Measures to be employed to mitigate potential vapor intrusion will be evaluated, selected, designed, installed, and

maintained based on the SVI evaluation, the NYSDOH guidance, and construction details of the proposed structure.

Preliminary (unvalidated) SVI sampling data will be forwarded to the NYSDEC and NYSDOH for initial review and interpretation. Upon validation, the final data will be transmitted to the agencies, along with a recommendation for follow-up action, such as mitigation. Validated SVI data will be transmitted to the property owner within 30 days of validation. If any indoor air test results exceed NYSDOH guidelines, relevant NYSDOH fact sheets will be provided to all tenants and occupants of the property within 15 days of receipt of validated data.

SVI sampling results, evaluations, and follow-up actions will also be summarized in the next Periodic Review Report.

2.4 INSPECTIONS AND NOTIFICATIONS

2.4.1 Inspections

Inspections of all remedial components installed at the site will be conducted at the frequency specified in the SMP Monitoring Plan schedule. A comprehensive site-wide inspection will be conducted annually, regardless of the frequency of the Periodic Review Report. The inspections will determine and document the following:

- Whether ECs continue to perform as designed;
- If these controls continue to be protective of human health and the environment;
- Compliance with requirements of this SMP and the Environmental Easement;
- If site records are complete and up to date; and
- Changes, or needed changes, to the remedial or monitoring system;

Inspections will be conducted in accordance with the procedures set forth in the Monitoring Plan of this SMP (Section 3). The reporting requirements are outlined in the Periodic Review Reporting section of this plan (Section 5).

If an emergency, such as a natural disaster or an unforeseen failure of any of the ECs occurs, an inspection of the site will be conducted within 5 days of the event to verify the effectiveness of the EC/ICs implemented at the site by a qualified environmental professional as determined by NYSDEC.

2.4.2 Notifications

Notifications will be submitted by the property owner to the NYSDEC as needed for the following reasons:

- 60-day advance notice of any proposed changes in site use that are required under the terms of the BCA, 6NYCRR Part 375, and/or ECL.
- 7-day advance notice of any proposed ground-intrusive activities pursuant to the EWP.
- Notice within 48-hours of any damage or defect to the foundation, structures or engineering control that reduces or has the potential to reduce the effectiveness of an EC and likewise any action to be taken to mitigate the damage or defect.
- Verbal notice by noon of the following day of any emergency, such as a fire, flood, or earthquake that reduces or has the potential to reduce the effectiveness of ECs in place at the site, with written confirmation within 7 days that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.
- Follow-up status reports on actions taken to respond to any emergency event requiring ongoing responsive action shall be submitted to the NYSDEC within 45 days and shall describe and document actions taken to restore the effectiveness of the ECs.

Any change in the ownership of the site or the responsibility for implementing this SMP will include the following notifications:

- At least 60 days prior to the change, the NYSDEC will be notified in writing of the proposed change. This will include a certification that the prospective purchaser has been provided with a copy of BCA, and all approved work plans and reports, including this SMP
- Within 15 days after the transfer of all or part of the site, the new owner's name, contact representative, and contact information will be confirmed in writing.

2.5 CONTINGENCY PLAN

Emergencies may include injury to personnel, fire or explosion, environmental release, or serious weather conditions.

2.5.1 Emergency Telephone Numbers

In the event of any environmentally related situation or unplanned occurrence requiring assistance the Owner or Owner's representative(s) should contact the appropriate party from the contact list below. For emergencies, appropriate emergency response personnel should be contacted. Prompt contact should also be made to the qualified environmental professional. These emergency contact lists must be maintained in an easily accessible location at the site.

Table: Emergency Contact Numbers

Medical, Fire, and Police:	911
One Call Center:	(800) 272-4480 (3 day notice required for utility markout)
Poison Control Center:	(800) 222-1222
Pollution Toxic Chemical Oil Spills:	(800) 424-8802
NYSDEC Spills Hotline	(800) 457-7362
qualified environmental professional(s):	(631)-589-6353

Andrew Lockwood James Rhodes PWGC	

* Note: Contact numbers subject to change and should be updated as necessary

2.5.2 Map and Directions to Nearest Health Facility

Site Location: 74 Wallabout Street, Brooklyn, NY

Nearest Hospital Name: Woodhull Hospital

Hospital Location: 760 Broadway, Brooklyn, NY 11206

Hospital Telephone: (718)963-8000

Directions to the Hospital:

1. Start out going east on Wallabout St toward Franklin Ave. (0.3 miles).

2. Turn right onto Lee Ave. (0.05 miles)

3. Take the 1st left onto Flushing Ave. (0.6 miles)

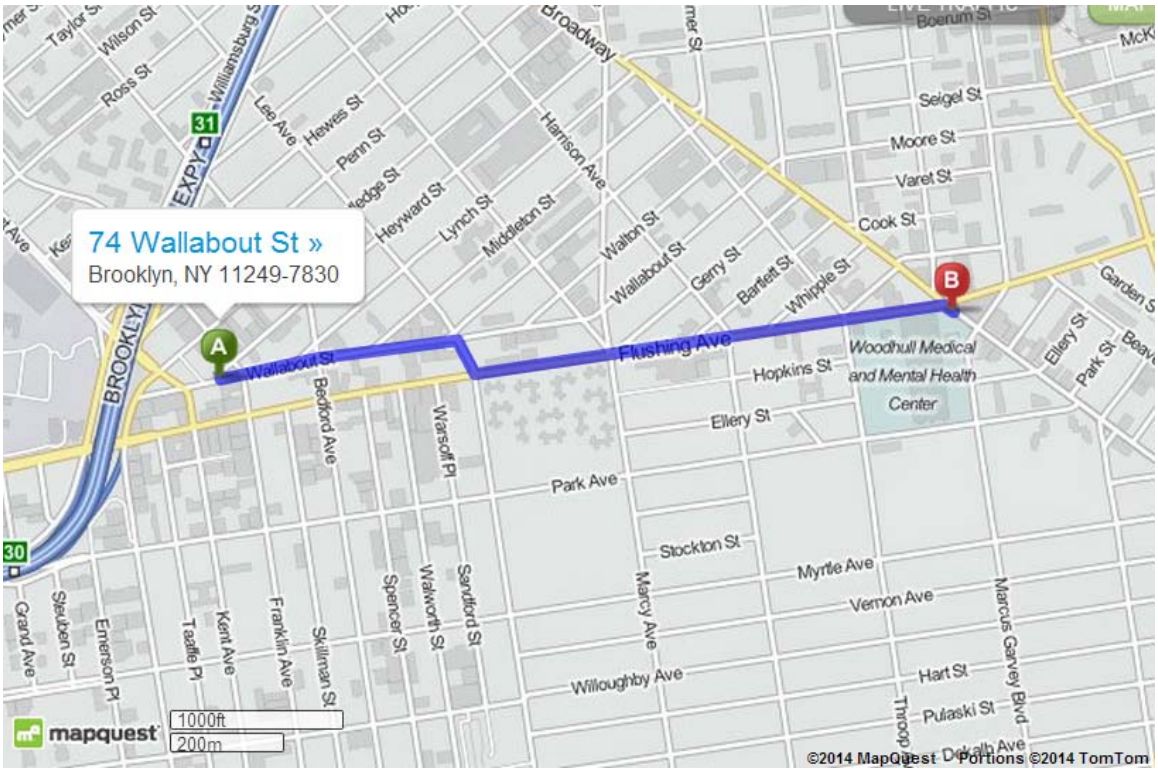
4. Turn right onto Broadway (0.02 miles)

5. 760 Broadway is on the right

Total Distance: 0.98 miles

Total Estimated Time: 3 minutes

Map Showing Route from the site to the Hospital:



2.5.3 Response Procedures

As appropriate, the fire department and other emergency response group will be notified immediately by telephone of the emergency. The emergency telephone number list is found at the beginning of this Contingency Plan in section 2.5.1. The list will also be posted prominently at the site and made readily available to all personnel at all times.

3.0 SITE MONITORING PLAN

3.1 INTRODUCTION

3.1.1 General

The Monitoring Plan describes the measures for evaluating the performance and effectiveness of the remedy to mitigate contamination at the site and the soil cover system. This Monitoring Plan may only be revised with the approval of NYSDEC.

3.1.2 Purpose and Schedule

This Monitoring Plan describes the methods to be used for:

- Evaluating site information periodically to confirm that the remedy continues to be effective in protecting public health and the environment; and
- Preparing the necessary reports for the various monitoring activities.

To adequately address these issues, this Monitoring Plan provides information on:

- Annual inspection and periodic certification.

Annual monitoring of the performance of the remedy will be conducted for the first five years. The frequency thereafter will be determined by NYSDEC.

3.2 COVER SYSTEM MONITORING

Inspection reports and certifications will be submitted to the NYSDEC, initially on an annual basis for the first five years. The periodic inspection certification, to be signed by a professional engineer or other qualified environmental professional, will certify that the composite cover system has not been modified or altered, and no violations have been observed. When modifications to the site have been observed, the certification will provide a description of the modifications observed and a proposed corrective action measure to address the deficiency.

3.3 SITE-WIDE INSPECTION

Site-wide inspections will be performed on a regular schedule at a minimum of once a year. Site-wide inspections will also be performed after all severe weather conditions that may affect ECs or monitoring devices. During these inspections, an inspection form will be completed (**Appendix D**). The form will compile sufficient information to assess the following:

- Compliance with all ICs, including site usage;
- An evaluation of the condition and continued effectiveness of ECs;
- General site conditions at the time of the inspection;
- The site management activities being conducted including, where appropriate, confirmation sampling and a health and safety inspection;
- Confirm that site records are up to date.

If an emergency, such as a natural disaster or an unforeseen failure of any of the ECs occurs, an inspection of the site will be conducted within 5 days of the event to verify the effectiveness of the EC/ICs implemented at the site by a qualified environmental professional as determined by NYSDEC.

3.4 MONITORING REPORTING REQUIREMENTS

Forms and any other information generated during regular inspections will be kept on file on-site. All forms, and other relevant reporting formats used during the inspection events, will be (1) subject to approval by NYSDEC and (2) submitted at the time of the Periodic Review Report, as specified in the Reporting Plan of this SMP.

Monitoring results will be reported to NYSDEC on a periodic basis in the Periodic Review Report.

4.0 OPERATION AND MAINTENANCE PLAN

4.1 INTRODUCTION

The site remedy does not rely on any mechanical systems, such as sub-slab depressurization systems or air sparge/ soil vapor extraction systems to protect public health and the environment.

A composite cover system is in place to protect public health and the environment. In the event that the composite cover is found to be damaged (cracks, penetrations, etc.), necessary repairs will be made.

In the event future testing should indicate the need for mechanical systems, additional operation and maintenance items may be added to this plan.

5.0 INSPECTIONS, REPORTING AND CERTIFICATIONS

5.1 SITE INSPECTIONS

5.1.1 Inspection Frequency

Inspections will be conducted at the frequency specified in the schedules provided in Section 3 Monitoring Plan. At a minimum, a site-wide inspection will be conducted annually. Inspections of remedial components will also be conducted whenever a severe condition has taken place, such as an erosion or flooding event that may affect the ECs.

If an emergency, such as a natural disaster or an unforeseen failure of any of the ECs occurs, an inspection of the site will be conducted within 5 days of the event to verify the effectiveness of the EC/ICs implemented at the site by a qualified environmental professional as determined by NYSDEC.

5.1.2 Inspection Forms, Sampling Data, and Maintenance Reports

Site-wide inspections will be recorded on the appropriate form which is contained in **Appendix D.** This form is subject to NYSDEC revision.

Applicable inspection forms and other records generated for the site during the reporting period will be provided in electronic format in the Periodic Review Report.

5.1.3 Evaluation of Records and Reporting

The results of the inspection and site monitoring data will be evaluated as part of the EC/IC certification to confirm that the:

- EC/ICs are in place, are performing properly, and remain effective;
- The Monitoring Plan is being implemented;
- The site remedy continues to be protective of public health and the environment and is performing as designed in the Remedial Action Work Plan and FER.

5.2 CERTIFICATION OF ENGINEERING AND INSTITUTIONAL CONTROLS

After the last inspection of the reporting period, a qualified environmental professional or Professional Engineer licensed to practice in New York State will prepare the following certification:

For each institutional or engineering control identified for the site, I certify that all of the following statements are true:

- The inspection of the site to confirm the effectiveness of the ECs/ICs required by the remedial program was performed under my direction;
- The ECs/ICs employed at this site is unchanged from the date the control was put in place, or last approved by the Department;
- Nothing has occurred that would impair the ability of the control to protect the public health and environment;
- Nothing has occurred that would constitute a violation or failure to comply with any site management plan for this control;
- Access to the site will continue to be provided to the Department to evaluate the remedy, including access to evaluate the continued maintenance of this control;
- Use of the site is compliant with the environmental easement;
- The EC systems are performing as designed and are effective;
- To the best of my knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the site remedial program and generally accepted engineering practices; and
- The information presented in this report is accurate and complete.
- I certify that the information and statements in this certification form are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law. I, [name], of

[business address], am certifying as [Owner or Owner's Designated Site Representative]) [I have been authorized and designated by all site owners to sign this certification] for the site.

The signed certification will be included in the Periodic Review Report described below.

5.3 PERIODIC REVIEW REPORT

A Periodic Review Report will be submitted to the Department every year, beginning fifteen months after the COC and the No Further Action Letter is issued. In the event that the site is subdivided into separate parcels with different ownership, a single Periodic Review Report will be prepared that addresses the site described in **Appendix A** (Metes and Bounds). The report will be prepared in accordance with NYSDEC DER-10 and submitted within 30 days of the end of each certification period. Media sampling results will also incorporated into the Periodic Review Report. The report will include:

- Identification, assessment and certification of the ECs/ICs required by the remedy for the site;
- Results of the required annual site inspections and severe condition inspections, if applicable;
- Applicable inspection forms and other records generated for the site during the reporting period in electronic format;
- A summary of any discharge monitoring data and/or information generated during the reporting period with comments and conclusions;
- Data summary tables and graphical representations of contaminants of concern by media (groundwater, soil vapor), which include a listing of all compounds analyzed, along with the applicable standards, with all exceedances highlighted.

These will include a presentation of past data as part of an evaluation of contaminant concentration trends;

- Results of all analyses, copies of all laboratory data sheets, and the required laboratory data deliverables for all samples collected during the reporting period will be submitted electronically in a NYSDEC-approved format;
- A site evaluation, which includes the following:
    - The compliance of the remedy with the requirements of the site-specific RWP, Record of Decision or Decision Document;
    - The operation and the effectiveness of all treatment units, etc., including identification of any needed repairs or modifications;
    - Any new conclusions or observations regarding site contamination based on inspections or data generated by the Monitoring Plan for the media being monitored;
    - Recommendations regarding any necessary changes to the remedy and/or Monitoring Plan; and
    - The overall performance and effectiveness of the remedy.

For those sites determined to be non-significant threat sites, but where contaminants in groundwater contravene drinking water standards at the site border, in addition to the items noted above, the remedial party will also have to certify:

- That no new information has come to the site owner's attention, including groundwater monitoring data from wells located at the site boundary, to indicate that the assumptions made in the qualitative exposure assessment of off-site contamination are no longer valid; and
- Every five years, that the assumptions made in the qualitative exposure assessment remain valid.

The Periodic Review Report will be submitted, in hard-copy format, to the NYSDEC Central Office and Regional Office in which the site is located, and in electronic format to NYSDEC Central Office, Regional Office and the NYSDOH Bureau of Environmental Exposure Investigation.

5.4 CORRECTIVE MEASURES PLAN

If any component of the remedy is found to have failed, or if the periodic certification cannot be provided due to the failure of an institutional or engineering control, a corrective measures plan will be submitted to the NYSDEC for approval. This plan will explain the failure and provide the details and schedule for performing work necessary to correct the failure. Unless an emergency condition exists, no work will be performed pursuant to the corrective measures plan until it is approved by the NYSDEC.

FIGURES

SUBJECT SITE VICINITY

74 WALLABOUT STREET
BROOKLYN, NEW YORK

0 ¼ ½ ¾ 1 Miles

Project:	RAB1301
Date:	8/27/2013
Designed by:	BB
Drawn by:	JMC
Approved by:	AL
Figure No:	1

PWGC
Strategic Environmental and Engineering Solutions
P.W. GROSSER CONSULTING ENGINEER AND HYDROGEOLOGIST, P.C.
630 Johnson Avenue, • Suite 7
Bohemia • NY • 11716-2618
Phone: (631) 589-6353 • Fax: (631) 589-8705
E-mail: INFO@PWGROSSER.COM

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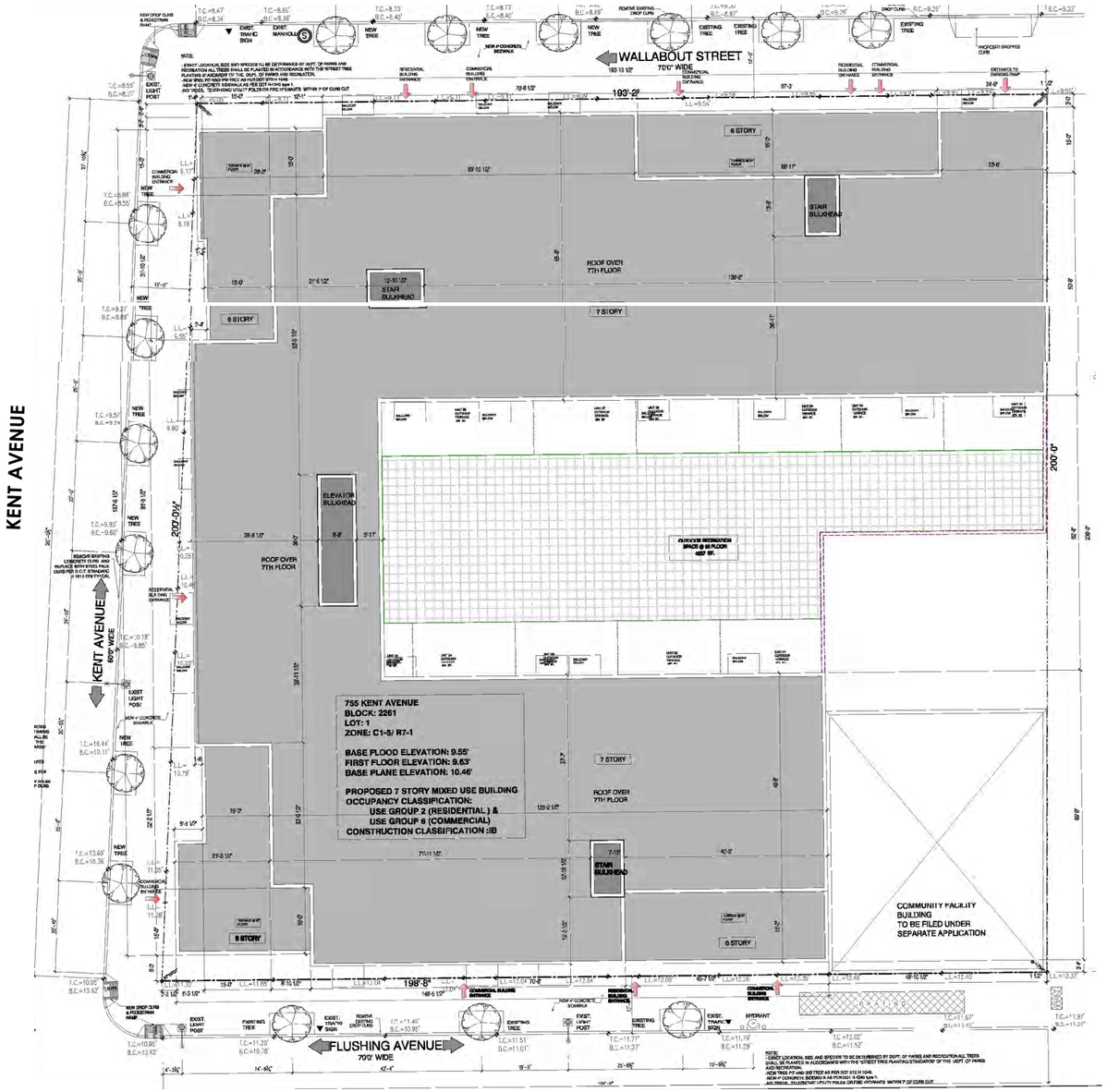

FLUSHING AVENUE

PARCEL PLAN

74 WALLABOUT STREET
BROOKLYN, NEW YORK

0 40 80 120 160 Feet

PWGC
Strategic Environmental and Engineering Solutions

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Bohemia • NY • 11716-2618
Phone: (631) 589-6353 • Fax: (631) 589-8705
E-mail: INFO@PWGROSSER.COM

DRAWING INFORMATION:

Project:	RAB1301	Designed by:	CC
Date:	8/19/2013	Drawn by:	BB
Scale:	AS SHOWN	Approved by:	AL

FIGURE NO: 2

SHEET:

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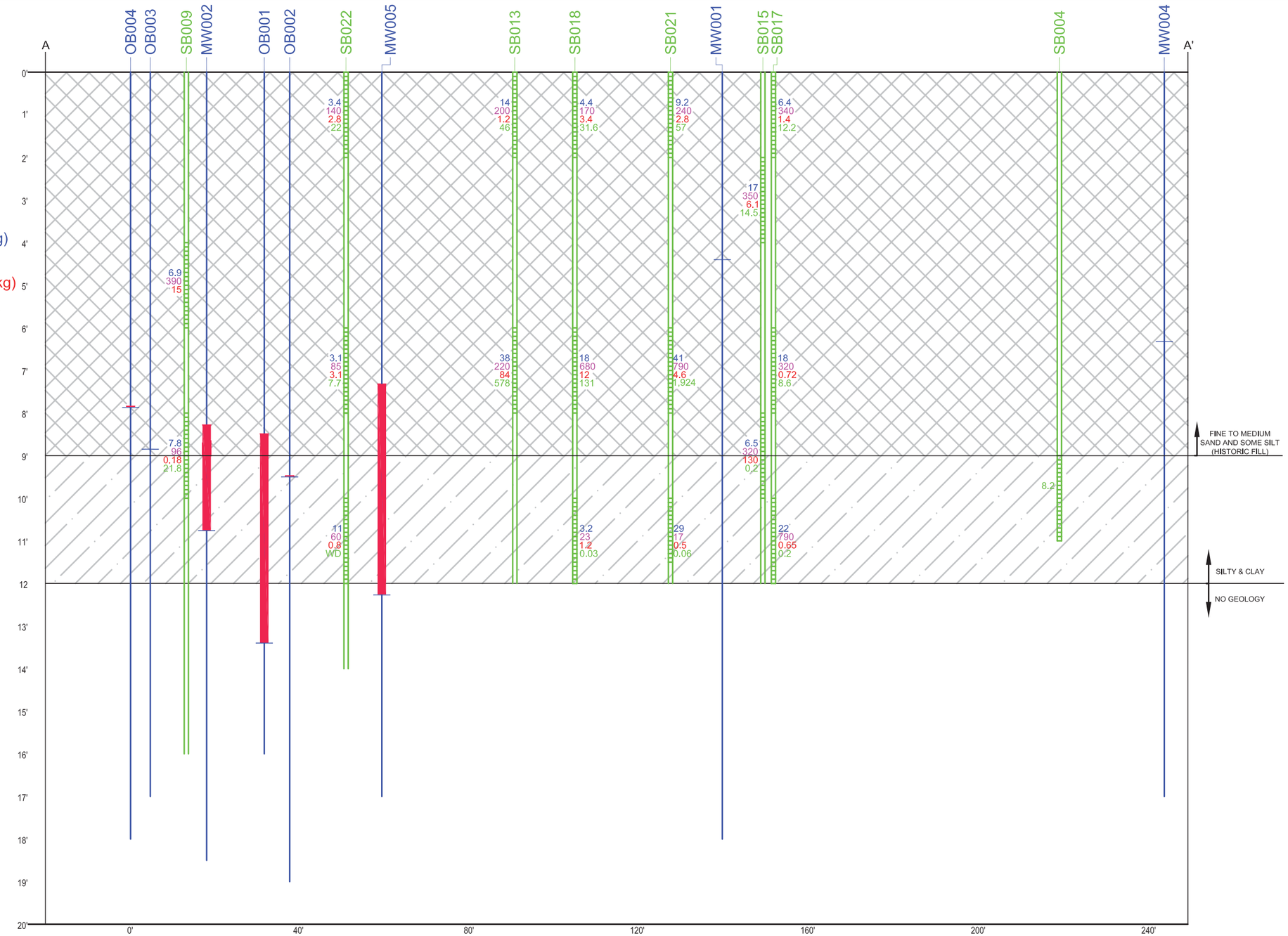

GENERALIZED GEOLOGIC CROSS SECTION A - A'

HORIZONTAL SCALE: 1"=25'

0 25' 50'

VERTICAL SCALE: 1"=2.5'

0 2.5' 5'

LEGEND

- WATER LEVEL
- LNAPL THICKNESS (ft)
- ARSENIC (mg/kg)
- LEAD (mg/kg)
- MERCURY (mg/kg)
- TSVOCs (mg/kg)

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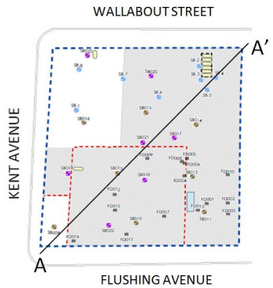
E-mail: INFO@PWGROSSER.COM

CONSULTANTS



DRAWINGS PREPARED FOR

74 WALLABOUT ST.
BROOKLYN, NY

REVISION	DATE	INITIAL	COMMENTS

DRAWING INFORMATION

PROJECT: MAB1301		APPROVED BY: KA	
DESIGNED BY: DE		DATE: 09-13-13	
DRAWN BY: AES		SCALE: -	

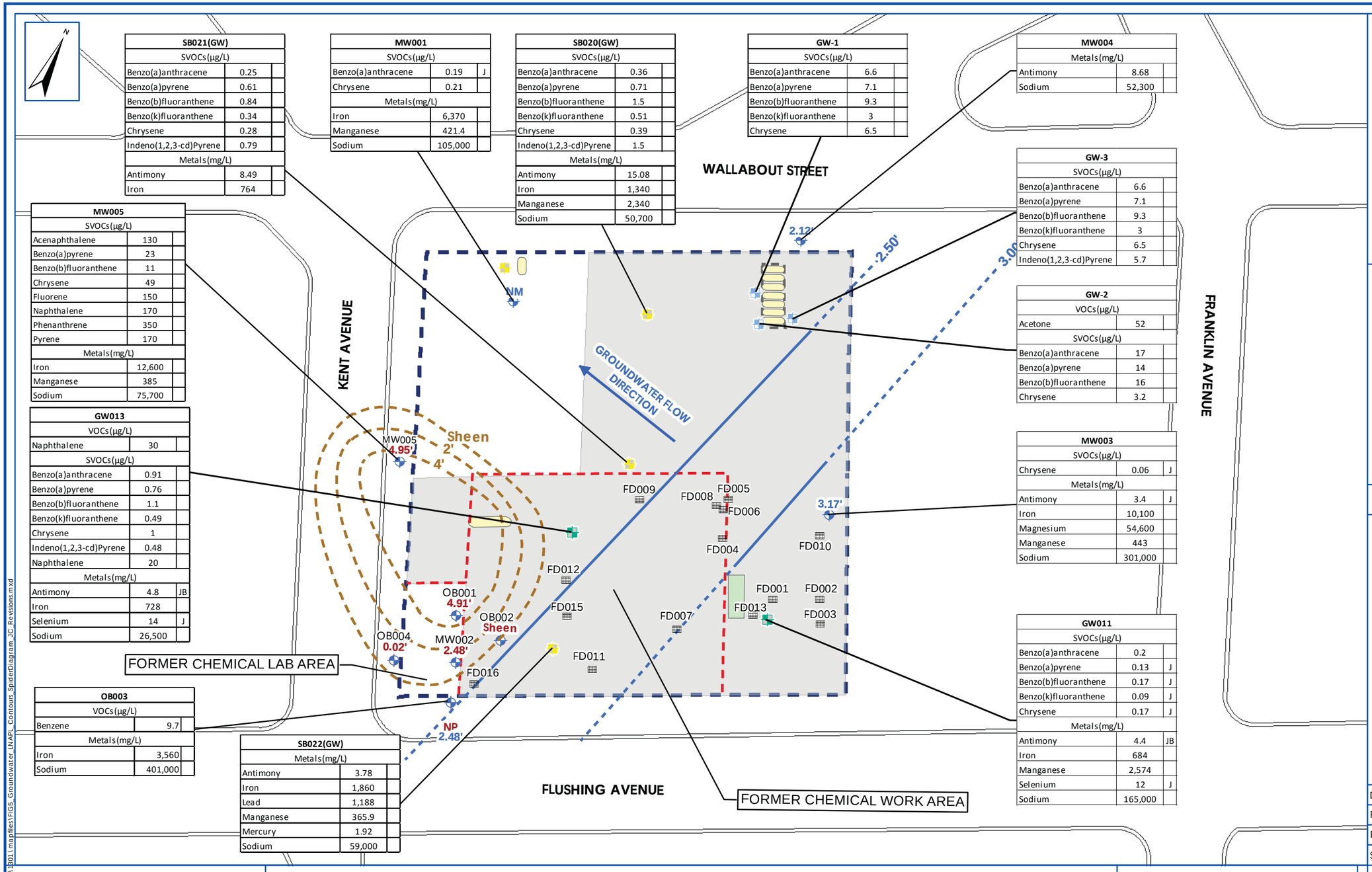
SHEET TITLE

CROSS SECTION A-A'

FIGURE NO 3

SHEET - OF -

J:\Projects M-R\RAB Simon Dushinsky\RAB1301\CADIA-A' Cross-Section.dwg (cross section A-A') Sep 23,2013-9:15am By: lund



SB021(GW)		
SVOCs(µg/L)		
Benzo(a)anthracene	0.25	
Benzo(a)pyrene	0.61	
Benzo(b)fluoranthene	0.84	
Benzo(k)fluoranthene	0.34	
Chrysene	0.28	
Indeno(1,2,3-cd)Pyrene	0.79	
Metals(mg/L)		
Antimony	8.49	
Iron	764	

MW001		
SVOCs(µg/L)		
Benzo(a)anthracene	0.19	J
Chrysene	0.21	
Metals(mg/L)		
Iron	6,370	
Manganese	421.4	
Sodium	105,000	

SB020(GW)		
SVOCs(µg/L)		
Benzo(a)anthracene	0.36	
Benzo(a)pyrene	0.71	
Benzo(b)fluoranthene	1.5	
Benzo(k)fluoranthene	0.51	
Chrysene	0.39	
Indeno(1,2,3-cd)Pyrene	1.5	
Metals(mg/L)		
Antimony	15.08	
Iron	1,340	
Manganese	2,340	
Sodium	50,700	

GW-1		
SVOCs(µg/L)		
Benzo(a)anthracene	6.6	
Benzo(a)pyrene	7.1	
Benzo(b)fluoranthene	9.3	
Benzo(k)fluoranthene	3	
Chrysene	6.5	

MW004		
Metals(mg/L)		
Antimony	8.68	
Sodium	52,300	

GW-3		
SVOCs(µg/L)		
Benzo(a)anthracene	6.6	
Benzo(a)pyrene	7.1	
Benzo(b)fluoranthene	9.3	
Benzo(k)fluoranthene	3	
Chrysene	6.5	
Indeno(1,2,3-cd)Pyrene	5.7	

GW-2		
VOCs(µg/L)		
Acetone	52	
SVOCs(µg/L)		
Benzo(a)anthracene	17	
Benzo(a)pyrene	14	
Benzo(b)fluoranthene	16	
Chrysene	3.2	

MW005		
SVOCs(µg/L)		
Acenaphthalene	130	
Benzo(a)pyrene	23	
Benzo(b)fluoranthene	11	
Chrysene	49	
Fluorene	150	
Naphthalene	170	
Phenanthrene	350	
Pyrene	170	
Metals(mg/L)		
Iron	12,600	
Manganese	385	
Sodium	75,700	

GW013		
VOCs(µg/L)		
Naphthalene	30	
SVOCs(µg/L)		
Benzo(a)anthracene	0.91	
Benzo(a)pyrene	0.76	
Benzo(b)fluoranthene	1.1	
Benzo(k)fluoranthene	0.49	
Chrysene	1	
Indeno(1,2,3-cd)Pyrene	0.48	
Naphthalene	20	
Metals(mg/L)		
Antimony	4.8	JB
Iron	728	
Selenium	14	J
Sodium	26,500	

MW003		
SVOCs(µg/L)		
Chrysene	0.06	J
Metals(mg/L)		
Antimony	3.4	J
Iron	10,100	
Magnesium	54,600	
Manganese	443	
Sodium	301,000	

GW011		
SVOCs(µg/L)		
Benzo(a)anthracene	0.2	
Benzo(a)pyrene	0.13	J
Benzo(b)fluoranthene	0.17	J
Benzo(k)fluoranthene	0.09	J
Chrysene	0.17	J
Metals(mg/L)		
Antimony	4.4	JB
Iron	684	
Manganese	2,574	
Selenium	12	J
Sodium	165,000	

OB003		
VOCs(µg/L)		
Benzene	9.7	
Metals(mg/L)		
Iron	3,560	
Sodium	401,000	

SB022(GW)		
Metals(mg/L)		
Antimony	3.78	
Iron	1,860	
Lead	1,188	
Manganese	365.9	
Mercury	1.92	
Sodium	59,000	

SITE PLAN - GROUNDWATER CONTOURS - SEPT. 18 2013

74 WALLABOUT STREET
BROOKLYN, NEW YORK

0 50 100 150 200 Feet

3.10 Groundwater Elevation (feet) Based Upon Arbitrary Datum
0.07 LNAPL Thickness
NP No LNAPL
NM Not Measured
Analytes in exceedence of 6NYCRR Part 703.5 GA Groundwater Quality Standards and Guidance Values 6/1998 are shown.
J - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

PWGC
Strategic Environmental and Engineering Solutions
P.W. GROSSER CONSULTING ENGINEER AND HYDROGEOLOGIST, P.C.
630 Johnson Avenue. • Suite 7
Bohemia • NY • 11716-2618
Phone: (631) 589-6353 • Fax: (631) 589-8705
E-mail: INFO@PWGROSSER.COM

- Monitoring Well Location
- Observation Well Location
- 2012 Groundwater Sampling Location
- 2013 Groundwater Sampling Location
- 2006 Groundwater Sampling Location
- Pit
- Inferred LNAPL Contour
- Actual Groundwater Contour
- Inferred Groundwater Contour
- Former Chemical Work/Lab Area
- Underground Storage Tank Locations
- Sub-Surface Vault
- Former Building
- Approximate UST Location
- Lot 1 Proposed Development Site
- Curbline

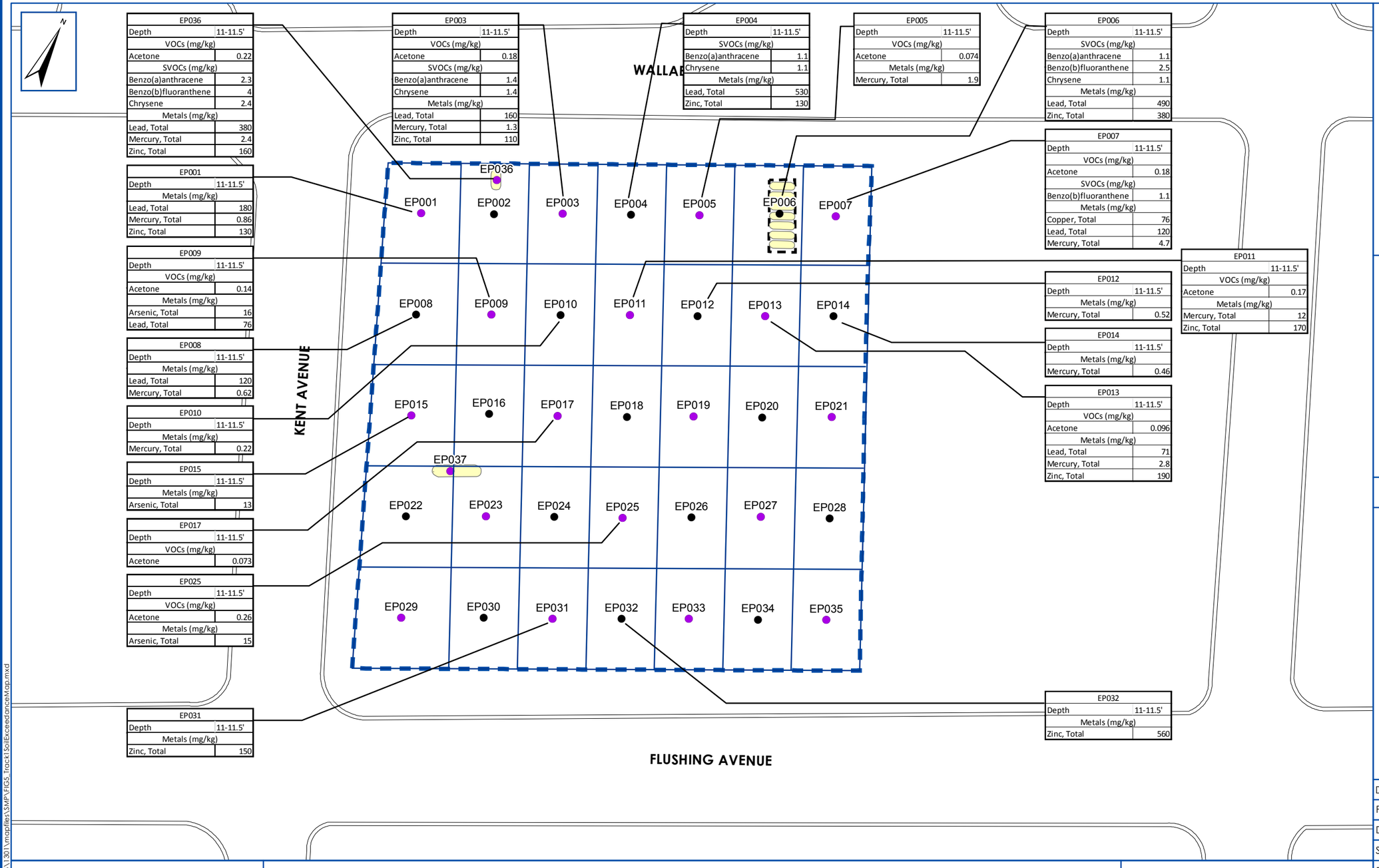
DRAWING INFORMATION:

Project:	RAB1301	Designed by:	CC
Date:	04/30/2014	Drawn by:	BB
Scale:	AS SHOWN	Approved by:	AL

FIGURE NO: 4

SHEET:

Document Path: Z:\GIS\Projects\M-R\RAB\1301\mapfiles\FIG5_Groundwater_LNAPL_Contours_SpiderDiagram_JC_Revisions.mxd



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Bohemia • NY • 11716-2618
Phone: (631) 589-6353 • Fax: (631) 589-8705
E-mail: INFO@PWGROSSER.COM

- Confirmatory Sample Location (VOCs, SVOCs, Metals, Pesticides, PCBs)
- ConfirmatorySample Location (Metals, SVOCs)
- Underground Storage Tanks
- Approximate UST Location
- Lot 1 Proposed Development Site
- Curbline

DRAWING INFORMATION:

Project:	RAB1301	Designed by:	AL
Date:	11/6/2014	Drawn by:	BB
Scale:	AS SHOWN	Approved by:	AL

FIGURE NO: 5

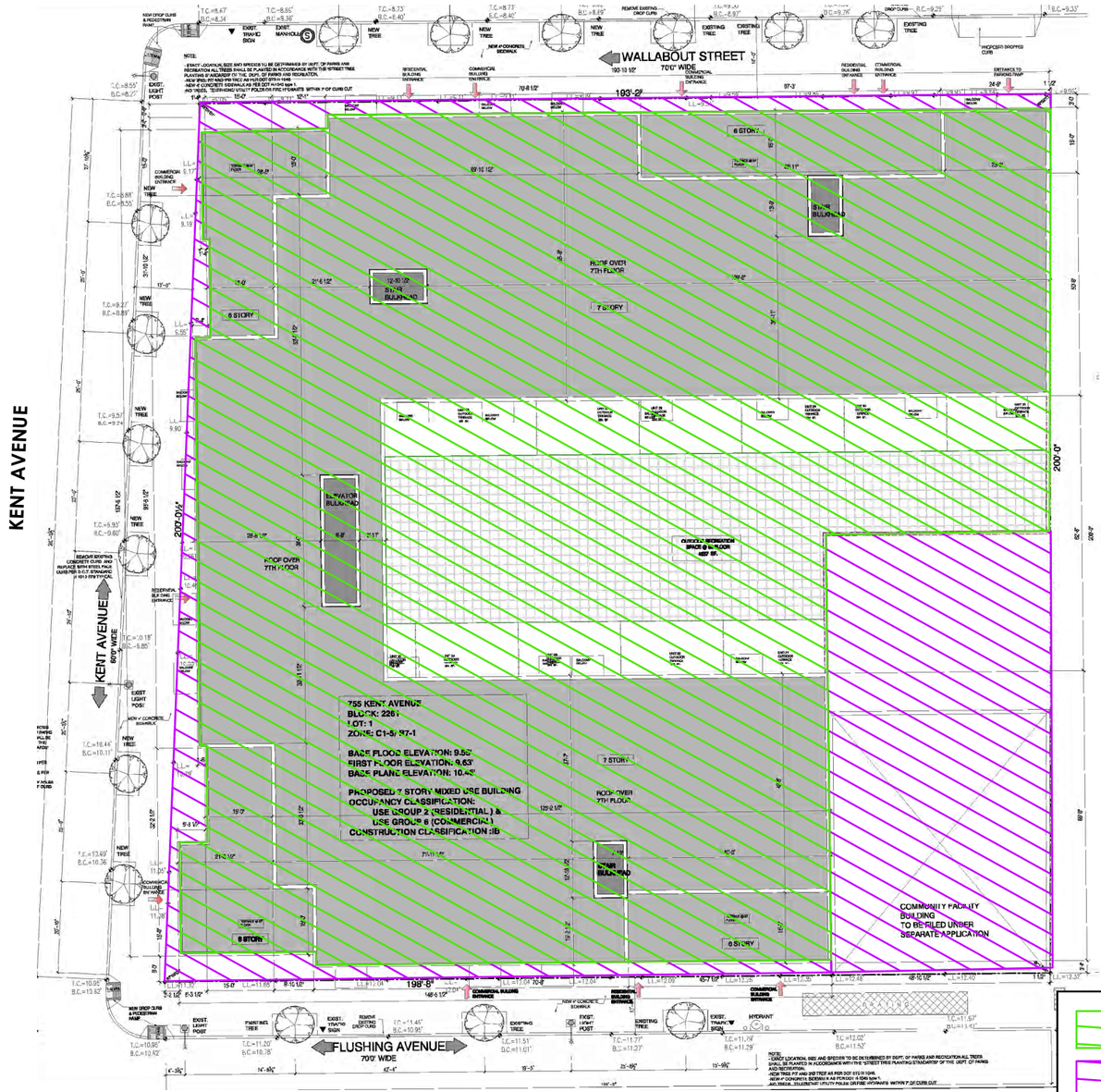
SHEET:

TRACK 1 SOIL EXCEEDANCE MAP

74 WALLABOUT STREET
BROOKLYN, NEW YORK

0 50 100 150 200 Feet

Document Path: D:\GIS\Projects\MAR\RAB\1301\mapfiles\SMP\FIG5_Track1SoilExceedanceMap.mxd



WALLABOUT STREET

KENT AVENUE

FLUSHING AVENUE

COMPOSITE COVER PLAN

74 WALLABOUT STREET
BROOKLYN, NEW YORK

0 40 80 120 160 Feet

PWGC
Strategic Environmental and Engineering Solutions

P.W. GROSSER CONSULTING ENGINEER AND HYDROGEOLOGIST, P.C.

630 Johnson Avenue. • Suite 7
Bohemia • NY • 11716-2618
Phone: (631) 589-6353 • Fax: (631) 589-8705
E-mail: INFO@PWGROSSER.COM

DRAWING INFORMATION:

Project:	RAB1301	Designed by:	CC
Date:	12/2/2014	Drawn by:	BB
Scale:	AS SHOWN	Approved by:	AL

FIGURE NO:

6

SHEET:

Document Path: Z:\GIS\Projects\M-R\RAB\1301\mapfiles\SMP\FIG6_CompositeCoverPlan.mxd

APPENDIX A – ENVIRONMENTAL EASEMENT

NYC DEPARTMENT OF FINANCE
OFFICE OF THE CITY REGISTER

This page is part of the instrument. The City Register will rely on the information provided by you on this page for purposes of indexing this instrument. The information on this page will control for indexing purposes in the event of any conflict with the rest of the document.

2014112501241001001E730C

RECORDING AND ENDORSEMENT COVER PAGE **PAGE 1 OF 13**

Document ID: 2014112501241001 Document Date: 11-17-2014 Preparation Date: 11-25-2014
Document Type: EASEMENT
Document Page Count: 11

PRESENTER:
PRESTIGE RESEARCH COMPANY (P/U RED VISION)
55 WEST 39TH STREET, 9TH FLOOR
NEW YORK, NY 10018
212-651-1200
SS14-253

RETURN TO:
PHILLIPS NIZER, LLP
666 FIFTH AVENUE
NEW YORK, NY 10103

PROPERTY DATA

Borough	Block	Lot	Unit	Address
BROOKLYN	2261	1	Entire Lot	74 WALLABOUT STREET

Property Type: COMMERCIAL REAL ESTATE

CROSS REFERENCE DATA

CRFN_____ *or* DocumentID_____ *or* _____ Year____ Reel____ Page____ *or* File Number_____

PARTIES

GRANTOR/SELLER:
NORTHLAND LLC
175 HEWES STREET
BROOKLYN, NY 11211

GRANTEE/BUYER:
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL
CONSERVATION, 625 BROADWAY
ALBANY, NY 12233

☒ Additional Parties Listed on Continuation Page

FEES AND TAXES

Mortgage :		
Mortgage Amount:	$	0.00
Taxable Mortgage Amount:	$	0.00
Exemption:		
TAXES: County (Basic):	$	0.00
City (Additional):	$	0.00
Spec (Additional):	$	0.00
TASF:	$	0.00
MTA:	$	0.00
NYCTA:	$	0.00
Additional MRT:	$	0.00
TOTAL:	$	0.00
Recording Fee:	$	92.00
Affidavit Fee:	$	0.00

Filing Fee:	$	100.00
NYC Real Property Transfer Tax:	$	0.00
NYS Real Estate Transfer Tax:	$	0.00

RECORDED OR FILED IN THE OFFICE OF THE CITY REGISTER OF THE CITY OF NEW YORK
Recorded/Filed 12-04-2014 13:09
City Register File No.(CRFN): **2014000400247**

City Register Official Signature

NYC DEPARTMENT OF FINANCE
OFFICE OF THE CITY REGISTER

2014112501241001001C718C

RECORDING AND ENDORSEMENT COVER PAGE (CONTINUATION) PAGE 2 OF 13

Document ID: 2014112501241001 Document Date: 11-17-2014 Preparation Date: 11-25-2014
Document Type: EASEMENT

PARTIES

GRANTOR/SELLER:
STARWOOD LLC
543 BEDFORD AVENUE
BROOKLYN, NY 11249

GRANTOR/SELLER:
74 WALLABOUT, LLC
505 FLUSHING AVENUE, SUITE 1D
BROOKLYN, NY 11205

ENVIRONMENTAL EASEMENT GRANTED PURSUANT TO ARTICLE 71, TITLE 36 OF THE NEW YORK STATE ENVIRONMENTAL CONSERVATION LAW

THIS INDENTURE made this 17th day of November, 2014, between Owner(s) Northland, LLC, having an office at 175 Hewes Street, Brooklyn, New York 11211, Starwood, LLC, having an office at 543 Bedford Avenue, Brooklyn, New York 11249 and 74 Wallabout, LLC, having an office at 505 Flushing Avenue, Suite 1D, Brooklyn, New York 11205, County of Kings, State of New York (the "Grantor"), and The People of the State of New York (the "Grantee."), acting through their Commissioner of the Department of Environmental Conservation (the "Commissioner", or "NYSDEC" or "Department" as the context requires) with its headquarters located at 625 Broadway, Albany, New York 12233,

WHEREAS, the Legislature of the State of New York has declared that it is in the public interest to encourage the remediation of abandoned and likely contaminated properties ("sites") that threaten the health and vitality of the communities they burden while at the same time ensuring the protection of public health and the environment; and

WHEREAS, the Legislature of the State of New York has declared that it is in the public interest to establish within the Department a statutory environmental remediation program that includes the use of Environmental Easements as an enforceable means of ensuring the performance of operation, maintenance, and/or monitoring requirements and the restriction of future uses of the land, when an environmental remediation project leaves residual contamination at levels that have been determined to be safe for a specific use, but not all uses, or which includes engineered structures that must be maintained or protected against damage to perform properly and be effective, or which requires groundwater use or soil management restrictions; and

WHEREAS, the Legislature of the State of New York has declared that Environmental Easement shall mean an interest in real property, created under and subject to the provisions of Article 71, Title 36 of the New York State Environmental Conservation Law ("ECL") which contains a use restriction and/or a prohibition on the use of land in a manner inconsistent with engineering controls which are intended to ensure the long term effectiveness of a site remedial program or eliminate potential exposure pathways to hazardous waste or petroleum; and

WHEREAS, Grantor, is the owner of real property located at the address of 74 Wallabout Street, Brooklyn, New York 11211 in the City of New York, County of Kings and State of New York, known and designated on the tax map of the County Clerk of Kings as tax map parcel numbers: Block 2261 Lot 1, being the same as that property conveyed to Grantor by deed dated August 20, 2012 and recorded in the City Register of the City of New York in Instrument No. CFRN 2012000337645. The property subject to this Environmental Easement (the "Controlled Property") comprises approximately 0.91 +/- acres, and is hereinafter more fully described in the Land Title Survey dated July 26, 2012, updated April 26, 2014, and revised October 1, 2014 prepared by AAA, which will be attached to the Site Management Plan. The Controlled Property description is set forth in and attached hereto as Schedule A; and

WHEREAS, the Department accepts this Environmental Easement in order to ensure the

protection of public health and the environment and to achieve the requirements for remediation established for the Controlled Property until such time as this Environmental Easement is extinguished pursuant to ECL Article 71, Title 36; and

NOW THEREFORE, in consideration of the mutual covenants contained herein and the terms and conditions of Brownfield Cleanup Agreement Index Number: C224172-04-13, Grantor conveys to Grantee a permanent Environmental Easement pursuant to ECL Article 71, Title 36 in, on, over, under, and upon the Controlled Property as more fully described herein ("Environmental Easement")

1. Purposes. Grantor and Grantee acknowledge that the Purposes of this Environmental Easement are: to convey to Grantee real property rights and interests that will run with the land in perpetuity in order to provide an effective and enforceable means of encouraging the reuse and redevelopment of this Controlled Property at a level that has been determined to be safe for a specific use while ensuring the performance of operation, maintenance, and/or monitoring requirements; and to ensure the restriction of future uses of the land that are inconsistent with the above-stated purpose.

2. Institutional and Engineering Controls. The controls and requirements listed in the Department approved Site Management Plan ("SMP") including any and all Department approved amendments to the SMP are incorporated into and made part of this Environmental Easement. These controls and requirements apply to the use of the Controlled Property, run with the land; are binding on the Grantor and the Grantor's successors and assigns, and are enforceable in law or equity against any owner of the Controlled Property, any lessees and any person using the Controlled Property.

A. (1) The Controlled Property may be used for:

Restricted Residential as described in 6 NYCRR Part 375-1.8(g)(2)(ii), Commercial as described in 6 NYCRR Part 375-1.8(g)(2)(iii) and Industrial as described in 6 NYCRR Part 375-1.8(g)(2)(iv)

(2) All Engineering Controls must be operated and maintained as specified in the Site Management Plan (SMP);

(3) All Engineering Controls must be inspected at a frequency and in a manner defined in the SMP;

(4) The use of groundwater underlying the property is prohibited without necessary water quality treatment as determined by the NYSDOH or the Kings County Department of Health to render it safe for use as drinking water or for industrial purposes, and the user must first notify and obtain written approval to do so from the Department;

(5) Groundwater and other environmental or public health monitoring must be performed as defined in the SMP;

(6) Data and information pertinent to Site Management of the Controlled Property must be reported at the frequency and in a manner defined in the SMP;

(7) All future activities on the property that will disturb remaining contaminated material must be conducted in accordance with the SMP;

(8) Monitoring to assess the performance and effectiveness of the remedy must be performed as defined in the SMP;

(9) Operation, maintenance, monitoring, inspection, and reporting of any mechanical or physical components of the remedy shall be performed as defined in the SMP;

(10) Access to the site must be provided to agents, employees or other representatives of the State of New York with reasonable prior notice to the property owner to assure compliance with the restrictions identified by this Environmental Easement.

B. The Controlled Property shall not be used for Residential purposes as defined in 6NYCRR 375-1.8(g)(2)(i), and the above-stated engineering controls may not be discontinued without an amendment or extinguishment of this Environmental Easement.

C. The SMP describes obligations that the Grantor assumes on behalf of Grantor, its successors and assigns. The Grantor's assumption of the obligations contained in the SMP which may include sampling, monitoring, and/or operating a treatment system, and providing certified reports to the NYSDEC, is and remains a fundamental element of the Department's determination that the Controlled Property is safe for a specific use, but not all uses. The SMP may be modified in accordance with the Department's statutory and regulatory authority. The Grantor and all successors and assigns, assume the burden of complying with the SMP and obtaining an up-to-date version of the SMP from:

Site Control Section
Division of Environmental Remediation
NYSDEC
625 Broadway
Albany, New York 12233
Phone: (518) 402-9553

D. Grantor must provide all persons who acquire any interest in the Controlled Property a true and complete copy of the SMP that the Department approves for the Controlled Property and all Department-approved amendments to that SMP.

E. Grantor covenants and agrees that until such time as the Environmental Easement is extinguished in accordance with the requirements of ECL Article 71, Title 36 of the ECL, the property deed and all subsequent instruments of conveyance relating to the Controlled Property shall state in at least fifteen-point bold-faced type:

This property is subject to an Environmental Easement held by the New York State Department of Environmental Conservation

pursuant to Title 36 of Article 71 of the Environmental Conservation Law.

F. Grantor covenants and agrees that this Environmental Easement shall be incorporated in full or by reference in any leases, licenses, or other instruments granting a right to use the Controlled Property.

G. Grantor covenants and agrees that it shall, at such time as NYSDEC may require, submit to NYSDEC a written statement by an expert the NYSDEC may find acceptable certifying under penalty of perjury, in such form and manner as the Department may require, that:

(1) the inspection of the site to confirm the effectiveness of the institutional and engineering controls required by the remedial program was performed under the direction of the individual set forth at 6 NYCRR Part 375-1.8(h)(3).

(2) the institutional controls and/or engineering controls employed at such site:

(i) are in-place;

(ii) are unchanged from the previous certification, or that any identified changes to the controls employed were approved b the NYSDEC and that all controls are in the Department-approved format; and

(iii) that nothing has occurred that would impair the ability of such control to protect the public health and environment;

(3) the owner will continue to allow access to such real property to evaluate the continued maintenance of such controls;

(4) nothing has occurred that would constitute a violation or failure to comply with any site management plan for such controls;

(5 the report and all attachments were prepared under the direction of, and reviewed by, the party making the certification;

(6) to the best of his/her knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the site remedial program, and generally accepted engineering practices; and

(7) the information presented is accurate and complete.

3. Right to Enter and Inspect. Grantee, its agents, employees, or other representatives of the State may enter and inspect the Controlled Property in a reasonable manner and at reasonable times to assure compliance with the above-stated restrictions.

4. Reserved Grantor's Rights. Grantor reserves for itself, its assigns, representatives, and successors in interest with respect to the Property, all rights as fee owner of the Property, including:

A. Use of the Controlled Property for all purposes not inconsistent with, or limited by the terms of this Environmental Easement;

B. The right to give, sell, assign, or otherwise transfer part or all of the underlying fee interest to the Controlled Property, subject and subordinate to this Environmental Easement;

5. Enforcement

A. This Environmental Easement is enforceable in law or equity in perpetuity by Grantor, Grantee, or any affected local government, as defined in ECL Section 71-3603, against the owner of the Property, any lessees, and any person using the land. Enforcement shall not be defeated because of any subsequent adverse possession, laches, estoppel, or waiver. It is not a defense in any action to enforce this Environmental Easement that: it is not appurtenant to an interest in real property; it is not of a character that has been recognized traditionally at common law; it imposes a negative burden; it imposes affirmative obligations upon the owner of any interest in the burdened property; the benefit does not touch or concern real property; there is no privity of estate or of contract; or it imposes an unreasonable restraint on alienation.

B. If any person violates this Environmental Easement, the Grantee may revoke the Certificate of Completion with respect to the Controlled Property.

C. Grantee shall notify Grantor of a breach or suspected breach of any of the terms of this Environmental Easement. Such notice shall set forth how Grantor can cure such breach or suspected breach and give Grantor a reasonable amount of time from the date of receipt of notice in which to cure. At the expiration of such period of time to cure, or any extensions granted by Grantee, the Grantee shall notify Grantor of any failure to adequately cure the breach or suspected breach, and Grantee may take any other appropriate action reasonably necessary to remedy any breach of this Environmental Easement, including the commencement of any proceedings in accordance with applicable law.

D. The failure of Grantee to enforce any of the terms contained herein shall not be deemed a waiver of any such term nor bar any enforcement rights.

6. Notice. Whenever notice to the Grantee (other than the annual certification) or approval from the Grantee is required, the Party providing such notice or seeking such approval shall identify the Controlled Property by referencing the following information:

County, NYSDEC Site Number, NYSDEC Brownfield Cleanup Agreement, State Assistance Contract or Order Number, and the County tax map number or the Liber and Page or computerized system identification number.

Parties shall address correspondence to:

Site Number: C224172
Office of General Counsel
NYSDEC
625 Broadway
Albany New York 12233-5500

With a copy to:

Site Control Section
Division of Environmental Remediation
NYSDEC
625 Broadway
Albany, NY 12233

All notices and correspondence shall be delivered by hand, by registered mail or by Certified mail and return receipt requested. The Parties may provide for other means of receiving and

communicating notices and responses to requests for approval.

7. Recordation. Grantor shall record this instrument, within thirty (30) days of execution of this instrument by the Commissioner or her/his authorized representative in the office of the recording officer for the county or counties where the Property is situated in the manner prescribed by Article 9 of the Real Property Law.

8. Amendment. Any amendment to this Environmental Easement may only be executed by the Commissioner of the New York State Department of Environmental Conservation or the Commissioner's Designee, and filed with the office of the recording officer for the county or counties where the Property is situated in the manner prescribed by Article 9 of the Real Property Law.

9. Extinguishment. This Environmental Easement may be extinguished only by a release by the Commissioner of the New York State Department of Environmental Conservation, or the Commissioner's Designee, and filed with the office of the recording officer for the county or counties where the Property is situated in the manner prescribed by Article 9 of the Real Property Law.

10. Joint Obligation. If there are two or more parties identified as Grantor herein, the obligations imposed by this instrument upon them shall be joint and several.

IN WITNESS WHEREOF, Grantor has caused this instrument to be signed in its name.

74 Wallabout, LLC:

By: _____

Print Name: Simon Dushinsky

Title: Member Date: 11-6-2014

Grantor's Acknowledgment

STATE OF NEW YORK)
) ss:
COUNTY OF KINGS)

On the 6 day of Nov, in the year 20 14, before me, the undersigned, personally appeared Simon Dushinsky, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

_____
Notary Public - State of New York

MENDEL KLEIN
NOTARY PUBLIC-STATE OF NEW YORK
No.01KL6200703
Qualified in Kings County
My Commission Expires February 09, 2017

IN WITNESS WHEREOF, Grantor has caused this instrument to be signed in its name.

Northland, LLC:

By: _____

Print Name: PAUL POLLAK

Title: Member Date: 11-6-2014

Grantor's Acknowledgment

STATE OF NEW YORK)
) ss:
COUNTY OF KINGS)

On the 6 day of NOV, in the year 20 14, before me, the undersigned, personally appeared Paul Pollak, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

_____
Notary Public - State of New York

MENDEL KLEIN
NOTARY PUBLIC-STATE OF NEW YORK
No.01KL6200703
Qualified in Kings County
My Commission Expires February 09, 2017

IN WITNESS WHEREOF, Grantor has caused this instrument to be signed in its name.

Starwood, LLC:

By: Y. Weiss

Print Name: Y. WEISS

Title: member Date: 11-6-2014

Grantor's Acknowledgment

STATE OF NEW YORK)
) ss:
COUNTY OF KINGS)

On the 6 day of NOV, in the year 20 14, before me, the undersigned, personally appeared Y Weiss, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

Notary Public - State of New York

MENDEL KLEIN
NOTARY PUBLIC-STATE OF NEW YORK
No.01KL6200703
Qualified in Kings County
My Commission Expires February 09, 2017

THIS ENVIRONMENTAL EASEMENT IS HEREBY ACCEPTED BY THE PEOPLE OF THE STATE OF NEW YORK, Acting By and Through the Department of Environmental Conservation as Designee of the Commissioner,

By: _____
Robert W. Schick, Director
Division of Environmental Remediation

Grantee's Acknowledgment

STATE OF NEW YORK)
) ss:
COUNTY OF ALBANY)

On the 17th day of November, in the year 2014, before me, the undersigned, personally appeared Robert W. Schick, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name is (are) subscribed to the within instrument and acknowledged to me that he/she/ executed the same in his/her/ capacity as Designee of the Commissioner of the State of New York Department of Environmental Conservation, and that by his/her/ signature on the instrument, the individual, or the person upon behalf of which the individual acted, executed the instrument.

_____
Notary Public - State of New York

David J. Chiusano
Notary Public, State of New York
No. 01CH5032146
Qualified in Schenectady County
Commission Expires August 22, 2018

SCHEDULE "A" PROPERTY DESCRIPTION

BLOCK 2261 LOT 1
74 WALLABOUT STREET

ALL that certain plot, piece or parcel of land, with the buildings and improvements thereon erected, situate, lying and being in the borough of Brooklyn, County of Kings, City and State of New York, bounded and described as follows:

BEGINNING at the southeasterly corner of Wallabout Street and Kent Avenue;

THENCE southerly along the easterly side of Kent Avenue, 200.04 feet;

THENCE easterly parallel with Flushing Avenue, 198.67 feet;

THENCE northerly parallel with Kent Avenue, 200 feet to the southerly side of Wallabout Street;

THENCE westerly along the southerly side of Wallabout Street, 193.17 feet (deed), 190.75' feet (actual), to the point or place of BEGINNING.

AREA OF LOT = 38,852.99 SQ. Ft = 0.8919 ACRE

LEGEND (FOR SITE PURPOSES ONLY) JOB #2261-1-11

GAS VALVE | PARKING METER | TRAFFIC SIGN | HYDRANT HYD. | TREE PIT | LIGHT POST | CATCH BASIN | UTIL.ITY POLE | PHONE BOX | WATER VALVE | S.H.B. WATER | TEL. MANHOLE | SEWER MANHOLE | ELECTRIC MANHOLE | CL. CLEAR | L.A. LOW AREA | W.W. WINDOW WELL | C.D. CELLAR DOOR | R.C. RISED CONCRETE | S.G.H. SAFETY GATE & HOUSING | F.E. FIRE ESCAPE | ENT.UND. ENTRANCE UNDER | A. AREAWAY | RT. RIGHT | CL. CENTERLINE | TC. TOP OF CURB | BC. BOTTOM OF CURB | LG. LEGAL GRADE | PI. POINT OF INTERSECTION | TW. TOP OF WALL | BW. BOTTOM OF WALL | F.F. FIRST FLOOR | B.F. BASEMENT FLOOR | L.F. LOWER FLOOR | EL. SPOT ELEVATION | EP. EDGE OF PAVE

LEGAL DESCRIPTIONS OF
ENVIRONMENTAL EASEMENT AREA
AND LOT
SCHEDULE 'A'

BLOCK 2261 LOT 1
74 WALLABOUT STREET

ALL that certain plot, piece or parcel of land, with the buildings and improvements thereon
erected, situate, lying and being in the borough of Brooklyn, County of Kings, City and State of New York, bounded and described as follows:

BEGINNING at the southeasterly corner of Wallabout Street and Kent Avenue;

THENCE southerly along the easterly side of Kent Avenue, 200.04 feet;

THENCE easterly parallel with Flushing Avenue, 198.67 feet;

THENCE northerly parallel with Kent Avenue, 200 feet to the southerly side of Wallabout Street;

THENCE westerly along the southerly side of Wallabout Street, 193.17 feet (deed), 190.75' feet (actual), to the point or place of BEGINNING.

VICINITY MAP N. T. S.

This property is located within an area having a Zone Designation AE base flood elevation = 8.92 feet NAVD88 datum (advisory base flood elevation 11 ft. NAVD88) by the Federal EmergencyManagement Agency (FEMA), on Flood Insurance Rate Map No.3604970204F, with a date of Identification of 9/5/2007, for Community No.360497, In Kings County, State of New York, which Is the current Flood Insurance Rate Map for the community In which said premises Is situated.

ZONING INFORMATION

ZONE : R7-1 COMMERCIAL OVERLAY: C1-5
EFFECTIVE DATE : 03/20/2013 C 130052 ZMM

AAA GROUP
LAND SURVEYORS & CONSULTANTS
100-A BROADWAY
BROOKLYN, N.Y. 11249
TEL.(718) 387-9800, FAX 384-5050

STATE OF NEW YORK — VINCENT M. AUTUNNO — 049307 — LICENSED LAND SURVEYOR

TITLE SURVEY

FORMER ARKANSAS COMPANY, INC.
SITE No. C224172
74 WALLABOUT STREET, BROOKLYN, NY 11206

SURVEYED:	
Date Field Work Performed	JULY 26, 2012
UPDATED:	APRIL 26, 2014
Date of Plat Last Revision	MAY 21, 2014
SCALE:	1"=10'
BLOCK:	2261
LOT(s):	1
SECTION:	1
COUNTY:	KINGS
DWG BY:	AAA-Mr.L

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

LOT AREA CALCULATION
AREA=38,852.99 SQ. FT.
AREA=0.8919 ACRES

NOTE: TEMPORARY CONSTRUCTION FENCES NOT SHOWN

0' 4' 8' 16' 24' 32'

HEYWARD STREET (34± WIDE ASPHALT ROADWAY) (70' WIDE)

WALLABOUT STREET (34'± WIDE ASPHALT ROADWAY) (70' WIDE)

ONE WAY TRAFFIC

KENT AVENUE (35'± WIDE ASPHALT ROADWAY) (60' WIDE)

TWO WAY TRAFFIC

FLUSHING AVENUE (44'± WIDE ASPHALT ROADWAY) (70' WIDE)

FRANKLIN AVENUE (30± WIDE ASPHALT ROADWAY) (60' WIDE)

190.75' (actual)
(190'-9")
193.17' (DEED)
(193'-2")

200.04' (DEED)
(200'-0 ½")

198.67'
(198'-8")

129'-10"

125'-3½"

120'-9"

100'-2"

200' (DEED)

AREA UNDER CONSTRUCTION

EASEMENT AREA IS ENTIRETY OF LOT

out of parcel

out of parcel

4 STORY BRICK

No. 2 FRANKLYN AV.

FIRST FLOOR EL.=10.60'

100'-0" WALL

GORE OR STRIP OF LAND RECORDED IN DEED. Reel 935, Page 325

WINDOWS

NEARLY PARALLEL WITH KENT AVENUE

No. 12 FRANKLYN AV.

4 STORY BRICK

100'-0" WALL

5 STORY BRICK (STUCCO)

ELEVATOR MOTOR

CHAIN LINK FENCE ON CONC. CURB

CONC. SIDEWALK

CONC. PAVED BUS STOP

STEEL BOUND CONC. CURB

IRREG. BLUESTONE CURB

DROP CURB

CONC. CURB

102" COMBINED SEWER

10" COMBINED SEWER LINE

12" COMBINED SEWER LINE

8" WATER MAIN

12" WATER MAIN

SEWER LINE

FLOW

GAS LINE

ELECTRIC LINE

WATER LINE

CATCH BASIN

GAS TEST

GAS MANHOLE

SEWER MANHOLE

ELECTRIC MANHOLE

WATER VALVE

GAS VALVE

TREE PIT

LIGHT POST

TRAFFIC SIGN

HYDRANT HYD.

FIRE ALARM BOX

N.Y.A.T.

APPENDIX B – EXCAVATION WORK PLAN

B-1 NOTIFICATION

At least 15 days prior to the start of any activity that is anticipated to encounter remaining contamination, the site owner or their representative will notify the Department. Currently, this notification will be made to:

Jon Greco

NYSDEC

625 Broadway

Albany, NY 12233-7016

This notification will include:

- A detailed description of the work to be performed, including the location and areal extent, plans for site re-grading, intrusive elements or utilities to be installed below the soil cover, estimated volumes of contaminated soil to be excavated and any work that may impact an engineering control,
- A summary of environmental conditions anticipated in the work areas, including the nature and concentration levels of contaminants of concern, potential presence of grossly contaminated media, and plans for any pre-construction sampling;
- A schedule for the work, detailing the start and completion of all intrusive work,
- A summary of the applicable components of this EWP,
- A statement that the work will be performed in compliance with this EWP and 29 CFR 1910.120,
- A copy of the contractor's health and safety plan, in electronic format, if it differs from the HASP provided in Appendix **C** of this document,
- Identification of disposal facilities for potential waste streams,

- Identification of sources of any anticipated backfill, along with all required chemical testing results.

B-2 SOIL SCREENING METHODS

Visual, olfactory and instrument-based soil screening will be performed by a qualified environmental professional during all remedial and development excavations into known or potentially contaminated material (remaining contamination). Soil screening will be performed regardless of when the invasive work is done and will include all excavation and invasive work performed during development, such as excavations for foundations and utility work, after issuance of the COC.

Soils will be segregated based on previous environmental data and screening results into material that requires off-site disposal, material that requires testing, material that can be returned to the subsurface, and material that can be used as cover soil.

B-3 STOCKPILE METHODS

Excavated soil from the site will be stockpiled separately and will be segregated from construction materials. Stockpiles will be used only when necessary and will be removed as soon as practicable. While stockpiles are in place, they will be inspected daily, and before and after every storm event. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by NYSDEC. Excavated soils will be stockpiled on, at minimum, double layers of 8-mil minimum sheeting, will be kept covered at all times with appropriately anchored plastic tarps, and will be routinely inspected. Broken or ripped tarps will be promptly replaced.

All stockpile activities will be compliant with applicable laws and regulations. Soil stockpile areas will be appropriately graded to control run-off in accordance with applicable laws and regulations. Stockpiles of excavated soils and other materials shall be located at least of 25 feet from the property boundaries, where possible. Hay bales or equivalent will surround soil stockpiles except for areas where access by

equipment is required. Silt fencing and hay bales will be used as needed near catch basins, surface waters and other discharge points.

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

B-4 MATERIALS EXCAVATION AND LOAD OUT

The professional engineer / qualified environmental professional overseeing the remedial action will:

- oversee remedial work and the excavation and load-out of excavated material;
- ensure that all loaded outbound trucks are inspected and cleaned if necessary before leaving the Site;
- ensure that all egress points for truck and equipment transport from the Site will be kept clean of Site-derived materials during Site remediation.

Locations where vehicles exit the Site shall be inspected daily for evidence of soil tracking off premises. Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to Site-derived materials.

Open and uncontrolled mechanical processing of historical fill and contaminated soil on-Site will not be performed.

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

The presence of utilities and easements on the site will be investigated by the qualified environmental professional. It will be determined whether a risk or impediment to the planned work under this SMP is posed by utilities or easements on the site.

Loaded vehicles leaving the site will be appropriately lined, tarped, securely covered, manifested, and placarded in accordance with appropriate Federal, State, local,

and New York State Department of Transportation (NYSDOT) requirements (and all other applicable transportation requirements).

A truck wash will be operated on-site. The qualified environmental professional will be responsible for ensuring that all outbound trucks will be washed at the truck wash before leaving the site until the activities performed under this section are complete.

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

The qualified environmental professional will be responsible for ensuring that all egress points for truck and equipment transport from the site are clean of dirt and other materials derived from the site during intrusive excavation activities. Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to site-derived materials.

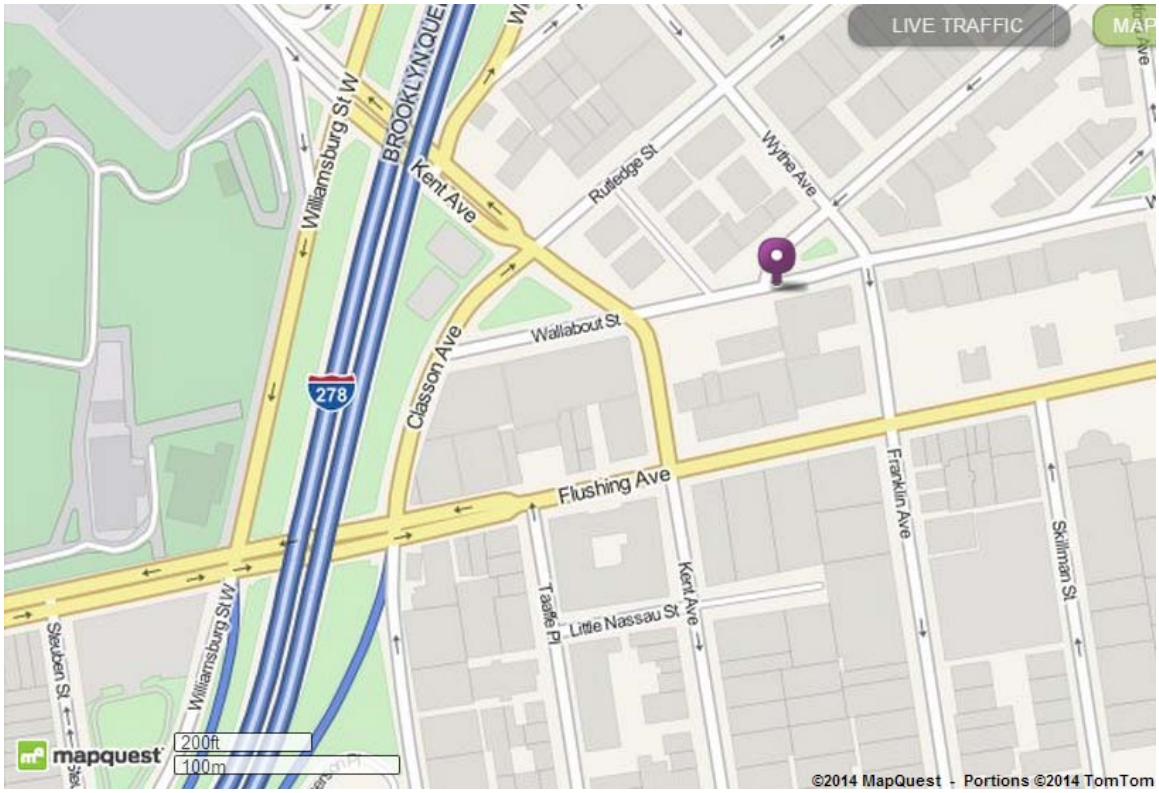
B-5 MATERIALS TRANSPORT OFF-SITE

Loaded vehicles leaving the Site will comply with all applicable materials transportation requirements (including appropriate covering, manifests, and placards) in accordance with applicable laws and regulations, including use of licensed haulers in accordance with 6 NYCRR Part 364. If loads contain wet material capable of causing leakage from trucks, truck liners will be used. Queuing of trucks will be performed on-Site, when possible in order to minimize off-site disturbance. Off-Site queuing will be minimized. Trucks will not stop or idle in the neighborhood after leaving the project Site.

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

Truck transport routes are as follows: trucks will leave the site and head west along Wallbout Street or Flushing Avenue towards the Brooklyn/Queens Expressway.

Truck Route Map



All trucks loaded with site materials will exit the vicinity of the site using only these approved truck routes. This is the most appropriate route and takes into account: (a) limiting transport through residential areas and past sensitive sites; (b) use of city mapped truck routes; (c) prohibiting off-site queuing of trucks entering the facility; (d) limiting total distance to major highways; (e) promoting safety in access to highways; and (f) overall safety in transport.

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

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

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

B-6 MATERIALS DISPOSAL OFF-SITE

The following documentation will be established and reported by the professional engineer / qualified environmental professional for each disposal destination used in this project to document that the disposal of regulated material exported from the Site conforms with applicable laws and regulations: (1) a letter from each disposal facility stating it is approved to accept the material.

All soil/fill/solid waste excavated and removed from the site will be treated as contaminated and regulated material and will be transported and disposed in accordance with all local, State (including 6NYCRR Part 360) and Federal regulations. If disposal of soil/fill from this site is proposed for unregulated off-site disposal (i.e. clean soil removed for development purposes), a formal request with an associated plan will be made to the NYSDEC. Unregulated off-site management of materials from this site will not occur without formal NYSDEC approval.

Off-site disposal locations for excavated soils will be identified in the pre-excavation notification. This will include estimated quantities and a breakdown by class of disposal facility if appropriate, i.e. hazardous waste disposal facility, solid waste landfill, petroleum treatment facility, Construction and Demolition (C/D) recycling facility, etc. Actual disposal quantities and associated documentation will be reported to the NYSDEC in the Periodic Review Report. This documentation will include: waste profiles, test results, facility acceptance letters, manifests, bills of lading and facility receipts.

Non-hazardous historic fill and contaminated soils taken off-site will be handled, at minimum, as a Municipal Solid Waste per 6NYCRR Part 360-1.2. Material that does not meet Track 1 unrestricted SCOs is prohibited from being taken to a New York State recycling facility (6NYCRR Part 360-16 Registration Facility).

B-7 MATERIALS REUSE ON-SITE

Soil and fill that is derived from the property will be excavated and disposed of off-site. There are no plans for re-use of excavated material on-site. If re-use of material on-site becomes an option the NYSDEC would be provided a detailed plan and must approve the material re-use prior to placement of the material.

The qualified environmental professional will ensure that procedures defined for materials reuse in this SMP are followed and that unacceptable material does not remain on-site. Contaminated on-site material, including historic fill and contaminated soil, that is acceptable for re-use on-site will be placed below the demarcation layer or impervious surface, and will not be reused within a cover soil layer, within landscaping berms, or as backfill for subsurface utility lines.

Any demolition material proposed for reuse on-site will be sampled for asbestos and the results will be reported to the NYSDEC for acceptance. Concrete crushing or processing on-site will not be performed without prior NYSDEC approval. Organic matter (wood, roots, stumps, etc.) or other solid waste derived from clearing and grubbing of the site will not be reused on-site.

B-8 FLUIDS MANAGEMENT

Liquids to be removed from the site, including excavation dewatering and groundwater monitoring well purge and development waters, will be handled, transported and disposed in accordance with applicable local, State, and Federal regulations. Dewatering, purge and development fluids will not be recharged back to the land surface or subsurface of the site, but will be managed off-site.

Discharge of water generated during large-scale construction activities to surface waters (i.e. a local pond, stream or river) will be performed under a State Pollution Discharge Elimination System (SPDES) permit.

B-9 COVER SYSTEM RESTORATION

After the completion of soil removal and any other invasive activities the cover system will be restored in a manner that complies with the Remedial Action Work Plan. The demarcation layer, consisting of orange snow fencing material or equivalent material will be replaced to provide a visual reference to the top of the 'Remaining Contamination Zone', the zone that requires adherence to special conditions for disturbance of remaining contaminated soils defined in this Site Management Plan. If the type of cover system changes from that which exists prior to the excavation (i.e., a soil cover is replaced by asphalt), this will constitute a modification of the cover element of the remedy and the upper surface of the 'Remaining Contamination'. A figure showing the modified surface will be included in the subsequent Periodic Review Report and in any updates to the SMP.

B-10 BACKFILL FROM OFF-SITE SOURCES

A process has been established to evaluate sources of backfill and cover soil to be imported to the Site, and will include an examination of source location, current and historical use(s), and any applicable documentation. Material from industrial sites, spill sites, environmental remediation sites or other potentially contaminated sites will not be imported to the Site. This process is discussed below.

The following potential sources may be used pending attainment of backfill and cover soil quality objectives:

- Clean soil from construction projects at non-industrial sites in compliance with applicable laws and regulations;
- Clean soil from roadway or other transportation-related projects in compliance with applicable laws and regulations;
- Clean recycled concrete aggregate (RCA) from facilities permitted or registered by the regulations of NYSDEC.

Materials received for import to the Site will be approved by a professional engineer / qualified environmental professional and will be in compliance with provisions in RWP. A report will be submitted that includes the source of the fill, evidence that an inspection was performed on the source, chemical sampling results, frequency of testing, and a Site map indicating the locations where backfill or soil cover was placed.

Imported soils will meet the backfill and cover soil quality standards established in 6NYCRR 375-6.7(d). Soils that meet 'exempt' fill requirements under 6 NYCRR Part 360, but do not meet backfill or cover soil objectives for this site, will not be imported onto the site without prior approval by NYSDEC. Solid waste will not be imported onto the site.

Trucks entering the site with imported soils will be securely covered with tight fitting covers. Imported soils will be stockpiled separately from excavated materials and covered to prevent dust releases.

B-11 STORMWATER POLLUTION PREVENTION

Erosion and sediment control measures will be installed, as needed, to prevent off-site migration of soil (silt fences and barriers, and hay bale checks). If installed, they will be inspected once a week and after every storm event to ensure that they are operating appropriately. Discharge locations will be inspected to determine whether erosion control measures are effective in preventing off-site impact. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by NYSDEC. Necessary repairs shall be made promptly. Accumulated sediments will be removed as required to keep the barrier and hay bale check functional. Undercutting or erosion of the silt fence anchor will be repaired promptly with appropriate backfill materials.

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

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

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

B-12 CONTINGENCY PLAN

This contingency plan is developed for the remedial construction to address the discovery of unknown structures or contaminated media during excavation. If underground tanks or other previously unidentified contaminant sources are found during post-remedial subsurface excavations or development related construction, excavation activities will be suspended until sufficient equipment is mobilized to address the condition.

Identification of unknown contamination source areas during invasive Site work will be promptly communicated to NYSDECs Project Manager. Petroleum spills will be reported to the NYSDEC Spill Hotline. If previously unidentified contaminant sources are found during on-Site remedial excavation or development-related excavation, sampling will be performed on contaminated source material and surrounding soils and reported to NYSDEC. Chemical analytical testing will be performed for Full List volatiles and semi-volatiles, pesticides/PCBs, and TAL metals, as appropriate.

These findings will be also included in the periodic reports prepared pursuant to Section 5 of the SMP.

B-13 COMMUNITY AIR MONITORING PLAN

This CAMP provides measures for protection for on-site workers, the adjacent school and the downwind community (i.e., off-site receptors including residences, businesses, and on-site workers not directly involved in the remedial measures) from

potential airborne contaminant releases resulting from IRM at 74 Wallabout Street, Brooklyn, New York.

The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that the remedial work did not spread contamination off-site through the air.

Based on previous investigations at the site, the primary concerns for this site are VOCs and dust particulates.

Regulatory Requirements

This CAMP was established in accordance with the following requirements:

- 29 CFR 1910.120(h): This regulation specifies that air shall be monitored to identify and quantify levels of airborne hazardous substances and health hazards, and to determine the appropriate level of protection for workers.
- NYSDOH Generic Community Air Monitoring Plan: This guidance specifies that a community air-monitoring program shall be implemented to protect the surrounding community and to confirm that the work does not spread contamination off-site through the air
- NYSDEC Technical and Guidance Memorandum (TAGM) #4031 - Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites: This guidance provides a basis for developing and implementing a fugitive dust suppression and particulate monitoring program as an element of a hazardous waste site's health and safety program.

AIR MONITORING

The following sections contain information describing the types, frequency and location of real-time monitoring.

Real-Time Monitoring

This section addresses the real-time monitoring that will be conducted within the work area, and along the site perimeter, during intrusive activities such as excavation.

Work Area

The following instruments will be used for work area monitoring:

- PID
- Dust Monitor

The tables below presents a breakdown of each main activity and provides the instrumentation, frequency and location of the real-time monitoring for the site.

ACTIVITY	AIR MONITORING INSTRUMENT	FREQUENCY AND LOCATION
Sampling, Excavation	PID, Dust Monitor	Continuously in Breathing Zone during intrusive activities or if odors become apparent, screening in the breathing zone every 30 minutes during non-intrusive activities. Every 15 minutes at the perimeter during intrusive activities.

The table below lists the Real-Time Air Monitoring Action Levels to be used in all work areas.

AIR MONITORING INSTRUMENT	MONITORING LOCATION	ACTION LEVEL	SITE ACTION	REASON
PID	Breathing Zone	0-25 ppm, non-transient	None	Exposure below established exposure limits

PID	Breathing Zone	25-100 ppm, non-transient	Don APR	Based on potential exposure to VOCs
PID	Breathing Zone	>100 ppm, non-transient	Don ASR or SCBA, Institute vapor/odor suppression measures, Notify HSM.	Increased exposure to site contaminants, potential for vapor release to public areas.
PID	Work Area Perimeter*	< 1 ppm	None	Exposure below established exposure limits.
PID	Work Area Perimeter*	> 1 ppm	Stop work and implement vapor release response plan until readings return to acceptable levels, Notify HSM.	Increased exposure to site contaminants, potential for vapor release to public areas
Aerosol Monitor	Work Area Perimeter*	< 150 $\mu g/m^3$	None	Exposure below established exposure limits.
Aerosol Monitor	Work Area Perimeter*	>150 $\mu g/m^3$	Stop work and implement dust suppression measures until readings return to acceptable levels, Notify HSM.	Increased exposure to site contaminants

VAPOR EMISSION RESPONSE PLAN

This section is excerpted from the NYSDOH guidance for CAMP - Ground Intrusive Activities.

If the ambient air concentration of organic vapors exceeds 1 part per million (ppm) above background at the perimeter of the work area or opposite the school's wall, activities will be halted and monitoring continued. Vapor suppression measures can also be taken at this time. If the organic vapor level decreases below 1 ppm above background, work activities can resume.

If the organic vapor level is above 1 ppm at the perimeter of the work area or opposite the school's wall, activities must be shut down. When work shutdown occurs, downwind air monitoring as directed by the SHSO will be implemented to ensure that vapor emission does not impact the nearest residential or commercial structure at levels exceeding those specified in the Major Vapor Emission Response Plan Section.

If any organic levels greater than 1 ppm over background are identified opposite the walls of the occupied school or next to the intake vents or 200 feet downwind from the work area or half the distance to the nearest residential or commercial property, whichever is less, all work activities must be halted.

If, following the cessation of the work activities or as the result of an emergency, organic level persists above 1 ppm, then the air quality must be monitored within the school.

If efforts to abate the emission source (see Section 5.0) are unsuccessful and if organic vapor levels are approaching 1 ppm above background for more than 15 minutes, then the Major Vapor Emission Response Plan shall automatically be placed into effect.

However, the Major Vapor Emission Response Plan shall be immediately placed in effect if organic vapor levels are greater than 10 ppm above background.

Upon activation, the following activities will be undertaken:

- All emergency Response Contacts as listed in the HASP will go into effect.

- The local police authorities will immediately be contacted by the SHSO and advised of the situation
- Frequent air monitoring will be conducted at 15-minute intervals. If two successive readings below action levels are measured, air monitoring may be halted or modified by the SHSO.

VAPOR SUPPRESSION TECHNIQUES

Vapor suppression techniques must be employed when action levels warrant the use of these techniques.

The techniques to be implemented for control of VOCs from stockpiled soil or from the open excavation will include one or more of the following:

- cover with plastic
- cover with "clean soil"
- application of hydro-mulch material or encapsulating foam
- limit working hours to favorable wind and temperature conditions

DUST SUPPRESSION TECHNIQUES

Reasonable dust-suppression techniques must be employed during all work that may generate dust, such as drilling, excavation, grading, and placement of clean fill. The following techniques were shown to be effective for controlling the generation and migration of dust during remedial activities:

- Wetting equipment and excavation faces;
- Spraying water on buckets during excavation and dumping;
- Hauling materials in properly covered containers; and,
- Restricting vehicle speeds to 10 mph.

It is imperative that utilizing water for suppressing dust will not create surface runoff.

B-14 ODOR CONTROL PLAN

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

This odor control plan is capable of controlling emissions of nuisance odors. If nuisance odors are identified, work will be halted and the source of odors will be identified and corrected. Work will not resume until all nuisance odors have been abated. NYSDEC will be notified of all odor complaint events. Implementation of all odor controls, including halt of work, will be the responsibility of the professional engineer / qualified environmental professional and will be discussed in the Periodic Review Report.

If nuisance odors develop during intrusive work that cannot be corrected, or where the control of nuisance odors cannot otherwise be achieved due to on-site conditions or close proximity to sensitive receptors, odor control will be achieved by sheltering the excavation and handling areas in a temporary containment structure equipped with appropriate air venting/filtering systems.

B-15 DUST CONTROL PLAN

Dust management during invasive on-Site work will include, at a minimum:

- Use of a dedicated water spray methodology for roads, excavation areas and stockpiles.
- Use of properly anchored tarps to cover stockpiles.

- Exercise extra care during dry and high-wind periods.
- Use of gravel or recycled concrete aggregate on egress and other roadways to provide a clean and dust-free road surface.

This dust control plan is capable of controlling emissions of dust. If nuisance dust emissions are identified, work will be halted and the source of dusts will be identified and corrected. Work will not resume until all nuisance dust emissions have been abated. DEC will be notified of all dust complaint events. Implementation of all dust controls, including halt of work, will be the responsibility of the professional engineer / qualified environmental professional responsible for certifying the Remedial Closure Report.

B-16 OTHER NUISANCES

Noise control will be exercised during the remedial program. All remedial work will conform, at a minimum, to New York City (NYC) noise control standards.

Rodent control will be provided, during Site clearing and grubbing, and during the remedial program, as necessary, to prevent nuisances.

APPENDIX C -HEALTH AND SAFETY PLAN

FORMER ARKANSAS CHEMICAL CO., INC SITE
74 WALLABOUT STREET
BRROKLYN, NEW YORK
BCP NO. C224172
NYSDEC SPILL NO. 12-13721

HEALTH AND SAFETY PLAN

SUBMITTED TO:

New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, NY 12233-7016

PREPARED FOR:

74 Wallabout LLC
505 Flushing Avenue, Suite 1D
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PWGC Project Number: RAB1301

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PROJECT No. RAB1203

HEALTH AND SAFETY PLAN

74 WALLABOUT STREET
BROOKLYN, NEW YORK

SUBMITTED:
September 2013

PREPARED FOR:
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, New York 12233

ON BEHALF OF:
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HEALTH AND SAFETY PLAN
74 WALLABOUT STREET
BROOKLYN, NEW YORK

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APPENDICES

1.0 STATEMENT OF COMMITMENT

This Health and Safety Plan (HASP) has been prepared to ensure that workers are not exposed to chemical, biological and physical hazards during the planned Interim Remedial Measure (IRM) activities to be performed at 74 Wallabout Street, Brooklyn, New York. P.W. Grosser Consulting Inc.'s (PWGC's) policy is to minimize the possibility of work-related exposure through awareness and qualified supervision, health and safety training, medical monitoring, use of appropriate personal protective equipment, and the following activity specific safety protocols contained in this HASP. PWGC has established a guidance program to implement this policy in a manner that protects personnel to the maximum reasonable extent.

This HASP, which applies to persons present at the site actually or potentially exposed to safety or health hazards, describes emergency response procedures for actual and potential physical, biological and chemical hazards. This HASP is also intended to inform and guide personnel entering the work area or exclusion zone. Persons are to acknowledge that they understand the potential hazards and the contents of this Health and Safety policy.

2.0 INTRODUCTION

2.1 Purpose

This HASP addresses the minimum health and safety practices that will be employed by site workers participating in IRM activities at the project site located at 74 Wallabout Street, Brooklyn, New York.

The HASP takes into account the specific hazards inherent to the site and presents the minimum requirements which are to be met by P.W. Grosser Consulting, Inc. (PWGC), its' subcontractors, and other on-site personnel in order to avoid and, if necessary, protect against health and/or safety hazards. PWGC sub-contractors will have the option of adopting this HASP or developing their own site-specific document. If a subcontractor chooses to prepare their own HASP, it must meet the minimum requirements as detailed in this HASP and must be made available to PWGC.

Activities performed under this HASP will comply with applicable parts of Occupational Safety and Health Administration (OSHA) Regulations, primarily 29 CFR Parts 1910 and 1926 and all other applicable federal, state, and local regulations. Modifications to the HASP may be made with the approval of the PWGC Health and Safety Manager (HSM) and/or Project Manager (PM). A copy of this HASP will be maintained on-site during all work activities.

Refusal to comply with the HASP or violation of any safety procedures by field personnel may result in their immediate removal from the site following consultation with the HSM and the Field Team Leader (FTL).

2.2 Scope

This HASP addresses the potential hazards related to the IRM activities. The primary IRM activities include the following:

- Site Mobilization/Demobilization;
- Excavation, and
- Soil Sampling

The potential hazards associated with this scope are listed below and are discussed in more detail in this HASP after the project organization and responsibilities section.

- Chemical Hazards
- Biological Hazards
- Physical Hazards

2.3 Application

The HASP applies to all personnel involved in the above tasks who wish to gain access to active work areas, including but not limited to:

- PWGC employees and subcontractors;
- Client representatives; and

- Federal, state or local representatives.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section specifies the project organization and responsibilities.

3.1 Project Manager

- Participates in major incident investigations;
- Ensures that the HASP has all of the required approvals before site work is conducted; and
- Has the overall project responsibility for project health and safety.

3.2 Field Team Leader (FTL)/ Site Health and Safety Officer (SHSO)

- Ensures that the HASP is implemented in conjunction with the Health and Safety Manager (HSM);
- Ensures that field work is scheduled with adequate equipment to complete the job safely;
- Enforces site health and safety rules;
- Ensures that proper personal protective equipment is utilized;
- Ensures that the HSM is informed of project changes that require modifications to the HASP;
- Ensures that the procedure modifications are implemented;
- Investigates incidents;
- Conducts the site safety briefing;
- Reports to HSM to provide summaries of field operations and progress; and
- Acts as Emergency Coordinator.

3.3 Health and Safety Manager

- Provides for the development of the HASP;
- Serves as the primary contact to review health and safety matters that may arise;
- Approves individuals who are assigned SHSO responsibilities;
- Coordinates revisions of this HASP with field personnel; and
- Assists in the investigation of major accidents.

3.4 Site Personnel

- Report any unsafe or potentially hazardous conditions to the FTL/SHSO;
- Maintain knowledge of the information, instructions and emergency response actions contained in this HASP; and
- Comply with rules, regulations and procedures as set forth in this HASP and any revisions.

4.0 SITE HISTORY AND PROJECT DESCRIPTION

4.1 Project Background

This Health and Safety Plan (HASP) has been prepared by PWGC, on behalf of 74 Wallabout LLC. Volatile Organic Compounds (VOCs), Semi-volatile Organic Compounds (SVOCs), pesticides and metals have been identified above guidance levels and/or standards in soil and groundwater at the site.

4.2 Site Location and Description

The site is located at 74 Wallabout Street in Brooklyn, New York. The property is bordered on the north by Wallabout Street and residential property, one the east by a hotel and school, on the west by Kent avenue and residential and commercial properties, and on the south by Flushing Avenue and a vacant lot and commercial property.

5.0 POTENTIAL HAZARDS OF THE SITE

This section presents an assessment of the chemical, biological, and physical hazards that may be encountered during the tasks specified under Section 1.0. Additional information can be found in **Appendix A** - Material Safety Data Sheets or in **Appendix B** - Activity Hazard Analyses.

5.1 Chemical Hazards

Review of historical information from the site indicates that the soil at the site is contaminated with VOCs, SVOCs, pesticides, and metals, which are present at elevated levels in soil and/or groundwater. These compounds may present an occupational exposure hazard during site operations.

The chemicals identified above may have an effect on the central nervous system, respiratory system and may cause chronic liver and kidney damage. Acute exposure symptoms may include headache, dizziness, nausea, diarrhea and skin and eye irritation. Specific information on the chemicals identified at the Site can be found in Table 5-1 as well as on the Material Safety Data Sheets found in Appendix A.

Table 5-1

Chemical Hazards

COMPOUND	CAS#	OSHA PEL	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
2-Butanone	78-93-3	TWA 200 mg/m^3	Inhalation Ingestion Skin/Eye	Confusion, cough, dizziness, drowsiness, headache, sore throat, vomiting, redness, dry skin, pain.	Skin, lungs, central nervous system, eyes, respiratory tract	Colorless liquid, with characteristic odor
Acenaphthene	83-32-9	None	Inhalation Ingestion Skin/Eye	Respiratory irritation	Lungs	Solid
Acetone	67-64-1	TWA 750 ppm	Inhalation Skin	Sore throat, cough, confusion, headache, dizziness, drowsiness, unconsciousness	Central nervous system, liver, kidneys, and gastrointestinal tract	Colorless liquid, with characteristic odor
Alpha-BHC	319-84-6	None	Inhalation Ingestion Skin	Cough, sore throat, diarrhea, dizziness, headache, nausea, vomiting, tremors	Central Nervous System	Crystalline powder, with characteristic odor
4,4'-DDD	72-54-8		Ingestion Skin	Skin irritation, toxic if swallowed		Colorless to off-white crystals
4,4-DDT	50-29-3	TWA 0.5 mg/m^3	Inhalation Ingestion Skin	Confusion, cough, dizziness, drowsiness, headache, sore throat, vomiting, redness, dry skin, pain.	None	Solid
Cadmium	7440-43-9	TWA 0.002 mg/m^3	Inhalation Ingestion	Cough, sore throat, redness, pain, abdominal pain, diarrhea, headache, nausea, vomiting	Kidneys	Soft Blue-White Metal Lumps or Grey powder
Naphthalene	91-20-3	TWA 10 ppm	Inhalation Ingestion Skin	Headache, weakness, nausea, vomiting, sweating, confusion, jaundice, dark urine	Blood, eyes	White solid in various forms, with characteristic odor
Copper	7440-50-8	TWA 0.2 mg/m^3	Inhalation Ingestion	Cough, headache, shortness of breath, sore throat, redness, pain, abdominal pain, nausea, vomiting	None	Red powder

COMPOUND	CAS#	OSHA PEL	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Iron	7439-89-6	None	Inhalation Ingestion	None	None	Grey crystalline powder
Lead	7439-92-1	TWA 0.05 mg/m^3	Inhalation Ingestion	None	Blood, bone marrow, central nervous system, kidneys	Bluish-White or Silvery-Grey Solid
Benzene	71-43-2	TLV: 0.5 ppm as TWA	Inhalation Ingestion Skin/Eye	Dizziness, drowsiness, headache, nausea, shortness of breath, convulsions, unconsciousness, dry skin, redness, pain, abdominal pain, sore throat, vomiting.	Bone marrow, immune system	Colorless liquid, with characteristic odor.
p/m-xylene	106-42-3	TLV: 100 ppm as TWA	Inhalation Ingestion Skin/Eye	Dizziness, drowsiness, headache, nausea, dry skin, redness, pain, burning sensation, abdominal pain.	Central nervous system	Colorless liquid, with characteristic odor.
Trichloroethene	79-01-6	TLV: 50 ppm as TWA	Inhalation Ingestion Skin/Eye	Dizziness, drowsiness, headache, weakness, nausea, unconsciousness, dry skin, redness, pain, abdominal pain.	Central nervous system, liver, kidneys.	Colorless liquid, with characteristic odor.
Benzo(a) anthracene	56-55-3	None	Inhalation Ingestion Skin/Eye	None	None	Flakes or Powder
Benzo(a) Pyrene	50-32-8	None	Inhalation Ingestion Skin/Eye	None	None	Crystals
Benzo(b) Fluoranthene	205-99-2	None	Inhalation Ingestion Skin/Eye	None	None	Crystals
Benzo(k)fluoranthene	207-08-9	None	Inhalation Skin	None	None	Yellow Crystals
Chrysene	218-01-9	None	Inhalation Ingestion Skin/Eye	None	None	Crystals

COMPOUND	CAS#	OSHA PEL	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Dibenzo(a,h)anthracene	53-70-3	None	Inhalation Ingestion Skin	Redness, swelling, itching	None	Colorless crystalline powder
Dibenzofuran	132-64-9	None	Skin	None	None	Crystals
Fluoranthene	206-44-0	None	Ingestion Skin/Eye	Irritant	None	Solid
Ideno(1,2,3-cd)pyrene	193-39-5	None	Inhalation Ingestion Skin/Eye	None	None	Yellow Crystals
Phenanthrene	85-01-8	None	Inhalation Ingestion Skin/Eye	Irritant	None	White crystals
Pyrene	129-00-0	None	Inhalation Ingestion Skin/Eye	None	None	Pale Yellow or colorless solid
Arsenic	7440-38-2	TWA 0.01 mg/m^3	Inhalation Ingestion	Cough, sore throat, shortness of breath, weakness, abdominal pain, diarrhea, nausea, vomiting	Liver, bone marrow, peripheral nervous system	Grey metallic-looking crystals
Barium	7440-39-3	TWA 0.5 mg/m^3	Inhalation Skin/Eye	Cough, sore throat, redness, pain.	Eyes, skin, respiratory tract	Yellowish to white lustrous solid in various forms
Chromium	7440-47-3	TWA 0.5 mg/m^3	Inhalation Eyes	Cough, redness in eyes.	Eyes, respiratory tract	Grey powder
Mercury	7439-97-6	TWA 0.025 mg/m^3	Inhalation Ingestion Skin/Eye	Abdominal pain, cough, diarrhea, shortness of breath, vomiting, fever	Central nervous system, kidneys	Silvery liquid metal
Nickel	7440-02-0	TWA 1.5 mg/m^3	Inhalation	Cough, shortness of breath	Lungs	Silvery metallic solid in various forms
Selenium	7782-49-2	TWA 0.2 mg/m^3	Inhalation Ingestion Skin/Eye	Cough, dizziness, headache, nausea, vomiting, redness, skin burns, pain, blurred vision, diarrhea	Respiratory tract, gastrointestinal tract	Odorless solid

COMPOUND	CAS#	OSHA PEL	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Silver	7440-22-4	TWA 0.1 mg/m^3	Inhalation Ingestion	None	Lungs	White Metal
Zinc	7440-66-6	None	Inhalation Ingestion	Metallic taste, dry skin, abdominal pain, nausea, vomiting	None	Odorless Grey to Blue Powder
Antimony	7440-36-0	None	Inhalation Ingestion Skin/Eye	None	None	Silver-White Metal
Manganese	7439-96-5	TWA 0.2 mg/m^3	Inhalation Ingestion	Cough, abdominal pain, nausea	Respiratory Tract	Grey-White Powder
Sodium	7440-23-5	None	Inhalation Ingestion Skin/Eye	Cough, sore throat, pain, blisters, loss of vision, shock or collapse	None	Silvery Solid
Magnesium	7439-95-4	None	Inhalation Ingestion	None	None	Silver or grey Rod

Abbreviations

C = Ceiling limit, not to be exceeded
CNS = Central Nervous System
PEL=Permissible Exposure Limit
OSHA = Occupational Safety and Health Administration
ppm = parts per million
TWA = Time-weighted average (8 hours)

5.2 Biological Hazards

Work will be performed in a developed area of Brooklyn, during the course of the project, there is potential for workers to come into contact with biological hazards such as animals, insects and plants. The Activity Hazard Analyses found in **Appendix B** includes specific hazards and control measures for each task, if applicable.

5.2.1 *Animals*

The Site is located in a predominantly developed area. It is possible that dogs, cats, rats and mice may be present. Workers shall use discretion and avoid all contact with animals.

5.2.2 *Insects*

Insects, such as mosquitoes, ticks, bees and wasps may be present during certain times of the year. Workers will be encouraged to wear repellents and PPE, if deemed necessary, when working in areas where insects are expected to be present.

During the months of April through October, particular caution must be exercised to minimize exposure to deer ticks and the potential for contracting Lyme disease. Specific precautionary work practices that are recommended include the following:

- Cover your body as much as possible. Wear long pants and long sleeved shirts. Light color clothing makes spotting of ticks easier.
- Try to eliminate possible paths by which the Deer Tick may reach unprotected skin. For example, tuck bottoms of pants into socks or boots and sleeves into gloves. (Duct tape may be utilized to help seal cuffs and ankles). If heavy concentrations of ticks or insects are anticipated or encountered, Tyvek coveralls may be utilized for added protection when the potential for heat stress is not a concern.
- Conduct periodic and frequent, (e.g., hourly), surveys of your clothing for the presence of ticks. Remove any tick, save it and report to the clinic with the tick.
- Use insect /tick repellents that contain the chemical DEET (n,n-Diethyltoluamide). Apply repellents in accordance with manufacturers' recommendations. These repellents are readily available and include such brands as Deep Woods OFF and Maximum Strength OFF.

5.2.3 *Plants*

Poison ivy, sumac and oak may be present on site. The FTL/SHSO should identify the susceptible individuals. Worker shall avoid all contact with these plants.

5.3 Physical Hazards

Most safety hazards are discussed in the Activity Hazard Analyses (AHA) in **Appendix B** for the different phases of the project. In addition to the AHAs, general work rules and other safety procedures are described in Section 10 of this HASP.

5.3.1 *Operation of Heavy Equipment*

The use of heavy equipment will be implemented for this project; therefore, Occupational Safety and Health Administration (OSHA) guidelines will be followed for operating heavy equipment as outlined in 29 CFR 1926.602.

5.3.2 *Excavation/Earthwork*

Soil excavation will be conducted as part of this project and PWGC will follow the OSHA 29 CFR 1926.651 (February 20, 1990) construction industry standards relating to excavation work. These standards include shoring and cutback requirements, equipment specifications, entry requirements, etc. To avoid exposure to site specific contaminants and to ensure acceptable atmospheric conditions, the following additional requirements apply when excavation work is performed:

- Air quality will be tested before employees enter excavations over four feet deep if a hazardous atmosphere exists or is suspected to exist. If the site safety officer determines that excavations are, by OSHA's definition, "confined space," the confined space entry policy (Section 8.0) will be followed.
- Open excavations will be backfilled as soon as practicable. While excavations remain open, appropriate warnings will be posted and barricades will be erected to protect pedestrian and worker safety. Where possible, excavation side walls will be cut at a gradual slope to maximize egress and access. Workers will not enter excavations unless absolutely required.
- To ensure atmospheric quality, tests shall be conducted as often as necessary as determined by the site safety officer. This includes tests for flammable gas and oxygen deficiency.
- When the site safety officer identifies hazardous atmospheres, emergency rescue equipment and PPE must be on the work site (Level C PPE) and readily accessible to employees (29 CFR 1926.651(g)(2)(l)).
- Daily site safety inspections will be conducted by the site safety officer.

5.3.3 *Temperature Extremes*

Heat Stress

Heat stress is a significant potential hazard, which is greatly exacerbated with the use of PPE in hot environments. The potential hazards of working in hot environments include dehydration, cramps, heat rash, heat exhaustion, and heat stroke.

Cold Stress

At certain times of the year, workers may be exposed to the hazards of working in cold environments. Potential hazards in cold environments include frostbite, trench foot or immersion foot, hypothermia as well as slippery surfaces, brittle equipment, and poor judgment.

PWGC's Heat/Cold Stress Protocols are specified in **Appendix C**.

5.3.4 *Steam, Heat and Splashing*

Exposure to steam/heat/splashing hazards can occur during steam cleaning activities. Splashing can also occur during well development and sampling activities. Exposure to steam/heat/splashing can result in scalding/burns,

eye injury, and puncture wounds.

5.3.5 *Noise*

Noise is a potential hazard associated with the operation of heavy equipment, drill rigs, pumps and engines. Workers will wear hearing protection while in the work zone when these types of machinery are operating.

5.3.6 *Fire and Explosion*

When conducting excavation activities, the opportunity of encountering fire and explosion hazards may exist from encountering underground utilities, from the use of diesel engine equipment, and other potential ignition sources. During dry periods there is an increased chance of forest and brush fires starting at the job site. If these conditions occur no smoking will be permitted at the site and all operations involving potential ignition sources will be monitored continuously (fire watch).

5.3.7 *Manual Lifting/Material Handling*

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

5.3.8 *Slips, Trips and Falls*

Working in and around the site will pose slip, trip and fall hazards due to slippery surfaces that may be oil covered, or from rough terrain, surfaces that are steep inclines, surfaced debris, or surfaces which are wet from rain or ice. Falls may result in twisted ankles, broken bones, head trauma or back injuries.

5.3.9 *Electrocution*

Encountering underground utilities may pose electrical hazards to workers. Additionally, overhead electrical lines can be a concern during drilling operations. Potential adverse effects of electrical hazards include burns and electrocution, which could result in death.

6.0 ACTIVITY HAZARD ANALYSES

The Activity Hazard Analysis (AHA) is a systematic way of identifying the potential health and safety hazards associated with major phases of work on the project and the methods to avoid, control and mitigate those hazards. The AHAs will be used to train work crews in proper safety procedures during phase preparatory meetings.

AHAs have been developed by PWGC for the following phases of work:

1. Site Mobilization/Demobilization;
2. Excavation
3. Soil sampling; and
4. Decontamination

Copies of these AHAs are included in **Appendix B** of this HASP.

7.0 PERSONAL PROTECTIVE EQUIPMENT

The personal protective equipment (PPE) specified in **Table 7-1** represents the hazard analysis and PPE selection required by 29 CFR 1910.132. Specific information on known potential hazards can be found under Section 4.0 and **Appendix B** - Activity Hazard Analyses. For the purposes of PPE selection, the HSM and FTL/SHSO are considered competent persons. The signatures on the approval page of the HASP constitute certification of the hazard assessment. For activities not covered by **Table 7-1**, the FTL/SHSO will conduct the hazard assessment, select the PPE, and document changes in the appropriate field logs. PPE selection will be made in consultation with the HSM.

Modifications for initial PPE selection may also be made by the FTL/SHSO in consultation with the HSM and changes documented accordingly. If major modifications occur, the HSM will notify the PM.

7.1 PPE Abbreviations

HEAD PROTECTION
HH = Hard Hat

HEARING PROTECTION
EP = ear plugs
EM = ear muffs

EYE/FACE PROTECTION
APR = Full Face Air Purifying Respirator
MFS = Mesh Face shield
PFS =Plastic Face shield
SG = ANSI approved safety glasses with side shields

FOOT PROTECTION
Neo = Neoprene
OB = Overboot
Poly = polyethylene coated boot
Rub = rubber slush boots
STB = Leather work boots with steel toe

HAND PROTECTION
Cot = cotton
But = Butyl
LWG = Leather Work Gloves
Neo = Neoprene
Nit = Nitrile
Sur = Surgical

BODY PROTECTION
WC = work clothes
Cot Cov = Cotton Coveralls
Poly = Polyethylene coated Tyvek® coveralls
Saran = Saranex coated coveralls
Tyvek® = Uncoated Tyvek® coveralls

RESPIRATORY PROTECTION
APR = Full-face air purifying respirator with organic vapor cartridges
ASR = Full face air supplied respirator with escape bottle
SCBA = Self-contained breathing apparatus

7.2 Hazard Assessment for Selection of Personal Protective Equipment

The initial selection of personal protective equipment for each task was done by performing a hazard assessment taking into consideration the following:

- Potential chemical and physical present;
- Work operations to be performed;
- Potential routes of exposure;

- Concentrations of contaminants present; and
- Characteristics, capabilities and limitations of PPE and any hazard that the PPE presents or magnifies.

A review of the analytical data from previous sampling events indicates that VOCs, SVOCs, pesticides, and metals identified in **Table 5-1** are the primary contaminants of concern.

The exposure routes for these chemicals are inhalation, skin absorption, skin/eye contact and ingestion. Chemical protective gloves will be required for all activities that involve sample handling and the likelihood for skin contact. The proper use of PPE and strict adherence to decontamination and personal hygiene procedures will effectively minimize skin contact and ingestion as potential routes of exposure.

Table 7-1

Personal Protective Equipment Selection

TASK	HEAD	EYE/FACE	FEET	HANDS	BODY	HEARING	RESPIRATOR
Mobilization/ Demobilization	HH	SG	STB	WG	WC	None	None
Excavation, loading and backfilling	HH	SG	STB	WG	WC	EM or EP	None initially APR if action levels exceeded
Soil sampling	HH	SG	STB	WG, Nit & Sur as needed	WC, Tyvek® as needed	None	None initially APR if action levels exceeded
Decontamination	HH	SG	STB	Nit + Sur	WC, Tyvek® as needed	None	None initially APR if action levels exceeded

7.3 Respirator Cartridge Change-Out Schedule

A respirator cartridge change-out schedule has been developed in order to comply with 29 CFR 1910.134. If the use of respirators is necessary, the respirator cartridge change-out schedule for this project will be as follows:

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

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

The schedule was developed based on the following scientific information and assumptions:

- Analytical data that is available regarding site contaminants;
- Using the Rule of Thumb provided by the AIHA;
- All of the chemicals have boiling points greater than 70□C;
- Total airborne concentration of contaminants is anticipated to be less than 200 ppm;
- The humidity is expected to be less than 85%; and
- Desorption of the contaminants (including those with poor warning properties) after partial use of the chemical cartridge can occur after a short period (hours) without use (eg, overnight) and result in a non-use exposure.

The following is a partial list of factors that may affect the usable cartridge service life and/or the degree of respiratory protection attainable under actual workplace conditions. These factors have been considered when developing the cartridge change-out schedule.

Type of contaminant(s);

- Contaminant concentration;
- Relative humidity;
- Breathing rate; Temperature; Changes in contaminant concentration, humidity, breathing rate and temperature;
- Mixtures of contaminants;
- Accuracy in the determination of the conditions;
- The contaminant concentration in the workplace can vary greatly. Consideration must be given to the quality of the estimate of the workplace concentration;
- Storage conditions between multiple uses of the same respirator cartridges. It is recommended that the chemical cartridges be replaced after each work shift. Contaminants adsorbed on a cartridge can migrate through the carbon bed without airflow;

- Age of the cartridge;
- Condition of the cartridge and respirator;
- Respirator and cartridge selection respirator fit;
- Respirator assembly, operation, and maintenance;
- User training, experience and medical fitness;
- Warning properties of the contaminant; and
- The quality of the warning properties should be considered when establishing the chemical cartridge change schedule. Good warning properties may provide a secondary or back-up indication for cartridge change-out.

8.0 AIR MONITORING

Air monitoring will be performed for protection for on-site workers and the downwind community (i.e., off-site receptors including residences, businesses, and on-site workers not directly involved in the remedial work) from potential airborne contaminant releases resulting from remedial activities at the site. Air monitoring will be used to help to confirm that the remedial work will not spread contamination off-site through the air. The primary concerns for this site are dust particulates and VOCs. Site monitoring with a photo-ionization detector (PID) will be performed during any invasive activities.

Real-time monitoring for dust and VOCs will be conducted both within the work area, and along the site perimeter, during intrusive activities such as excavation activities.

Detailed information on the types, frequency and location of real-time monitoring and community air monitoring requirements are provided in the Community Air Monitoring Plan prepared for this project.

9.0 ZONES, PROTECTION AND COMMUNICATION

9.1 Site Control

Site zones are intended to control the potential spread of contamination throughout the site and to assure that only authorized individuals are permitted into potentially hazardous areas. A three-zone approach will be utilized. It shall include an Exclusion Zone (EZ), Contamination Reduction Zone (CRZ) and a Support Zone (SZ). Specific zones shall be established on the work site when operations begin.

This project is a hazardous waste remediation project, and any person working in an area where the potential for exposure to site contaminants exists, will only be allowed access after providing the FTL/SHSO with proper training and medical documentation.

The zones are based upon current knowledge of proposed site activities. It is possible that the zone configurations may be altered due to work plan revisions. Should this occur, the work zone will be adjusted accordingly, and documented through use of a field-change request form.

The following shall be used for guidance in revising these preliminary zone designations, if necessary.

Support Zone - The SZ is an uncontaminated area that will be the field support area for most operations. The SZ provides for field team communications and staging for emergency response. Appropriate safety equipment will be located in this zone. Potentially contaminated personnel/materials are not allowed in this zone. The only exception will be appropriately packaged/decontaminated and labeled samples.

Contamination Reduction Zone - The CRZ is established between the EZ and the SZ. The CRZ contains the contamination reduction corridor and provides for an area for decontamination of personnel and portable hand-held equipment, tools and heavy equipment. A personnel decontamination area will be prepared at each exclusion zone. The CRZ will be used for EZ entry and egress in addition to access for heavy equipment and emergency support services.

Exclusion Zone - All activities, which may involve exposure to site contaminants, hazardous materials and/or conditions, should be considered an EZ. The FTL/SHSO may establish more than one EZ where different levels of protection may be employed or different hazards exist. The size of the EZ shall be determined by the site HSO allowing adequate space for the activity to be completed, field members and emergency equipment.

9.2 Contamination Control

Decontamination areas will be established for excavation/sampling activities.

9.2.1 *Personnel Decontamination Station*

All personnel and portable equipment used in the EZ shall be subject to a thorough decontamination process, as deemed necessary by the FTL/SHSO. Sampling equipment shall be decontaminated. As necessary, all boots and

gloves will be decontaminated using soap and water solution and scrub brushes or simple removal and disposal. All used respiratory protective equipment will be decontaminated daily and sanitized with appropriate sanitizer solution.

All drums generated as a result of sampling and decontamination activities will be marked and stored at a designated area at the site until the materials can be property disposed of off-site.

All non-expendable sampling equipment will be decontaminated. This usually entails the use of Alconox, solvent and distilled/deionized water rinses to eliminate contaminants.

9.3 Communication

- Each team member will have a cell phone/radio for communication with the PM, HSO and other team members during field activities.
- Hand Signals - Hand signals shall be used by field teams, along with the buddy system. The entire field team shall know them before operations commence and their use covered during site-specific training. Typical hand signals are the following:

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

10.0 MEDICAL SURVEILLANCE PROCEDURES

All contractor and subcontractor personnel performing field work where potential exposure to contaminants exists at the site are required to have passed a complete medical surveillance examination in accordance with 29 CFR 1910.120(f).

10.1 Medical Surveillance Requirements

A physician's medical release for work will be confirmed by the HSM before an employee can work in the exclusion zone. The examination will be taken annually at a minimum and upon termination of hazardous waste site work if the last examination was not taken within the previous six months. Additional medical testing may be required by the HSM in consultation with the Corporate Medical Consultant and the FTL/SHSO if an over-exposure or accident occurs, if an employee exhibits symptoms of exposure, or if other site conditions warrant further medical surveillance.

10.2 Medical Data Sheet

A medical data sheet is provided in **Appendix D**. This medical data sheet is voluntary and should be completed by all on-site personnel and will be maintained at the site. Where possible, this medical data sheet will accompany the personnel needing medical assistance. The medical data sheet will be maintained in a secure location, treated as confidential, and used only on a need-to-know basis.

11.0 SAFETY CONSIDERATIONS

11.1 General Health and Safety Work Practices

A list of general health and safety work practices is included as an included in **Appendix E**. The work rules will be posted in a conspicuous location at the site.

11.2 The Buddy System

At a minimum, employees shall work in groups of two in such a manner that they can observe each other and maintain line-of-sight for each employee within the work group. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.

11.3 Sample Handling

Personnel responsible for the handling of samples should wear the prescribed level of protection. Samples should be identified as to their hazard and packaged as to prevent spillage or breakage. Sample containers shall be decontaminated in the CRZ or EZ before entering a clean Support Zone area. Any unusual sample conditions, odors, or real-time readings should be noted. Laboratory personnel should be advised of sample hazard level and the potential contaminants present. This can be accomplished by a phone call to the lab coordinator and/or including a written statement with the samples reviewing lab safety procedures in handling, in order to assure that the practices are appropriate for the suspected contaminants in the sample.

12.0 DISPOSAL PROCEDURES

All discarded materials, waste materials or other objects shall be handled in such a way as to preclude the potential for spreading contamination, creating a sanitary hazard or causing litter to be left on site.

All potentially contaminated materials, e.g., clothing, gloves, etc., will be bagged or drummed as necessary, labeled and segregated for disposal. All non-contaminated materials will be collected and bagged for appropriate disposal as non-hazardous solid waste. Additional waste disposal procedures may be developed as applicable.

13.0 EMERGENCY RESPONSE PLAN

This section establishes procedures and provides information for use during a project emergency. Emergencies happen unexpectedly and quickly, and require an immediate response; therefore, contingency planning and advanced training of staff is essential. Specific elements of emergency support procedures which are addressed in the following subsections include communications, local emergency support units, preparation for medical emergencies, first aid for injuries incurred on site, record keeping, and emergency site evacuation procedures.

13.1 Responsibilities

13.1.1 *Health and Safety Manager (HSM)*

The HSM oversees and approves the Emergency Response/Contingency Plan and performs audits to determine that the plan is in effect and that all pre-emergency requirements are met. The HSM acts as a liaison to applicable regulatory agencies and notifies OSHA of reportable accidents.

13.1.2 *Field Team Leader/Site Health and Safety Officer (FOL/HSO)*

The FTL/SHSO is responsible for ensuring that all personnel are evacuated safely and that machinery and processes are shut down or stabilized in the event of a stop work order or evacuation. The FTL/SHSO is required to immediately notify the HSM of any fatalities or catastrophes (three or more workers injured and hospitalized) so that the HSM can ensure that OSHA is notified within the required time frame. The HSM will be notified of all OSHA recordable injuries, fires, spills, releases or equipment damage in excess of $500 within 24 hours.

13.1.3 *Emergency Coordinator*

The Emergency Coordinator for the project is the FTL/SHSO.

The Emergency Coordinator shall make contact with Local Emergency Response personnel prior to beginning work on site. In these contacts the emergency coordinator will inform interested parties about the nature and duration of work expected on the site and the type of contaminants and possible health or safety effects of emergencies involving these contaminants. The emergency coordinator will locate emergency phone numbers and identify hospital routes prior to beginning work on site. The emergency coordinator shall make necessary arrangements to be prepared for any emergencies that could occur.

The Emergency Coordinator will implement the Emergency Response/Contingency Plan whenever conditions at the site warrant such action.

13.1.4 *Site Personnel*

Site personnel are responsible for knowing the Emergency Response/Contingency Plan and the procedures contained herein. Personnel are expected to notify the Emergency Coordinator of situations that could constitute a site emergency.

13.2 Communication

A variety of communication systems may be utilized during emergency situations. These are discussed in the

following sections.

13.2.1 *Hand Signals*

Downrange field teams will employ hand signals where necessary for communication during emergency situations. Hand signals are found in Section 8.3.

13.2.2 *Field Radios and Cell Phones*

PWGC field personnel are provided cellular phones for site communication and emergency use.

13.3 Local Emergency Support Units

A route map from the site to the nearest hospital can be found in **Appendix F**. This map will be placed with the above emergency telephone numbers in all on-site vehicles.

13.4 Pre-Emergency Planning

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

Before the field activities begin, the local emergency response personnel will be notified of the schedule for field activities and about the materials that are thought to exist on the site so that they will be able to respond quickly and effectively in the event of a fire, explosion, or other emergency. Before fieldwork on the site commences, each person who will be working there or observing the operations will complete a medical data sheet (**Appendix D**). These data sheets will be filled out during site-specific training and will be kept on the site.

In the event of an incident where a team member becomes exposed or suffers from an acute symptom of exposure to site materials and has to be taken to a hospital, a copy of his/her medical data sheet will be presented to the attending physician.

Table 13-1

Emergency Telephone Numbers

Contact	Firm or Agency	Telephone Number
Police		911
Fire		911
Hospital	Woodhull Medical Center	(718) 963-8000
Ambulance		911
Project Manager/Health and Safety Manager	Andrew Lockwood PWGC	(631) 589-6353
Health & Safety Officer	Derek Ersbak PWGC	(631) 589-6353
NYSDEC Site Contact	Jonathan Greco	(518) 402-9768
Poison Control Center		(800) 962-1253
Chemtrec		(800) 424-9300

13.5 Emergency Medical Treatment

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

- First Aid Kit: Support Zone (or designated by FTL/SHSO upon arrival)
- Emergency Eye Wash: Support Zone (or designated by FTL/SHSO upon arrival)

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

There will be at least two people with current First Aid and CPR certification on each active work shift. When personnel are transported to the hospital, the FTL/SHSO will provide a copy of the Medical Data Sheet to the

paramedics and treating physician.

Only in non-emergency situations will an injured person be transported to the hospital by means other than an ambulance. **A map and directions to the hospital can be found in Appendix F.**

13.6 Emergency Site Evacuation Routes and Procedures

In order to mobilize the manpower resources and equipment necessary to cope with a fire or other emergency, a clear chain of authority will be established. The EC will take charge of all emergency response activities and dictate the procedures that will be followed for the duration of the emergency. The EC will report immediately to the scene of the emergency, assess the seriousness of the situation, and direct whatever efforts are necessary until the emergency response units arrive. At his/her discretion, the EC also may order the closure of the site for an indefinite period.

All project personnel will be instructed on proper emergency response procedures and locations of emergency telephone numbers during the initial site safety meeting. If an emergency occurs, including but not limited to fire, explosion or significant release of toxic gas into the atmosphere, an air horn will be sounded on the site. The horn will sound continuously for one blast, signaling that immediate evacuation of all personnel is necessary due to an immediate or impending danger. All heavy equipment will be shut down and all personnel will evacuate the work areas and assemble at the evacuation meeting point, which will be determined upon arrival at the site by the FTL/SHSO, prior to work beginning. This will then be conveyed to all crew members during the site-specific briefing.

The EC will give directions for implementing whatever actions are necessary. Any project team member may be assigned to be in charge of emergency communications during an emergency. He/she will attend the site telephone specified by the EC from the time the alarm sounds until the emergency has ended.

After sounding the alarm and initiating emergency response procedures, the EC will check and verify that access roads are not obstructed. If traffic control is necessary, as in the event of a fire or explosion, a project team member, who has been trained in these procedures and designated at the site safety meeting, will take over these duties until local police and fire fighters arrive.

The EC will remain at the site to provide any assistance requested by emergency-response squads as they arrive to deal with the situation. A map showing evacuation routes, meeting places and the location of emergency equipment will be posted in all trailers and used during site-specific training.

13.7 Fire Prevention and Protection

In the event of a fire or explosion, procedures will include immediately evacuating the site (air horn will sound for a single continuous blast), and notification of local fire and police departments. No personnel will fight a fire beyond the stage where it can be put out with a portable extinguisher (incipient stage).

13.7.1 *Fire Prevention*

Adhering to the following precautions will prevent fires:

- Good housekeeping and storage of materials;
- Storage of flammable liquids and gases away from oxidizers;
- No smoking in the exclusion zone or any work area;
- No hot work without a properly executed hot work permit;
- Shutting off engines to refuel;
- Grounding and bonding metal containers during transfer of flammable liquids;
- Use of UL approved flammable storage cans;
- Fire extinguishers rated at least 10 pounds ABC located on all heavy equipment, in all trailers and near all hot work activities; and
- Monthly inspections of all fire extinguishers.

13.8 Overt Chemical Exposure

The following are standard procedures to treat chemical exposures. Other, specific procedures detailed on the Material Safety Data Sheet or recommended by the Corporate Medical Consultant will be followed, when necessary.

SKIN AND EYE CONTACT: Use copious amounts of soap and water. Wash/rinse affected areas thoroughly, and then provide appropriate medical attention. Eyes should be rinsed for 15 minutes upon chemical contamination. Skin should also be rinsed for 15 minutes if contact with caustics, acids or hydrogen peroxide occurs.

INHALATION: Move to fresh air. Decontaminate and transport to hospital or local medical provider.

INGESTION: Decontaminate and transport to emergency medical facility.

PUNCTURE WOUND OR LACERATION: Decontaminate and transport to emergency medical facility.

13.9 Decontamination during Medical Emergencies

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

material which could also cause severe injury or loss of life to emergency response personnel. For minor medical problems or injuries, the normal decontamination procedures will be followed.

13.10 Accident/Incident Reporting

As soon as first aid and/or emergency response needs have been met, the following parties are to be contacted by telephone:

- Health and Safety Manager;
- Project Manager; and
- The employer of any injured worker who is not a PWGC employee.

Written confirmation of verbal reports are to be completed by the FTL/SHSO using the Incident Report Form and submitted within 24 hours. The incident report and investigation form is found in **Appendix G**. If the employee involved is not a PWGC employee, his employer will receive a copy of the report.

13.11 Adverse Weather Conditions

In the event of adverse weather conditions, the FTL/SHSO will determine if work can continue without potentially risking the safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

- Potential for heat stress and heat-related injuries;
- Potential for cold stress and cold-related injuries;
- Treacherous weather-related working conditions (hail, rain, snow, ice, high winds);
- Limited visibility (fog);
- Potential for electrical storms;
- Earthquakes; and
- Other major incidents.

Site activities will be limited to daylight hours, or when suitable artificial light is provided, and acceptable weather conditions prevail. The FTL/SHSO will determine the need to cease field operations or observe daily weather reports and evacuate, if necessary, in case of severe inclement weather conditions.

13.12 Spill Control and Response

All small hazardous spills/environmental releases shall be contained as close to the source as possible. Whenever possible, the MSDS will be consulted to assist in determining the best means of containment and cleanup. For small spills, sorbent materials such as sand, sawdust or commercial sorbents should be placed directly on the substance to contain the spill and aid recovery. Any acid spills should be diluted or neutralized carefully prior to attempting recovery. Berms of earthen or sorbent materials can be used to contain the leading edge of the spills. Drains or drainage areas should be blocked. All spill containment materials will be properly disposed. An exclusion zone of 50 to 100 feet around the spill area should be established depending on the size of the spill. The

following seven steps should be taken by the Emergency Coordinator:

- Determine the nature, identity and amounts of major spill components;
- Make sure all unnecessary persons are removed from the spill area;
- Notify appropriate response teams and authorities;
- Use proper PPE in consultation with the FTL/SHSO;
- If a flammable liquid, gas or vapor is involved, remove all ignition sources and use non-sparking and/or explosive proof equipment to contain or clean up the spill (diesel only vehicles, air operated pumps, etc.);
- If possible, try to stop the leak with appropriate material; and,
- Remove all surrounding materials that can react or compound with the spill.

13.13 Emergency Equipment

The following minimum emergency equipment shall be kept and maintained on-site:

- Industrial first aid kit;
- Burn kit and portable eye washes (one per field team);
- Fire extinguishers (one per work area); and
- Absorbent material /spill kit.

14.0 TRAINING

14.1 General Health and Safety Training

In accordance with PWGC corporate policy, and pursuant to 29 CFR 1910.120, hazardous waste site workers shall, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations unless otherwise noted in the above reference. At a minimum, the training shall have consisted of instruction in the topics outlined in the standard. Personnel who have not met the requirements for initial training shall not be allowed to work in any site activities in which they may be exposed to hazards (chemical or physical).

14.1.1 *Three Day Supervised On the Job Training*

In addition to the required initial hazardous waste operations training, each employee shall have received three days of directly supervised on-the-job training. This training will address the duties the employees are expected to perform.

14.2 Annual Eight-Hour Refresher Training

Annual eight-hour refresher training will be required of all hazardous waste site field personnel in order to maintain their qualifications for fieldwork. The training will cover a review of 1910.120 requirements and related company programs and procedures.

14.3 Site-Specific Training

Prior to commencement of field activities, all field personnel assigned to the project will have completed training that will specifically address the activities, procedures, monitoring, and equipment used in the site operations. It will include site and facility layout, hazards and emergency services at the site, and will highlight all provisions contained within this HASP. This training will also allow field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity.

14.4 On-Site Safety Briefings

Project personnel and visitors will be given on-site health and safety briefings daily by the FTL/SHSO to assist site personnel in safely conducting their work activities. A copy of the Daily Briefing Sign-In Sheet is contained in **Appendix H**. The briefings will include information on new operations to be conducted, changes in work practices or changes in the site's environmental conditions, as well as periodic reinforcement of previously discussed topics. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety inspections. The meetings will also be an opportunity to periodically update the crews on monitoring results. Prior to starting any new activity, a training session using the Activity Hazard Analysis will be held for crew members involved in the activity.

14.5 First Aid and CPR

The HSM will identify those individuals requiring first aid and CPR training to ensure that emergency medical treatment is available during field activities. It is anticipated that a minimum of one field person on-site at any

one time will have first aid and CPR training. The training will be consistent with the requirements of the American Red Cross Association or American Heart Association. If none are available on-site, then the HSM shall be notified.

14.6 Supervisory Training

Supervisors and health and safety personnel shall have completed an additional eight hours of specialized training in accordance with 29 CFR 1910.120.

15.0 LOGS, REPORTS AND RECORDKEEPING

Changes to the HASP will be documented in the Health and Safety log book and as appropriate, the HSM and/or PM will be notified. Daily tailgate meetings will be documented in the H&S log book as well as personnel on-site.

15.1 Medical and Training Records

Copies or verification of training (40-hour, 8-hour, supervisor, site-specific training and documentation of three day OJT) and medical clearance for hazardous waste site work and respirator use will be maintained on-site. Records for all subcontractor employees will also be kept on-site.

15.2 Incident Report and Investigation Form

The incident report and investigation form is to be completed for all accidents and incidents, including near misses. The form can be found in **Appendix G**.

15.3 Health and Safety Logbooks

The FTL/SHSO will maintain a logbook during site work. The daily site conditions, personnel, monitoring results and significant events will be recorded. The original logbooks will become part of the exposure records file.

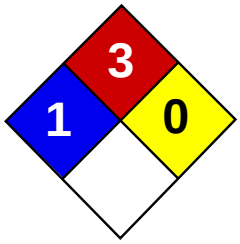
16.0 FIELD PERSONNEL REVIEW

This form serves as documentation that field personnel have read, or have been informed of, and understand the provisions of the HASP. It is maintained on site by the FTL/SHSO as a project record. Each field team member shall sign this section after site-specific training is completed and before being permitted to work on site.

I have read, or have been informed of, the Health and Safety Plan and understand the information presented. I will comply with the provisions contained therein.

Name (Print and Sign)	***Date***

Appendix A
Material Safety Data Sheets



Material Safety Data Sheet
Methyl ethyl ketone MSDS

Section 1: Chemical Product and Company Identification

Product Name: Methyl ethyl ketone

Catalog Codes: SLM2626, SLM3232

CAS#: 78-93-3

RTECS: EL6475000

TSCA: TSCA 8(b) inventory: Methyl ethyl ketone

CI#: Not applicable.

Synonym: 2-Butanone

Chemical Name: Methyl Ethyl Ketone

Chemical Formula: C4H8O

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
Methyl ethyl ketone	78-93-3	100

Toxicological Data on Ingredients: Methyl ethyl ketone: ORAL (LD50): Acute: 2737 mg/kg [Rat]. 4050 mg/kg [Mouse]. DERMAL (LD50): Acute: 6480 mg/kg [Rabbit]. VAPOR (LC50): Acute: 23500 mg/m 8 hours [Rat].

Section 3: Hazards Identification

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

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Classified POSSIBLE for human. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to gastrointestinal tract, upper respiratory tract, skin, eyes, 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. 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.

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: 404°C (759.2°F)

Flash Points: CLOSED CUP: -9°C (15.8°F). OPEN CUP: -5.5556°C (22°F) (Tag).

Flammable Limits: LOWER: 1.8% UPPER: 10%

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

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

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. 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:
Ignition on contact with potassium t-butoxide. Vapor may cause a flash fire

Special Remarks on Explosion Hazards:
Reaction with Hydrogen Peroxide + nitric acid forms heat and shock-sensitive explosive product. Mixture with 2-propanol will produce explosive peroxides during storage.

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, metals, acids, alkalis.

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: 200 STEL: 300 (ppm) from ACGIH (TLV) [United States] [1999] TWA: 150 STEL: 300 (ppm) [Australia] TWA: 590 STEL: 885 (mg/m3) from NIOSH TWA: 200 STEL: 300 (ppm) from NIOSH TWA: 590 STEL: 885 (mg/m3) [Canada] TWA: 200 STEL: 300 (ppm) from OSHA (PEL) [United States] TWA: 590 STEL: 885 (mg/m3) from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor:
Acetone-like Pleasant. Pungent. Sweetish. (Strong.)

Taste: Not available.

Molecular Weight: 72.12g/mole

Color: Clear Colorless.

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

Boiling Point: 79.6 (175.3°F)

Melting Point: -86°C (-122.8°F)

Critical Temperature: 262.5°C (504.5°F)

Specific Gravity: 0.805(Water = 1)

Vapor Pressure: 10.3 kPa (@ 20°C)

Vapor Density: 2.41 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.25 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 0.3

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility: Soluble in cold water, diethyl ether, acetone.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, mechanical shock, incompatible materials.

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

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with chloroform, copper, hydrogen peroxide, nitric acid, potassium t-butoxide, 2-propanol, chlorosulfonic acid, strong oxidizers, amines, ammonia, inorganic acids, isocyanates, caustics, pyrindines. Vigorous reaction with chloroform +alkali.

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): 2737 mg/kg [Rat]. Acute dermal toxicity (LD50): 6480 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 32000 mg/m3 4 hours [Mouse].

Chronic Effects on Humans:
MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Classified POSSIBLE for human. May cause damage to the following organs: gastrointestinal tract, upper respiratory tract, skin, eyes, central nervous system (CNS).

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

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: May cause birth defects based on animal dats. Embryotoxic and/or foetotoxic in animal.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. May be absorbed through the skin. Eyes: Causes eye irritation. Inhalation: Inhalation of high concentrations may cause central nervous effects characterized by headache, dizziness, unconsciousness, and coma. Causes respiratory tract irritation and affects the sense organs. May affect the liver and urinary system. Ingestion: Causes gastrointestinal tract irritation with nausea, vomiting and diarrhea. May affect the liver. Chronic Potential Health Effects: Chronic inhalation may cause effects similar to those of acute inhalation. Prolonged or repeated skin contact may cause defatting and dermatitis.

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): 3220 mg/l 96 hours [Fathead Minnow]. 1690 mg/l 96 hours [Bluegill].

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: : Ethyl methyl ketone UNNA: 1193 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
New York release reporting list: Methyl ethyl ketone Rhode Island RTK hazardous substances: Methyl ethyl ketone Pennsylvania RTK: Methyl ethyl ketone Minnesota: Methyl ethyl ketone Massachusetts RTK: Methyl ethyl ketone New Jersey: Methyl ethyl ketone California Director's list of Hazardous Substances: Methyl ethyl ketone TSCA 8(b) inventory: Methyl ethyl ketone TSCA 8(d) H and S data reporting: Methyl ethyl ketone: Effective: 10/4/82; Sunset: 10/4/92 SARA 313 toxic chemical notification and release reporting: Methyl ethyl ketone CERCLA: Hazardous substances.: Methyl ethyl ketone: 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):
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. R36/37- Irritating to eyes and respiratory system. S9- Keep container in a well-ventilated place. S16- Keep away from sources of ignition - No smoking. S25- Avoid contact with eyes. S33- Take precautionary measures against static discharges.

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: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:39 PM

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

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Safety (MSDS) data for iron

Click here for data on iron in student-friendly format, from the HSci project

General

Synonyms: metallic iron, elemental iron
Molecular formula: Fe
CAS No: 7439-89-6
EC No:

Physical data

Appearance: grey crystalline powder, rod or chips
Melting point: 1535 C
Boiling point: 3000 C
Vapour density:
Vapour pressure:
Density (g cm^{-3}): 7.86
Flash point:
Explosion limits:
Autoignition temperature:
Water solubility:

Stability

Stable. Reacts slowly with moist air and water. Dust may form an explosive or combustible mixture with air. Incompatible with organic acids, strong oxidizing agents, water, mineral acids.

Toxicology

Dust may be harmful if inhaled.

Toxicity data
(The meaning of any abbreviations which appear in this section is given here.)

Risk phrases
(The meaning of any risk phrases which appear in this section is given here.)

Transport information

Non-hazardous for air, sea and road freight.

Personal protection

Avoid breathing dust or powder.

Safety phrases
(The meaning of any safety phrases which appear in this section is given here.)

[Return to Physical & Theoretical Chemistry Lab. Safety home page.]

COPPER

0240
September 1993

CAS No: 7440-50-8
RTECS No: GL5325000
UN No:
EC No:

Cu
Atomic mass: 63.5

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Special powder, dry sand, NO other agents.
EXPLOSION			
EXPOSURE		**PREVENT DISPERSION OF DUST!**	
Inhalation	Cough. Headache. Shortness of breath. Sore throat.	Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
Skin	Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes	Redness. Pain.	Safety goggles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Abdominal pain. Nausea. Vomiting.	Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Sweep spilled substance into containers. Carefully collect remainder. Then remove to safe place (extra personal protection: P2 filter respirator for harmful particles).	Symbol R: S:

EMERGENCY RESPONSE	STORAGE
	Separated from: see Chemical Dangers.

IPCS
International Programme on Chemical Safety

Prepared in the context of cooperation between the International Programme on Chemical Safety and the European Commission

SEE IMPORTANT INFORMATION ON THE BACK.

IMPORTANT DATA

Physical State; Appearance
RED POWDER, TURNS GREEN ON EXPOSURE TO MOIST AIR.

Chemical Dangers
Shock-sensitive compounds are formed with acetylenic compounds, ethylene oxides and azides. Reacts with strong oxidants like chlorates, bromates and iodates, causing explosion hazard.

Occupational Exposure Limits
TLV: ppm; 0.2 mg/m^3 fume (ACGIH 1992-1993).
TLV (as Cu, dusts & mists): ppm; 1 mg/m3 (ACGIH 1992-1993).

Routes of Exposure
The substance can be absorbed into the body by inhalation and by ingestion.

Inhalation Risk
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.

Effects of Short-term Exposure
Inhalation of fume may cause metal fever (see Notes).

Effects of Long-term or Repeated Exposure
Repeated or prolonged contact may cause skin sensitization.

PHYSICAL PROPERTIES

Boiling point: 2595°C
Melting point: 1083°C
Relative density (water = 1): 8.9
Solubility in water: none

ENVIRONMENTAL DATA

NOTES

The symptoms of metal fume fever do not become manifest until several hours.

ADDITIONAL INFORMATION

NAPHTHALENE

0667
April 2005

CAS No: 91-20-3
RTECS No: QJ0525000
UN No: 1334 (solid); 2304 (molten)
EC No: 601-052-00-2

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

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

SPILLAGE DISPOSAL	PACKAGING & LABELLING	
Personal protection: filter respirator for organic gases and vapours. Do NOT let this chemical enter the environment. Sweep spilled substance into covered containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place.	Xn Symbol N Symbol R: 22-40-50/53 S: (2-)36/37-46-60-61 UN Hazard Class: 4.1 UN Pack Group: III	Do not transport with food and feedstuffs. Marine pollutant.

EMERGENCY RESPONSE	SAFE STORAGE
Transport Emergency Card: TEC (R)-41S1334 (solid); 41GF1-II+III (solid); 41S2304 (molten) NFPA Code: H2; F2; R0	Separated from strong oxidants, food and feedstuffs. Store in an area without drain or sewer access.

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IMPORTANT DATA

Physical State; Appearance
WHITE SOLID IN VARIOUS FORMS, WITH CHARACTERISTIC ODOUR.

Physical dangers
Dust explosion possible if in powder or granular form, mixed with air.

Chemical dangers
On combustion, forms irritating and toxic gases. Reacts with strong oxidants.

Occupational exposure limits
TLV: 10 ppm as TWA; 15 ppm as STEL; (skin); A4 (not classifiable as a human carcinogen); (ACGIH 2005).
MAK: skin absorption (H); Carcinogen category: 2; Germ cell mutagen group: 3B; (DFG 2004).

Routes of exposure
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

Inhalation risk
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20/C. See Notes.

Effects of short-term exposure
The substance may cause effects on the blood, resulting in lesions of blood cells (haemolysis). See Notes. The effects may be delayed. Exposure by ingestion may result in death. Medical observation is indicated.

Effects of long-term or repeated exposure
The substance may have effects on the blood, resulting in chronic haemolytic anaemia. The substance may have effects on the eyes, resulting in the development of cataract. This substance is possibly carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 218/C Sublimation slowly at room temperature
Melting point: 80/C
Density: 1.16 g/cm^3
Solubility in water, g/100 ml at 25/C: none
Vapour pressure, Pa at 25/C: 11
Relative vapour density (air = 1): 4.42
Flash point: 80/C c.c.
Auto-ignition temperature: 540/C
Explosive limits, vol% in air: 0.9-5.9
Octanol/water partition coefficient as log Pow: 3.3

ENVIRONMENTAL DATA

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

NOTES

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

ADDITIONAL INFORMATION

CADMIUM

0020
April 2005

CAS No: 7440-43-9
RTECS No: EU9800000
UN No: 2570
EC No: 048-002-00-0

Cd
Atomic mass: 112.4

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Flammable in powder form and spontaneously combustible in pyrophoric form. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking. NO contact with heat or acid(s).	Dry sand. Special powder. NO other agents.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	

EXPOSURE		**PREVENT DISPERSION OF DUST! AVOID ALL CONTACT!**	**IN ALL CASES CONSULT A DOCTOR!**
Inhalation	Cough. Sore throat.	Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
Skin		Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes	Redness. Pain.	Safety goggles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Abdominal pain. Diarrhoea. Headache. Nausea. Vomiting.	Do not eat, drink, or smoke during work.	Rest. Refer for medical attention.

SPILLAGE DISPOSAL	**PACKAGING & LABELLING**	
Evacuate danger area! Personal protection: chemical protection suit including self-contained breathing apparatus. Remove all ignition sources. Sweep spilled substance into containers. Carefully collect remainder, then remove to safe place.	T+ Symbol N Symbol R: 45-26-48/23/25-62-63-68-50/53 S: 53-45-60-61 Note: E UN Hazard Class: 6.1	Airtight. Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs.

EMERGENCY RESPONSE	**SAFE STORAGE**
	Fireproof. Dry. Keep under inert gas. Separated from igntion sources, oxidants acids, food and feedstuffs.

IPCS
International Programme on Chemical Safety

Prepared in the context of cooperation between the International Programme on Chemical Safety and the European Commission

SEE IMPORTANT INFORMATION ON THE BACK.

IMPORTANT DATA

Physical State; Appearance
SOFT BLUE-WHITE METAL LUMPS OR GREY POWDER. MALLEABLE. TURNS BRITTLE ON EXPOSURE TO 80/C AND TARNISHES ON EXPOSURE TO MOIST AIR.

Physical dangers
Dust explosion possible if in powder or granular form, mixed with air.

Chemical dangers
Reacts with acids forming flammable/explosive gas (hydrogen - see ICSC0001). Dust reacts with oxidants, hydrogen azide, zinc, selenium or tellurium, causing fire and explosion hazard.

Occupational exposure limits
TLV: (Total dust) 0.01 mg/m^3; (Respirable fraction) 0.002 mg/m^3; as TWA; A2 (suspected human carcinogen); BEI issued; (ACGIH 2005).
MAK: skin absorption (H); Carcinogen category: 1; Germ cell mutagen group: 3A; (DFG 2004).

Routes of exposure
The substance can be absorbed into the body by inhalation of its aerosol and by ingestion.

Inhalation risk
A harmful concentration of airborne particles can be reached quickly when dispersed, especially if powdered.

Effects of short-term exposure
The fume is irritating to the respiratory tract. Inhalation of fume may cause lung oedema (see Notes). Inhalation of fumes may cause metal fume fever. The effects may be delayed. Medical observation is indicated.

Effects of long-term or repeated exposure
Lungs may be affected by repeated or prolonged exposure to dust particles. The substance may have effects on the kidneys, resulting in kidney impairment. This substance is carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 765/C
Melting point: 321/C
Density: 8.6 g/cm^3

Solubility in water: none
Auto-ignition temperature: (cadmium metal dust) 250/C

ENVIRONMENTAL DATA

NOTES

Reacts violently with fire extinguishing agents such as water, foam, carbon dioxide and halons.
Depending on the degree of exposure, periodic medical examination is indicated.
The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential.
Do NOT take working clothes home.
Cadmium also exists in a pyrophoric form (EC No. 048-011-00-X), which bears the additional EU labelling symbol F, R phrase 17, and S phrases 7/8 and 43. UN numbers and packing group will vary according to the physical form of the substance.

ADDITIONAL INFORMATION

Material Safety Data Sheet

Version 4.3
Revision Date 01/17/2012
Print Date 07/26/2012

1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	4,4′-DDT
Product Number	:	386340
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
Carcinogen, Toxic by ingestion, Toxic by skin absorption

Target Organs

Liver, Pancreas.

GHS Classification
Acute toxicity, Dermal (Category 3)
Acute toxicity, Oral (Category 3)
Carcinogenicity (Category 2)
Specific target organ toxicity - repeated exposure, Oral (Category 1)
Acute aquatic toxicity (Category 1)
Chronic aquatic toxicity (Category 4)

GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)

H301 + H311	Toxic if swallowed or in contact with skin
H351	Suspected of causing cancer.
H372	Causes damage to organs through prolonged or repeated exposure if swallowed.
H400	Very toxic to aquatic life.
H413	May cause long lasting harmful effects to aquatic life.

Precautionary statement(s)

P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing.
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.
P314	Get medical advice/ attention if you feel unwell.

HMIS Classification

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

NFPA Rating

Health hazard:	2
Fire:	2
Reactivity Hazard:	0

Potential Health Effects

Inhalation	May be harmful if inhaled. May cause respiratory tract irritation.
Skin	Toxic if absorbed through skin. May cause skin irritation.
Eyes	May cause eye irritation.
Ingestion	Toxic if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms : 1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane
1,1-Bis(4-chlorophenyl)-2,2,2-trichloroethane

Formula : $C_{14}H_9Cl_5$

Molecular Weight : 354.49 g/mol

Component		Concentration
1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane		
CAS-No.	50-29-3	-
EC-No.	200-024-3	
Index-No.	602-045-00-7	

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. Take victim immediately to hospital. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Conditions of flammability
Not flammable or combustible.

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

6. ACCIDENTAL RELEASE MEASURES

Personal precautions
Wear respiratory protection. Avoid dust formation. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

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
Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

7. HANDLING AND STORAGE

Precautions for safe handling
Avoid contact with skin and eyes. Avoid formation of dust and aerosols.
Provide appropriate exhaust ventilation at places where dust is formed.

Conditions for safe storage
Keep container tightly closed in a dry and well-ventilated place.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Value	Control parameters	Basis
1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane	50-29-3	TWA	0.5 mg/m3	USA. NIOSH Recommended Exposure Limits
Remarks	Potential Occupational Carcinogen See Appendix A			
		TWA	1 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Liver damage Confirmed animal carcinogen with unknown relevance to humans			
		TWA	1 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
	Skin notation			
		TWA	1 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
	Skin designation Substance listed; for more information see OSHA document 1910.1044			

Personal protective equipment

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) 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, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures
Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	solid
Colour	no data available

Safety data

pH	no data available
Melting point/freezing point	Melting point/range: 107 - 110 °C (225 - 230 °F) - lit.
Boiling point	260.0 °C (500.0 °F)
Flash point	72.0 - 77.0 °C (161.6 - 170.6 °F)
Ignition temperature	no data available
Autoignition temperature	no data available
Lower explosion limit	no data available
Upper explosion limit	no data available
Vapour pressure	0.0000021 hPa (0.0000016 mmHg) at 20.0 °C (68.0 °F)
Density	0.99 g/cm3
Water solubility	no data available
Partition coefficient: n-octanol/water	log Pow: 6.91
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
no data available

Conditions to avoid
no data available

Materials to avoid
Oxidizing agents, Iron and iron salts.

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 - 87.0 mg/kg

Inhalation LC50
no data available

Dermal LD50
LD50 Dermal - rabbit - 300.0 mg/kg
Remarks: Behavioral:Tremor. Behavioral:Muscle weakness. Behavioral:Ataxia.

Other information on acute toxicity
no data available

Skin corrosion/irritation
no data available

Serious eye damage/eye irritation
no data available

Respiratory or skin sensitization
no data available

Germ cell mutagenicity

no data available

Carcinogenicity

Limited evidence of carcinogenicity in animal studies

IARC:	2B - Group 2B: Possibly carcinogenic to humans (1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane)
NTP:	Reasonably anticipated to be a human carcinogen (1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane)
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)
Ingestion - Causes damage to organs through prolonged or repeated exposure.

Aspiration hazard
no data available

Potential health effects

Inhalation	May be harmful if inhaled. May cause respiratory tract irritation.
Ingestion	Toxic if swallowed.

Skin	Toxic if absorbed through skin. May cause skin irritation.
Eyes	May cause eye irritation.

Signs and Symptoms of Exposure
CNS stimulation.

Synergistic effects
no data available

Additional Information
RTECS: KJ3325000

12. ECOLOGICAL INFORMATION

Toxicity

Toxicity to fish	LC50 - Pimephales promelas (fathead minnow) - 0.01 mg/l - 96.0 h
	LC50 - Lepomis macrochirus (Bluegill) - 0.01 mg/l - 96.0 h
	LC50 - Oncorhynchus mykiss (rainbow trout) - 0.003400 mg/l - 96.0 h
	LOEC - Oncorhynchus mykiss (rainbow trout) - 150 mg/l - 3.0 d
	NOEC - Oncorhynchus mykiss (rainbow trout) - 113 mg/l - 3.0 d
Toxicity to daphnia and other aquatic invertebrates	Immobilization EC50 - Daphnia magna (Water flea) - 0.00108 mg/l - 48 h
Toxicity to algae	LC100 - Scenedesmus quadricauda (Green algae) - > 20 mg/l - 7 d

Persistence and degradability

Bioaccumulative potential

Bioaccumulation	Oncorhynchus mykiss (rainbow trout) - 20 d Bioconcentration factor (BCF): 46,670

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.

Very toxic to aquatic life.

13. DISPOSAL CONSIDERATIONS

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 2811 Class: 6.1 Packing group: III
Proper shipping name: Toxic solids, organic, n.o.s. (1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane)
Reportable Quantity (RQ): 1 lbs
Marine pollutant: Severe marine pollutant
Poison Inhalation Hazard: No

IMDG

UN number: 2811 Class: 6.1 Packing group: III EMS-No: F-A, S-A
Proper shipping name: TOXIC SOLID, ORGANIC, N.O.S. (1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane)
Marine pollutant: Marine pollutant

IATA
UN number: 2811 Class: 6.1 Packing group: III
Proper shipping name: Toxic solid, organic, n.o.s. (1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane)

15. REGULATORY INFORMATION

OSHA Hazards
Carcinogen, Toxic by ingestion, Toxic by skin absorption

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
Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane	50-29-3	2007-03-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane	50-29-3	2007-03-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane	50-29-3	2007-03-01

California Prop. 65 Components

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the State of California to cause cancer. 1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane	50-29-3	1990-06-15

California Prop. 65 Components

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the State of California to cause birth defects or other reproductive harm. 1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane	50-29-3	1990-06-15

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.

alpha-HEXACHLOROCYCLOHEXANE

0795

November 1998

CAS No: 319-84-6
RTECS No: GV3500000
EC No: 602-042-00-0

1-alpha,2-alpha,3-beta,4-alpha,5-beta,6-beta-Hexachlorocyclohexane
alpha-1,2,3,4,5,6-Hexachlorocyclohexane
alpha-Benzenehexachloride (alpha-BHC)
$C_6H_6Cl_6$
Molecular mass: 290.8

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Not combustible. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION			
EXPOSURE		**PREVENT DISPERSION OF DUST! STRICT HYGIENE!**	
Inhalation	Cough. Sore throat. See Notes.	Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
Skin	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
Eyes		Safety goggles, or face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Diarrhoea. Dizziness. Headache. Nausea. Vomiting. Tremors.	Do not eat, drink, or smoke during work.	Rinse mouth. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment. (Extra personal protection: P2 filter respirator for harmful particles).	**EU classification** T Symbol N Symbol R: 21-25-40-50/53 S: (1/2-)22-36/37-4 Note: C5-60-61

EMERGENCY RESPONSE	SAFE STORAGE
	Well closed. Store in an area without drain or sewer access.

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International Programme on Chemical Safety

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SEE IMPORTANT INFORMATION ON THE BACK.

IMPORTANT DATA

Physical State; Appearance
CRYSTALLINE POWDER, WITH CHARACTERISTIC ODOUR.

Chemical dangers
The substance decomposes in a fire, producing toxic fumes phosgene (see ICSC # 0007) and hydrogen chloride (see ICSC 0163). Reacts with bases.

Occupational exposure limits
TLV not established.
MAK: (Inhalable fraction) 0.5 mg/m^3; Peak limitation category: II(8); skin absorption (H); (DFG 2006).

Routes of exposure
The substance can be absorbed into the body by inhalation of its aerosol, through the skin and by ingestion.

Inhalation risk
Evaporation at 20/C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.

Effects of short-term exposure
The substance may cause effects on the central nervous system.

Effects of long-term or repeated exposure
The substance may have effects on the blood and liver. This substance is possibly carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 288/C
Melting point: 157-160/C
Density: 1.9 g/cm^3
Solubility in water: none
Vapour pressure, Pa at 20/C: 2.7
Octanol/water partition coefficient as log Pow: 3.8

ENVIRONMENTAL DATA

The substance is very toxic to aquatic organisms. In the food chain important to humans, bioaccumulation takes place, specifically in seafood. The substance may cause long-term effects in the aquatic environment. It is strongly advised that this substance does not enter the environment.

NOTES

This substance is a component of the insecticide hexachlorocyclohexane (mixed isomers).
Insufficient data are available on the effect of this substance on human health, therefore utmost care must be taken.
Do NOT take working clothes home.
Also consult ICSC # 0487 (Hexachlorocyclohexane).
Card has been partially updated in August 2007: see Storage, Occupational Exposure Limits, Environmental Data.

ADDITIONAL INFORMATION

ACETONE

0087
April 1994

CAS No: 67-64-1
RTECS No: AL3150000
UN No: 1090
EC No: 606-001-00-8

2-Propanone
Dimethyl ketone
Methyl ketone
C_3H_6O / CH_3-CO-CH_3
Molecular mass: 58.1

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

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Ventilation. Collect leaking liquid in sealable containers. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. Then wash away with plenty of water. Personal protection: self-contained breathing apparatus.	F Symbol Xi Symbol R: 11-36-66-67 S: (2-)9-16-26 UN Hazard Class: 3 UN Pack Group: II

EMERGENCY RESPONSE	SAFE STORAGE
Transport Emergency Card: TEC (R)-30S1090 NFPA Code: H 1; F 3; R 0	Fireproof. Separated from strong oxidants.

IPCS
International Programme on Chemical Safety

Prepared in the context of cooperation between the International Programme on Chemical Safety and the European Commission

IMPORTANT DATA

Physical State; Appearance
COLOURLESS LIQUID, WITH CHARACTERISTIC ODOUR.

Physical dangers
The vapour is heavier than air and may travel along the ground; distant ignition possible.

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

Occupational exposure limits
TLV: 500 ppm as TWA, 750 ppm as STEL; A4 (not classifiable as a human carcinogen); BEI issued; (ACGIH 2004).
MAK: 500 ppm 1200 mg/m^3 Peak limitation category: I(2); Pregnancy risk group: IIc; (DFG 2004).

Routes of exposure
The substance can be absorbed into the body by inhalation and through the skin.

Inhalation risk
A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20/C ; on spraying or dispersing, however, much faster.

Effects of short-term exposure
The vapour irritates the eyes and the respiratory tract. The substance may cause effects on the central nervous system, liver, kidneys and gastrointestinal tract.

Effects of long-term or repeated exposure
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the blood and bone marrow.

PHYSICAL PROPERTIES

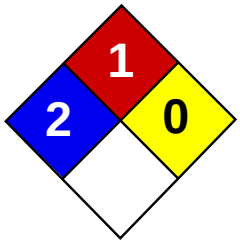
Boiling point: 56/C
Melting point: -95/C
Relative density (water = 1): 0.8
Solubility in water: miscible
Vapour pressure, kPa at 20/C: 24
Relative vapour density (air = 1): 2.0
Relative density of the vapour/air-mixture at 20/C (air = 1): 1.2
Flash point: -18/C c.c.
Auto-ignition temperature: 465/C
Explosive limits, vol% in air: 2.2-13
Octanol/water partition coefficient as log Pow: -0.24

ENVIRONMENTAL DATA

NOTES

Use of alcoholic beverages enhances the harmful effect.
Card has been partly updated in October 2005. See sections Occupational Exposure Limits, EU classification.

ADDITIONAL INFORMATION



Health	2
Fire	1
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Acenaphthene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Acenaphthene

Catalog Codes: SLA2332

CAS#: 83-32-9

RTECS: AB1000000

TSCA: TSCA 8(b) inventory: Acenaphthene

CI#: Not applicable.

Synonym: Ethylenenaphthalene

Chemical Name: 1,8-Dehydroacenaphthalene

Chemical Formula: C10H6(CH2)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
Acenaphthene	83-32-9	100

Toxicological Data on Ingredients: Acenaphthene LD50: Not available. LC50: Not available.

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: 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.

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. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

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

Fire Hazards in Presence of Various Substances: Flammable in presence of oxidizing materials.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Combustible.

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.

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. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.

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: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Solid needles.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 154.21 g/mole

Color: White.

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

Boiling Point: 277.5°C (531.5°F)

Melting Point: 93.6 (200.5°F)

Critical Temperature: Not available.

Specific Gravity: 1.02 (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: See solubility in water, methanol.

Solubility:
Partially soluble in methanol. Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

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: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Material is irritating to mucous membranes and upper respiratory tract.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

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

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: 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:

Pennsylvania RTK: Acenaphthene Massachusetts RTK: Acenaphthene New Jersey: Acenaphthene TSCA 8(b) inventory: Acenaphthene CERCLA: Hazardous substances.: Acenaphthene

Other Regulations: Not available.

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC): R36/38- Irritating to eyes and skin.

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:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II.

Other Special Considerations: Not available.

Created: 10/09/2005 03:35 PM

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

LEAD

0052
October 2002

CAS No: 7439-92-1
RTECS No: OF7525000

Lead metal
Plumbum
(powder)
Pb
Atomic mass: 207.2

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Not combustible. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: use appropriate extinguishing media.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE	**See EFFECTS OF LONG-TERM OR REPEATED EXPOSURE.**	**PREVENT DISPERSION OF DUST! AVOID EXPOSURE OF (PREGNANT) WOMEN!**	
Inhalation		Local exhaust or breathing protection.	Fresh air, rest.
Skin		Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes		Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Abdominal pain. Nausea. Vomiting.	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Give plenty of water to drink. Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment. Personal protection: P3 filter respirator for toxic particles.	

EMERGENCY RESPONSE	SAFE STORAGE
	Separated from food and feedstuffs and incompatible materials. See Chemical Dangers.

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IMPORTANT DATA

Physical State; Appearance
BLUISH-WHITE OR SILVERY-GREY SOLID IN VARIOUS FORMS. TURNS TARNISHED ON EXPOSURE TO AIR.

Physical dangers
Dust explosion possible if in powder or granular form, mixed with air.

Chemical dangers
On heating, toxic fumes are formed. Reacts with oxidants. Reacts with hot concentrated nitric acid, boiling concentrated hydrochloric acid and sulfuric acid. Attacked by pure water and by weak organic acids in the presence of oxygen.

Occupational exposure limits
TLV: 0.05 mg/m^3 as TWA; A3 (confirmed animal carcinogen with unknown relevance to humans); BEI issued; (ACGIH 2004).
MAK: Carcinogen category: 3B; Germ cell mutagen group: 3A; (DFG 2004).
EU OEL: as TWA 0.15 mg/m^3; (EU 2002).

Routes of exposure
The substance can be absorbed into the body by inhalation and by ingestion.

Inhalation risk
A harmful concentration of airborne particles can be reached quickly when dispersed, especially if powdered.

Effects of long-term or repeated exposure
The substance may have effects on the blood, bone marrow, central nervous system, peripheral nervous system and kidneys, resulting in anaemia, encephalopathy (e.g., convulsions), peripheral nerve disease, abdominal cramps and kidney impairment. Causes toxicity to human reproduction or development.

PHYSICAL PROPERTIES

Boiling point: 1740/C
Melting point: 327.5/C
Density: 11.34 g/cm^3
Solubility in water: none

ENVIRONMENTAL DATA

Bioaccumulation of this chemical may occur in plants and in mammals. It is strongly advised that this substance does not enter the environment.

NOTES

Depending on the degree of exposure, periodic medical examination is suggested.
Do NOT take working clothes home.
Card has been partly updated in April 2005. See section Occupational Exposure Limits.

ADDITIONAL INFORMATION

BENZENE	ICSC: 0015

Date of Peer Review: May 2003

Cyclohexatriene
Benzol

CAS #	71-43-2	C_6H_6
RTECS #	CY1400000	Molecular mass: 78.1
UN #	1114	
EC #	601-020-00-8	

TYPES OF HAZARD / EXPOSURE	ACUTE HAZARDS / SYMPTOMS	PREVENTION	FIRST AID / FIRE FIGHTING
FIRE	Highly flammable.	NO open flames, NO sparks, and NO smoking.	Powder, AFFF, foam, carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive. Risk of fire and explosion: see Chemical Dangers.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT use compressed air for filling, discharging, or handling. Use non-sparking handtools. Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		**AVOID ALL CONTACT!**	
Inhalation	Dizziness. Drowsiness. Headache. Nausea. Shortness of breath. Convulsions. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
Skin	MAY BE ABSORBED! Dry skin. Redness. Pain. (Further see Inhalation).	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
Eyes	Redness. Pain.	Face shield, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to

			a doctor.
Ingestion	Abdominal pain. Sore throat. Vomiting. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	**PACKAGING & LABELLING**
Remove all ignition sources. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. Do NOT let this chemical enter the environment. Personal protection: complete protective clothing including self-contained breathing apparatus.	Do not transport with food and feedstuffs. **EU Classification** Symbol: F, T R: 45-46-11-36/38-48/23/24/25-65 S: 53-45 Note: [E] **UN Classification** UN Hazard Class: 3 UN Pack Group: II
EMERGENCY RESPONSE	**SAFE STORAGE**
Transport Emergency Card: TEC (R)-30S1114 / 30GF1-II NFPA Code: H2; F3; R0	Fireproof. Separated from food and feedstuffs oxidants and halogens.

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UNEP

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SEE IMPORTANT INFORMATION ON BACK

BENZENE — ICSC: 0015

IMPORTANT DATA

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

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

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

OCCUPATIONAL EXPOSURE LIMITS:

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

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

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is irritating to the eyes, the skin and the respiratory tract. Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous

TLV: 0.5 ppm as TWA; 2.5 ppm as STEL; (skin); A1; BEI issued; (ACGIH 2004). MAK: H; Carcinogen category: 1; Germ cell mutagen group: 3A; (DFG 2004).	system, resulting in lowering of consciousness. Exposure far above the occupational exposure limit value may result in unconsciousness and death. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The liquid defats the skin. The substance may have effects on the bone marrow and immune system, resulting in a decrease of blood cells. This substance is carcinogenic to humans.

PHYSICAL PROPERTIES

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

ENVIRONMENTAL DATA

The substance is very toxic to aquatic organisms.

NOTES

Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient.
Card has been partly updated in October 2004. See sections Occupational Exposure Limits, EU classification, Emergency Response.

ADDITIONAL INFORMATION

p-XYLENE

0086
August 2002

CAS No: 106-42-3
RTECS No: ZE2625000
UN No: 1307
EC No: 601-022-00-9

para-Xylene
1,4-Dimethylbenzene
p-Xylol
$C_6H_4(CH_3)_2$ / C_8H_{10}
Molecular mass: 106.2

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Flammable.	NO open flames, NO sparks, and NO smoking.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Above 27/C explosive vapour/air mixtures may be formed.	Above 27/C use a closed system, ventilation, and explosion-proof electrical equipment. Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		**STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN!**	
Inhalation	Dizziness. Drowsiness. Headache. Nausea.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
Skin	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Burning sensation. Abdominal pain. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Ventilation. Remove all ignition sources. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment. (Extra personal protection: filter respirator for organic gases and vapours.)	**EU classification** Xn Symbol R: 10-20/21-38 S: (2-)25 Note: C **UN classification** UN Hazard Class: 3 UN Pack Group: III

EMERGENCY RESPONSE	SAFE STORAGE
Transport Emergency Card: TEC (R)-30S1307-III NFPA Code: H 2; F 3; R 0	Fireproof. Separated from strong oxidants, and strong acids.

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IMPORTANT DATA

Physical State; Appearance
COLOURLESS LIQUID, WITH CHARACTERISTIC ODOUR.

Physical dangers
As a result of flow, agitation, etc., electrostatic charges can be generated.

Chemical dangers
Reacts with strong acids and strong oxidants.

Occupational exposure limits
TLV: 100 ppm as TWA; 150 ppm as STEL A4 (ACGIH 2001). BEI specified by (ACGIH 2001).
MAK: 100 ppm, 440 mg/m^3. Peak limitation category: II(2) skin absorption (H); Pregnancy risk group: D (DFG 2005).
EU OEL: 50 ppm as TWA; 100 ppm as STEL (skin) (EU 2000).

Routes of exposure
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

Inhalation risk
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20/C.

Effects of short-term exposure
The substance is irritating to the eyes and the skin. The substance may cause effects on the central nervous system. If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis.

Effects of long-term or repeated exposure
The liquid defats the skin. The substance may have effects on the central nervous system. Exposure to the substance may enhance hearing damage caused by exposure to noise. Animal tests show that this substance possibly causes toxicity to human reproduction or development.

PHYSICAL PROPERTIES

Boiling point: 138/C
Melting point: 13/C
Relative density (water = 1): 0.86
Solubility in water: none
Vapour pressure, kPa at 20/C: 0.9
Relative vapour density (air = 1): 3.7
Relative density of the vapour/air-mixture at 20/C (air = 1): 1.02
Flash point: 27/C c.c.
Auto-ignition temperature: 528/C
Explosive limits, vol% in air: 1.1-7.0
Octanol/water partition coefficient as log Pow: 3.15

ENVIRONMENTAL DATA

The substance is toxic to aquatic organisms.

NOTES

Depending on the degree of exposure, periodic medical examination is indicated.
The recommendations on this Card also apply to technical xylene.
See ICSC 0084 o-Xylene and 0085 m-Xylene.

ADDITIONAL INFORMATION

m-XYLENE

0085
August 2002

CAS No: 108-38-3
RTECS No: ZE2275000
UN No: 1307
EC No: 601-022-00-9

meta-Xylene
1,3-Dimethylbenzene
m-Xylol
$C_6H_4(CH_3)_2$ / C_8H_{10}
Molecular mass: 106.2

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Flammable.	NO open flames, NO sparks, and NO smoking.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Above 27/C explosive vapour/air mixtures may be formed.	Above 27/C use a closed system, ventilation, and explosion-proof electrical equipment. Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		**STRICT HYGIENE!**	
Inhalation	Dizziness. Drowsiness. Headache. Nausea.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
Skin	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Burning sensation. Abdominal pain. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Ventilation. Remove all ignition sources. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment. (Extra personal protection: filter respirator for organic gases and vapours.)	**EU classification** Xn Symbol R: 10-20/21-38 S: (2-)25 Note: C **UN classification** UN Hazard Class: 3 UN Pack Group: III

EMERGENCY RESPONSE	SAFE STORAGE
NFPA Code: H 2; F 3; R 0; Transport Emergency Card: TEC (R)-30S1307-III	Fireproof. Separated from strong oxidants and strong acids.

IPCS
International Programme on Chemical Safety

Prepared in the context of cooperation between the International Programme on Chemical Safety and the European Commission

SEE IMPORTANT INFORMATION ON THE BACK.

IMPORTANT DATA

Physical State; Appearance
COLOURLESS LIQUID, WITH CHARACTERISTIC ODOUR.

Physical dangers
As a result of flow, agitation, etc., electrostatic charges can be generated.

Chemical dangers
Reacts with strong acids and strong oxidants.

Occupational exposure limits
TLV: 100 ppm as TWA; 150 ppm as STEL A4 (ACGIH 2001). BEI specified by (ACGIH 2001).
MAK: 100 ppm, 440 mg/m^3. Peak limitation category: II(2) skin absorption (H); Pregnancy risk group: D (DFG 2005).
EU OEL: 50 ppm as TWA; 100 ppm as STEL (skin) (EU 2000).

Routes of exposure
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

Inhalation risk
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20/C.

Effects of short-term exposure
The substance is irritating to the eyes and the skin. The substance may cause effects on the central nervous system. If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis.

Effects of long-term or repeated exposure
The liquid defats the skin. The substance may have effects on the central nervous system. Exposure to the substance may enhance hearing damage caused by exposure to noise. Animal tests show that this substance possibly causes toxicity to human reproduction or development.

PHYSICAL PROPERTIES

Boiling point: 139/C
Melting point: -48/C
Relative density (water = 1): 0.86
Solubility in water: none
Vapour pressure, kPa at 20/C: 0.8
Relative vapour density (air = 1): 3.7
Relative density of the vapour/air-mixture at 20/C (air = 1): 1.02
Flash point: 27/C c.c.
Auto-ignition temperature: 527/C
Explosive limits, vol% in air: 1.1-7.0
Octanol/water partition coefficient as log Pow: 3.20

ENVIRONMENTAL DATA

The substance is toxic to aquatic organisms.

NOTES

Depending on the degree of exposure, periodic medical examination is indicated.
The recommendations on this Card also apply to technical xylene.
See ICSC 0084 o-Xylene and 0086 p-Xylene.

ADDITIONAL INFORMATION

TRICHLOROETHYLENE

0081
October 2000

CAS No: 79-01-6
RTECS No: KX4550000
UN No: 1710
EC No: 602-027-00-9

1,1,2-Trichloroethylene
Trichloroethene
Ethylene trichloride
Acetylene trichloride
C_2HCl_3 / $ClCH=CCl_2$
Molecular mass: 131.4

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Combustible under specific conditions. See Notes.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION		Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		**PREVENT GENERATION OF MISTS! STRICT HYGIENE!**	
Inhalation	Dizziness. Drowsiness. Headache. Weakness. Nausea. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration may be needed. Refer for medical attention.
Skin	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes	Redness. Pain.	Safety spectacles, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Abdominal pain. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Give plenty of water to drink. Rest.

SPILLAGE DISPOSAL	PACKAGING & LABELLING	
Ventilation. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Personal protection: filter respirator for organic gases and vapours. Do NOT let this chemical enter the environment.	T Symbol R: 45-36/38-52/53-67 S: 53-45-61 UN Hazard Class: 6.1 UN Pack Group: III	Do not transport with food and feedstuffs. Marine pollutant.

EMERGENCY RESPONSE	SAFE STORAGE
Transport Emergency Card: TEC (R)-61S1710 NFPA Code: H2; F1; R0	Separated from metals (see Chemical Dangers), strong bases, food and feedstuffs. Dry. Keep in the dark. Ventilation along the floor.

IPCS
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IMPORTANT DATA

Physical State; Appearance
COLOURLESS LIQUID, WITH CHARACTERISTIC ODOUR.

Physical dangers
The vapour is heavier than air. As a result of flow, agitation, etc., electrostatic charges can be generated.

Chemical dangers
On contact with hot surfaces or flames this substance decomposes forming toxic and corrosive fumes (phosgene, hydrogen chloride). The substance decomposes on contact with strong alkali producing dichloroacetylene, which increases fire hazard. Reacts violently with metal powders such as magnesium, aluminium, titanium, and barium. Slowly decomposed by light in presence of moisture, with formation of corrosive hydrochloric acid.

Occupational exposure limits
TLV: 50 ppm as TWA; 100 ppm as STEL; A5; BEI issued; (ACGIH 2004).
MAK: Carcinogen category: 1; Germ cell mutagen group: 3B; (DFG 2004).

Routes of exposure
The substance can be absorbed into the body by inhalation and by ingestion.

Inhalation risk
A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20/C.

Effects of short-term exposure
The substance is irritating to the eyes and the skin. Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system, resulting in respiratory failure. Exposure could cause lowering of consciousness.

Effects of long-term or repeated exposure
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the central nervous system, resulting in loss of memory. The substance may have effects on the liver and kidneys (see Notes). This substance is probably carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 87/C
Melting point: -73/C
Relative density (water = 1): 1.5
Solubility in water, g/100 ml at 20/C: 0.1
Vapour pressure, kPa at 20/C: 7.8
Relative vapour density (air = 1): 4.5
Relative density of the vapour/air-mixture at 20/C (air = 1): 1.3
Auto-ignition temperature: 410/C
Explosive limits, vol% in air: 8-10.5
Octanol/water partition coefficient as log Pow: 2.42

ENVIRONMENTAL DATA

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

NOTES

Combustible vapour/air mixtures difficult to ignite, may be developed under certain conditions.
Use of alcoholic beverages enhances the harmful effect.
Depending on the degree of exposure, periodic medical examination is suggested.
The odour warning when the exposure limit value is exceeded is insufficient.
Do NOT use in the vicinity of a fire or a hot surface, or during welding.
An added stabilizer or inhibitor can influence the toxicological properties of this substance, consult an expert.
Card has been partly updated in October 2004. See sections Occupational Exposure Limits, EU classification, Emergency Response.

ADDITIONAL INFORMATION

BENZ(a)ANTHRACENE

0385
October 1995

CAS No: 56-55-3
RTECS No: CV9275000
EC No: 601-033-00-9

1,2-Benzoanthracene
Benzo(a)anthracene
2,3-Benzphenanthrene
Naphthanthracene
$C_{18}H_{12}$
Molecular mass: 228.3

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Combustible.		Water spray, powder. In case of fire in the surroundings: use appropriate extinguishing media.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		**AVOID ALL CONTACT!**	
Inhalation		Local exhaust or breathing protection.	Fresh air, rest.
Skin		Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes		Safety goggles, face shield or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion		Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Sweep spilled substance into sealable containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Personal protection: complete protective clothing including self-contained breathing apparatus.	T Symbol N Symbol R: 45-50/53 S: 53-45-60-61

EMERGENCY RESPONSE	SAFE STORAGE
	Well closed.

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SEE IMPORTANT INFORMATION ON THE BACK.

IMPORTANT DATA

Physical State; Appearance
COLOURLESS TO YELLOW - BROWN FLUORESCENT FLAKES OR POWDER.

Physical dangers
Dust explosion possible if in powder or granular form, mixed with air.

Occupational exposure limits
TLV: A2 (suspected human carcinogen); (ACGIH 2004).

Routes of exposure
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

Inhalation risk
Evaporation at 20/C is negligible; a harmful concentration of airborne particles can, however, be reached quickly.

Effects of long-term or repeated exposure
This substance is probably carcinogenic to humans.

PHYSICAL PROPERTIES

Sublimation point: 435/C
Melting point: 162/C
Relative density (water = 1): 1.274

Solubility in water: none
Vapour pressure, Pa at 20/C: 292
Octanol/water partition coefficient as log Pow: 5.61

ENVIRONMENTAL DATA

Bioaccumulation of this chemical may occur in seafood.

NOTES

This substance is one of many polycyclic aromatic hydrocarbons - standards are usually established for them as mixtures, e.g., coal tar pitch volatiles. However, it may be encountered as a laboratory chemical in its pure form.
Insufficient data are available on the effect of this substance on human health, therefore utmost care must be taken.
Do NOT take working clothes home.
Tetraphene is a common name.
Card has been partly updated in October 2005. See sections Occupational Exposure Limits, EU classification.

ADDITIONAL INFORMATION

BENZO(a)PYRENE

0104
October 2005

CAS No: 50-32-8
RTECS No: DJ3675000
EC No: 601-032-00-3

Benz(a)pyrene
3,4-Benzopyrene
Benzo(d,e,f)chrysene
$C_{20}H_{12}$
Molecular mass: 252.3

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Water spray, foam, powder, carbon dioxide.
EXPLOSION			
EXPOSURE	**See EFFECTS OF LONG-TERM OR REPEATED EXPOSURE.**	**AVOID ALL CONTACT! AVOID EXPOSURE OF (PREGNANT) WOMEN!**	
Inhalation		Local exhaust or breathing protection.	Fresh air, rest.
Skin	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes		Safety goggles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion		Do not eat, drink, or smoke during work.	Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Evacuate danger area! Personal protection: complete protective clothing including self-contained breathing apparatus. Do NOT let this chemical enter the environment. Sweep spilled substance into sealable containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place.	T Symbol N Symbol R: 45-46-60-61-43-50/53 S: 53-45-60-61

EMERGENCY RESPONSE	SAFE STORAGE
	Separated from strong oxidants.

IPCS
International Programme on Chemical Safety

Prepared in the context of cooperation between the International Programme on Chemical Safety and the European Commission

IMPORTANT DATA

Physical State; Appearance
PALE-YELLOW CRYSTALS

Chemical dangers
Reacts with strong oxidants causing fire and explosion hazard.

Occupational exposure limits
TLV: Exposure by all routes should be carefully controlled to levels as low as possible A2 (suspected human carcinogen); (ACGIH 2005).
MAK: Carcinogen category: 2; Germ cell mutagen group: 2; (DFG 2005).

Routes of exposure
The substance can be absorbed into the body by inhalation of its aerosol, through the skin and by ingestion.

Inhalation risk
Evaporation at 20/C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.

Effects of long-term or repeated exposure
This substance is carcinogenic to humans. May cause heritable genetic damage to human germ cells. Animal tests show that this substance possibly causes toxicity to human reproduction or development.

PHYSICAL PROPERTIES

Boiling point: 496/C
Melting point: 178.1/C
Density: 1.4 g/cm^3

Solubility in water: none (<0.1 g/100 ml)
Vapour pressure : negligible
Octanol/water partition coefficient as log Pow: 6.04

ENVIRONMENTAL DATA

The substance is very toxic to aquatic organisms. Bioaccumulation of this chemical may occur in fish, in plants and in molluscs. The substance may cause long-term effects in the aquatic environment.

NOTES

Do NOT take working clothes home.
Benzo(a)pyrene is present as a component of polycyclic aromatic hydrocarbons (PAHs) in the environment, usually resulting from the incomplete combustion or pyrolysis of organic matters, especially fossil fuels and tobacco.

ADDITIONAL INFORMATION

BENZO(b)FLUORANTHENE

0720
March 1999

CAS No: 205-99-2
RTECS No: CU1400000
EC No: 601-034-00-4

Benz(e)acephenanthrylene
2,3-Benzofluoroanthene
Benzo(e)fluoranthene
3,4-Benzofluoranthene
$C_{20}H_{12}$
Molecular mass: 252.3

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE			In case of fire in the surroundings: use appropriate extinguishing media.
EXPLOSION			
EXPOSURE		**AVOID ALL CONTACT!**	
Inhalation		Local exhaust or breathing protection.	Fresh air, rest.
Skin		Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes		Safety spectacles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion		Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Sweep spilled substance into covered containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.	T Symbol N Symbol R: 45-50/53 S: 53-45-60-61

EMERGENCY RESPONSE	SAFE STORAGE
	Provision to contain effluent from fire extinguishing. Well closed.

IPCS
International Programme on Chemical Safety

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IMPORTANT DATA

Physical State; Appearance
COLOURLESS CRYSTALS

Chemical dangers
Upon heating, toxic fumes are formed.

Occupational exposure limits
TLV: A2 (suspected human carcinogen); (ACGIH 2004).
MAK: Carcinogen category: 2; (DFG 2004).

Routes of exposure
The substance can be absorbed into the body by inhalation of its aerosol and through the skin.

Inhalation risk
Evaporation at 20/C is negligible; a harmful concentration of airborne particles can, however, be reached quickly.

Effects of long-term or repeated exposure
This substance is possibly carcinogenic to humans. May cause genetic damage in humans.

PHYSICAL PROPERTIES

Boiling point: 481/C
Melting point: 168/C
Solubility in water: none
Octanol/water partition coefficient as log Pow: 6.12

ENVIRONMENTAL DATA

This substance may be hazardous to the environment; special attention should be given to air quality and water quality.

NOTES

Benzo(b)fluoranthene is present as a component of polycyclic aromatic hydrocarbons (PAH) content in the environment usually resulting from the incomplete combustion or pyrolysis of organic matters, especially fossil fuels and tobacco. ACGIH recommends environment containing benzo(b)fluoranthene should be evaluated in terms of the TLV-TWA for coal tar pitch volatile, as benzene soluble 0.2 mg/m^3.
Insufficient data are available on the effect of this substance on human health, therefore utmost care must be taken.
Card has been partly updated in October 2005. See section Occupational Exposure Limits.

ADDITIONAL INFORMATION

BENZO(k)FLUORANTHENE

0721
March 1999

CAS No: 207-08-9
RTECS No: DF6350000
EC No: 601-036-00-5

Dibenzo(b,jk)fluorene
8,9-Benzofluoranthene
11,12-Benzofluoranthene
$C_{20}H_{12}$
Molecular mass: 252.3

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE			In case of fire in the surroundings: use appropriate extinguishing media.
EXPLOSION			
EXPOSURE		**AVOID ALL CONTACT!**	
Inhalation		Local exhaust or breathing protection.	Fresh air, rest.
Skin		Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes		Safety spectacles or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion		Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Sweep spilled substance into covered containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.	T Symbol N Symbol R: 45-50/53 S: 53-45-60-61

EMERGENCY RESPONSE	SAFE STORAGE
	Provision to contain effluent from fire extinguishing. Well closed.

IPCS
International Programme on Chemical Safety

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IMPORTANT DATA

Physical State; Appearance
YELLOW CRYSTALS

Chemical dangers
Upon heating, toxic fumes are formed.

Occupational exposure limits
TLV not established.
MAK: Carcinogen category: 2; (DFG 2004).

Routes of exposure
The substance can be absorbed into the body by inhalation of its aerosol and through the skin.

Inhalation risk
Evaporation at 20/C is negligible; a harmful concentration of airborne particles can, however, be reached quickly.

Effects of long-term or repeated exposure
This substance is possibly carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 480/C
Melting point: 217/C

Solubility in water: none
Octanol/water partition coefficient as log Pow: 6.84

ENVIRONMENTAL DATA

This substance may be hazardous to the environment; special attention should be given to air quality and water quality. Bioaccumulation of this chemical may occur in crustacea and in fish.

NOTES

Benzo(k)fluoranthene is present as a component of polycyclic aromatic hydrocarbons (PAH) content in the environment usually resulting from the incomplete combustion or pyrolysis of organic matters, especially fossil fuels and tobacco. ACGIH recommends environment containing benzo(k)fluoranthene should be evaluated in terms of the TLV-TWA for coal tar pitch volatile, as benzene soluble 0.2 mg/m^3.
Insufficient data are available on the effect of this substance on human health, therefore utmost care must be taken.
Card has been partly updated in October 2005. See section Occupational Exposure Limits.

ADDITIONAL INFORMATION

Safety (MSDS) data for chrysene

General

Synonyms: 1,2-benzophenanthrene, benzo(a)phenanthrene, 1,2-benzphenanthrene, coal tar pitch, benz(a)phenanthrene, 1,2,5,6-dibenzonaphthalene
Molecular formula: $C_{18}H_{12}$
CAS No: 218-01-9
EC No: 205-923-4

Physical data

Appearance: crystalline powder
Melting point: 253 C
Boiling point: 448 C
Vapour density:
Vapour pressure:
Density (g cm^{-3}): 1.27
Flash point:
Explosion limits:
Autoignition temperature:
Water solubility: insoluble

Stability

Stable. Combustible. Incompatible with strong oxidizing agents.

Toxicology

Toxic. Confirmed animal carcinogen, possible human carcinogen. Harmful if

swallowed, inhaled or absorbed through the skin.

Toxicity data
(The meaning of any abbreviations which appear in this section is given here.)
IPR-MUS LD50 >320 mg kg^{-1}

Risk phrases
(The meaning of any risk phrases which appear in this section is given here.)
R20 R21 R22 R45 R46.

Transport information

(The meaning of any UN hazard codes which appear in this section is given here.)
UN No 2811. Packing group I. Hazard class 6.1. CDG UK Transport category 1. EMS No 6.1-04.

Personal protection

Safety glasses, good ventilation, gloves. Handle as a carcinogen. A COSHH assessment is required.

Safety phrases
(The meaning of any safety phrases which appear in this section is given here.)
S3 S7 S9 S36 S37 S39 S45.

[Return to Physical & Theoretical Chemistry Lab. Safety home page.]

DIBENZO(a,h)ANTHRACENE

0431

October 1995

CAS No: 53-70-3
RTECS No: HN2625000
EC No: 601-041-00-2

1,2:5,6-Dibenzanthracene
$C_{22}H_{14}$
Molecular mass: 278.4

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Water spray, powder.
EXPLOSION			
EXPOSURE		**AVOID ALL CONTACT!**	
Inhalation		Local exhaust or breathing protection.	Fresh air, rest.
Skin	Redness. Swelling. Itching.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes	Redness.	Face shield or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion		Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Sweep spilled substance into sealable containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Personal protection: P3 filter respirator for toxic particles.	T Symbol N Symbol R: 45-50/53 S: 53-45-60-61

EMERGENCY RESPONSE	SAFE STORAGE
	Well closed.

IPCS
International Programme on Chemical Safety

Prepared in the context of cooperation between the International Programme on Chemical Safety and the European Commission

IMPORTANT DATA

Physical State; Appearance
COLOURLESS CRYSTALLINE POWDER.

Occupational exposure limits
TLV not established.

Routes of exposure
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

Inhalation risk
Evaporation at 20/C is negligible; a harmful concentration of airborne particles can, however, be reached quickly.

Effects of long-term or repeated exposure
The substance may have effects on the skin, resulting in photosensitization. This substance is probably carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 524/C
Melting point: 267/C
Relative density (water = 1): 1.28

Solubility in water: none
Octanol/water partition coefficient as log Pow: 6.5

ENVIRONMENTAL DATA

Bioaccumulation of this chemical may occur in seafood.

NOTES

This is one of many polycyclic aromatic hydrocarbons - standards are usually established for them as mixtures, e.g., coal tar pitch volatiles. However, it may be encountered as a laboratory chemical in its pure form.
Insufficient data are available on the effect of this substance on human health, therefore utmost care must be taken.
Do NOT take working clothes home.
DBA is a commonly used name.
This substance is one of many polycyclic aromatic hydrocarbons (PAH).
Card has been partly updated in October 2005. See section EU classification.

ADDITIONAL INFORMATION

Institute for Reference Materials and Measurements

SAFETY DATA SHEET

Based on Regulation (EC) No. 1907/2006 (REACH) Article 31 and Annex II

BCR-337: dibenzofuran

1. Identification of the substance/preparation and of the company/undertaking

1.1 Identification of the substance or preparation:

Product name: BCR-337: dibenzofuran

CAS number	132-64-9
EINECS number	205-071-3
RTECS number	HP4430000
Molecular mass	168.19 g/mol
Formula	C12H80

1.2 Use of the substance/preparation:

Certified reference material for laboratory use only

1.3 Company/undertaking identification:

Institute for Reference Materials and Measurements
Retieseweg
B-2440 Geel
Tel: +32 14 57 12 11
Fax: +32 14 59 04 06
JRC-IRMM-RM-Sales@ec.europa.eu

1.4 Emergency telephone:

Poison Centre: +32 70 245 245

2. Hazards identification

DSD/DPD

Classified dangerous in accordance with Directives 67/548/EEC and 1999/45/EC
Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment

Other hazards

Combustible
Its dust is explosive with air
Dust cloud can be ignited by a spark
Highly bioaccumulative
Not readily biodegradable in water

CLP

Classified as dangerous according to the criteria of Regulation (EC) No 1272/2008
Aquatic Chronic 2 Toxic to aquatic life with long lasting effects. (H411)

Other hazards

Combustible
Its dust is explosive with air
Dust cloud can be ignited by a spark
Highly bioaccumulative
Not readily biodegradable in water

3. Composition/information on ingredients

Name	CAS No EINECS/ELINCS	Conc.	Classification according to DSD/DPD	Classification according to CLP	Note
dibenzofuran	132-64-9 205-071-3		N; R51-53	Aquatic Chronic 2; H411	

4. First aid measures

4.1 After inhalation:

Remove the victim into fresh air
Respiratory problems: consult a doctor/medical service

4.2 Skin contact:
Rinse with water
Soap may be used
Take victim to a doctor if irritation persists

4.3 Eye contact:
Rinse with water
Take victim to an ophthalmologist if irritation persists

4.4 After ingestion:
Rinse mouth with water
Consult a doctor/medical service if you feel unwell

5. Fire-fighting measures

5.1 Suitable extinguishing media:
Water spray
Polyvalent foam
Polymer foam
ABC powder
Carbon dioxide

5.2 Unsuitable extinguishing media:
No unsuitable extinguishing media known

5.3 Special exposure hazards:
Temperature above flashpoint: higher fire/explosion hazard
Dust cloud can be ignited by a spark
Upon combustion CO and CO2 are formed

5.4 Instructions:
Take account of environmentally hazardous firefighting water
Use water moderately and if possible collect or contain it

5.5 Special protective equipment for fire-fighters:
Gloves
Protective clothing
Heat/fire exposure: compressed air/oxygen apparatus

6. Accidental release measures

6.1 Personal precautions:
See heading 8.2

6.2 Environmental precautions:
Dam up the solid spill
Prevent soil and water pollution
Prevent spreading in sewers
See heading 13

6.3 Methods for cleaning up:
Scoop solid spill into closing containers
Carefully collect the spill/leftovers
Clean contaminated surfaces with an excess of water
Wash clothing and equipment after handling

7. Handling and storage

7.1 Handling:
Avoid raising dust
Avoid prolonged and repeated contact with skin
Keep away from naked flames/heat
Keep container tightly closed

Do not discharge the waste into the drain

7.2 Storage:

Safe storage requirements:

Store in a cool area
Store in a dry area
Store in a dark area
Keep container in a well-ventilated place
Fireproof storeroom
Meet the legal requirements

Keep away from:

oxidizing agents

7.3 Specific use(s):

See information supplied by the manufacturer for the identified use(s)

8. Exposure controls/Personal protection

8.1 Exposure limit values:

8.1.1 Occupational exposure:

If limit values are applicable and available these will be listed below.

8.1.2 Sampling methods:

Product name	Test	Number	Sampling method	Remarks
No data available				

8.2 Exposure controls:

8.2.1 Occupational exposure controls:

Carry operations in the open/under local exhaust/ventilation or with respiratory protection

Personal protective equipment:

a) Respiratory protection:

Dust formation: dust mask

b) Hand protection:

Gloves

- PVC

c) Eye protection:

Safety glasses

In case of dust production: protective goggles

d) Skin protection:

Protective clothing

8.2.2 Environmental exposure controls:

See headings 6.2, 6.3 and 13

9. Physical and chemical properties

9.1 General information:

Physical form	Crystalline solid
	Crystalline powder
	Needles
Odour	Characteristic odour
Colour	White

9.2 Important health, safety and environmental information:

Boiling point	287 °C
Flashpoint	130 °C
Relative density	1.1
Solubility in water	0.00031 g/100 ml
Solubility in solvents	Soluble in ethanol
	Soluble in ether
	Soluble in acetone
	Soluble in acetic acid
	Soluble in chloroform
Relative vapour density	5.8
Dynamic viscosity	(0 °C) 0.099 Pa.s
Log Pow	4.12 - 5.16

9.3 Other information:

Melting point	86 °C

10. Stability and reactivity

10.1 Conditions to avoid:

Possible fire hazard

heat sources

ignition sources

Stability

No data available

10.2 Materials to avoid:

oxidizing agents

10.3 Hazardous decomposition products:

Upon combustion CO and CO2 are formed

11. Toxicological information

11.1 Acute toxicity:

No (test)data available.

11.2 Chronic toxicity:

Not listed in carcinogenicity class (IARC,EC,TLV,MAK)

Mutagenicity: AMES test negative

Mutagenicity tests: negative

Not listed in mutagenicity class (EC,MAK)

Not classified as toxic to reproduction (EC)

11.3 Acute effects/symptoms:

Inhalation:

No data available

Skin contact:

No data available

Eye contact:

No data available

Ingestion:

No data available

11.4 Chronic effects:

ON CONTINUOUS/REPEATED EXPOSURE/CONTACT:

Skin rash/inflammation

May stain the skin

12. Ecological information

12.1 Ecotoxicity:

BCR-337: dibenzofuran

LC50 fishes

species	value	duration (h)	remarks
PIMEPHALES PROMELAS	1.78 - 1.85 mg/l	96 h	

12.2 Mobility:

Volatile organic compounds (VOC)	0 %
Solubility in/reaction with water	Insoluble in water
Water physicochemical processes	Forming sediments in water

12.3 Persistence and degradability:

Half-life soil > 48 days

Not readily biodegradable in water

test: 0%, 28d, OECD 301C mitil

12.4 Bioaccumulative potential:

Log Pow 4.12 - 5.16

Highly bioaccumulative

12.5 Results of PBT assessment:

Not applicable, based on available data

12.6 Other adverse effects:

Not dangerous for the ozone layer (Council Regulation (EC) no 1005/2009)

13. Disposal considerations

13.1 Provisions relating to waste:

Waste material code (Directive 2008/98/EC, decision 2001/118/EC)

16 05 06* : laboratory chemicals, consisting of or containing dangerous substances, including mixtures of laboratory chemicals

Depending on branch of industry and production process, also other EURAL codes may be applicable

Hazardous waste according to Directive 2008/98/EC

13.2 Disposal methods:

Remove to an authorized incinerator equipped with an afterburner and a flue gas scrubber with energy recovery

Remove waste in accordance with local and/or national regulations

Obtain the consent of pollution control authorities before discharging to wastewater treatment plants

13.3 Packaging/Container:

Waste material code packaging (Directive 2008/98/EC)

15 01 10* : packaging containing residues of or contaminated by dangerous substances

14. Transport information

ADR

Proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Techn./chem. name ADR	dibenzofuran
UN number	3077
Class	9
Packing group	III
Hazard identification number	90
Classification code	M7
Labels	9
Environmentally hazardous substance mark	yes

RID

Proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Techn./chem. name RID	dibenzofuran
UN number	3077
Class	9
Packing group	III
Classification code	M7
Labels	9
Environmentally hazardous substance mark	yes

ADNR

Proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Techn./chem. name ADNR	dibenzofuran
UN number	3077
Class	9
Packing group	III

Classification code	M7
Labels	9
Environmentally hazardous substance mark	yes

IMO

Proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Techn./chem. name IMO	dibenzofuran
UN number	3077
Class	9
Packing group	III
Labels	9
Marine pollutant	P
Environmentally hazardous substance mark	yes

ICAO

Proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Techn./chem. name ICAO	dibenzofuran
UN number	3077
Class	9
Packing group	III
Labels	9
Environmentally hazardous substance mark	yes

15. Regulatory information

15.1 EU Legislation:

DSD/DPD

Not listed in Annex I of directive 67/548/EEC et sequens. Labelling established on the basis of the available data.

Dangerous for the environment

R-phrases

51/53	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment

S-phrases

(29)	(Do not empty into drains)
61	Avoid release to the environment. Refer to special instructions/safety data sheets.

CLP

Classification and labelling according to the criteria of Regulation (EC) No 1272/2008 and after evaluation of available test data

Signal word

	No signal word

H-statements

H411	Toxic to aquatic life with long lasting effects.

P-statements

P273	Avoid release to the environment.
P391	Collect spillage.
P501	Dispose of contents/container to manufacturer/competent authority.

15.2 National provisions:

16. Other information

The information in this safety data sheet is based on data and samples provided to BIG. The sheet was written to the best of our ability and according to the state of knowledge at that time. The safety data sheet only constitutes a guideline for the safe handling, use, consumption, storage, transport and disposal of the substances/preparations/mixtures mentioned under point 1. New safety data sheets are written from time to time. Only the most recent versions may be used. Old versions must be destroyed. Unless indicated otherwise word for word on the safety data sheet, the information does not apply to substances/preparations/mixtures in purer form, mixed with other substances or in processes. The safety data sheet offers no quality specification for the substances/preparations/mixtures in question.

Compliance with the instructions in this safety data sheet does not release the user from the obligation to take all measures dictated by common sense, regulations and recommendations or which are necessary and/or useful based on the real applicable circumstances. BIG does not guarantee the accuracy or exhaustiveness of the information provided. Use of this safety data sheet is subject to the licence and liability limiting conditions as stated in your BIG licence agreement. All intellectual property rights to this sheet are the property of BIG and its distribution and reproduction are limited. Consult your BIG licence agreement for details.

(*) = INTERNAL CLASSIFICATION (NFPA)

PBT-substances = persistent, bioaccumulative and toxic substances

DSD Dangerous Substance Directive
DPD Dangerous Preparation Directive
CLP (EU-GHS) Classification, labelling and packaging (Globally Harmonised System in Europe)

Full text of any R-phrases referred to under headings 2 and 3:

R51/53	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment

Full text of any H-statements referred to under headings 2 and 3:

H411	Toxic to aquatic life with long lasting effects.

Full text of any classes referred to under headings 2 and 3:

Aquatic Chronic	Hazardous to the aquatic environment - chronic

Safety (MSDS) data for fluoranthene

General

Synonyms: 1,2-(1,8-naphthylene)benzene, idryl, benzo[jk]fluorene, 1,2-(1,8-naphthalenediyl)benzene, 1,2-benzacenaphthene
Use:
Molecular formula: $C_{16}H_{10}$
CAS No: 206-44-0
EINECS No: 205-912-4

Physical data

Appearance: solid
Melting point: 105 - 110 C
Boiling point: 375 C
Vapour density:
Vapour pressure:
Density (g cm^{-3}):
Flash point: 198 C
Explosion limits:
Autoignition temperature:
Water solubility:

Stability

Stable. Incompatible with strong oxidizing agents.

Toxicology

Harmful if swallowed. Limited evidence that this may act as a carcinogen. Skin, eye and respiratory irritant.

Toxicity data

(The meaning of any toxicological abbreviations which appear in this section is given here.)

ORL-RAT LD50 2000 mg kg^{-1}

IVN-MUS LD50 100 mg kg^{-1}

SKN-RBT LD50 3180 mg kg^{-1}

Risk phrases

(The meaning of any risk phrases which appear in this section is given here.)
R22 R36 R37 R38 R40.

Transport information

(The meaning of any UN hazard codes which appear in this section is given here.)

Personal protection

Safety glasses, good ventilation. Rubber gloves.

Safety phrases

(The meaning of any safety phrases which appear in this section is given here.)

[Return to Physical & Theoretical Chemistry Lab. Safety home page.]

INDENO(1,2,3-cd)PYRENE

0730
March 1999

CAS No: 193-39-5
RTECS No: NK9300000

o-Phenylenepyrene
2,3-Phenylenepyrene
$C_{22}H_{12}$
Molecular mass: 276.3

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE			In case of fire in the surroundings: use appropriate extinguishing media.
EXPLOSION			
EXPOSURE		**AVOID ALL CONTACT!**	
Inhalation		Local exhaust or breathing protection.	Fresh air, rest.
Skin		Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes		Safety spectacles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion		Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Sweep spilled substance into covered containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.	

EMERGENCY RESPONSE	SAFE STORAGE
	Provision to contain effluent from fire extinguishing. Well closed.

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International Programme on Chemical Safety

Prepared in the context of cooperation between the International Programme on Chemical Safety and the European Commission

IMPORTANT DATA

Physical State; Appearance
YELLOW CRYSTALS

Chemical dangers
Upon heating, toxic fumes are formed.

Occupational exposure limits
TLV not established.
MAK: Carcinogen category: 2; (DFG 2004).

Routes of exposure
The substance can be absorbed into the body by inhalation of its aerosol and through the skin.

Inhalation risk
Evaporation at 20/C is negligible; a harmful concentration of airborne particles can, however, be reached quickly.

Effects of long-term or repeated exposure
This substance is possibly carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 536/C
Melting point: 164/C

Solubility in water: none
Octanol/water partition coefficient as log Pow: 6.58

ENVIRONMENTAL DATA

This substance may be hazardous to the environment; special attention should be given to air quality and water quality. Bioaccumulation of this chemical may occur in fish.

NOTES

Indeno(1,2,3-cd)pyrene is present as a component of polycyclic aromatic hydrocarbons (PAH) content in the environment usually resulting from the incomplete combustion or pyrolysis of organic matters, especially fossil fuels and tobacco. ACGIH recommends environment containing Indeno(1,2,3-c,d)pyrene should be evaluated in terms of the TLV-TWA for coal tar pitch volatile, as benzene soluble 0.2 mg/m^3.
Insufficient data are available on the effect of this substance on human health, therefore utmost care must be taken.
Card has been partly updated in October 2005. See section Occupational Exposure Limits.

ADDITIONAL INFORMATION

Safety (MSDS) data for phenanthrene

General

Synonyms: coal tar pitch volatiles, ravatite, phenantrin
Use:
Molecular formula: $C_{14}H_{10}$
CAS No: 85-01-8
EC No: 201-581-5

Physical data

Appearance: white crystals
Melting point: 99 - 101 C
Boiling point: 336 C
Vapour density:
Vapour pressure:
Density (g cm^{-3}): 1.063
Flash point:
Explosion limits:
Autoignition temperature:
Water solubility:

Stability

Stable. Combustible. Incompatible with strong oxidizing agents.

Toxicology

Harmful if swallowed. May be harmful if inhaled or absorbed through the skin. Skin, eye and respiratory irritant. Causes photosensitivity.

Toxicity data

(The meaning of any abbreviations which appear in this section is given here.)

ORL-MUS LD50 700 mg kg^{-1}

IPR-MUS LD50 700 mg kg^{-1}

IVN-MUS LD50 56 mg kg^{-1}

Risk phrases

(The meaning of any risk phrases which appear in this section is given here.)

R20 R21 R22 R36 R37 R38 R40.

Transport information

Non-hazardous for air, sea and road freight.

Personal protection

Safety glasses, adequate ventilation.

Safety phrases

(The meaning of any safety phrases which appear in this section is given here.)

S26 S27 S36 S37 S39 S45.

[Return to Physical & Theoretical Chemistry Lab. Safety home page.]

PYRENE

1474
November 2003

CAS No: 129-00-0
RTECS No: UR2450000

Benzo (d,e,f) phenanthrene
beta-Pyrene
$C_{16}H_{10}$
Molecular mass: 202.26

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking.	Water spray, carbon dioxide, dry powder, alcohol-resistant foam, or polymer foam.
EXPLOSION			
EXPOSURE			
Inhalation		Avoid inhalation of dust.	Fresh air, rest.
Skin	Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes	Redness.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion		Do not eat, drink, or smoke during work.	Do NOT induce vomiting. Give plenty of water to drink. Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder. Do NOT let this chemical enter the environment. (Extra personal protection: P2 filter respirator for harmful particles.)	Do not transport with food and feedstuffs.

EMERGENCY RESPONSE	STORAGE
	Separated from strong oxidants. Keep in a well-ventilated room.

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IMPORTANT DATA

Physical State; Appearance
PALE YELLOW OR COLOURLESS SOLID IN VARIOUS FORMS

Chemical dangers
The substance decomposes on heating producing irritating fumes.

Occupational exposure limits
TLV not established.
MAK not established.

Routes of exposure
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

Inhalation risk
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.

Effects of short-term exposure
Exposure to sun may provoke an irritating effect of pyrene on skin and lead to chronic skin discoloration.

PHYSICAL PROPERTIES

Boiling point: 404°C
Melting point: 151°C
Density: 1.27 g/cm^3

Solubility in water: 0.135 mg/l at 25°C
Vapour pressure, Pa at °C: 0.08
Octanol/water partition coefficient as log Pow: 4.88

ENVIRONMENTAL DATA

Bioaccumulation of this chemical may occur in crustacea, in fish, in milk, in algae and in molluscs. It is strongly advised that this substance does not enter the environment.

NOTES

Pyrene is one of many polycyclic aromatic hydrocarbons - standards are usually established for them as mixtures, e.g., coal tar pitch volatiles. However, pyrene may be encountered as a laboratory chemical in its pure form.
Health effects of exposure to the substance have not been investigated adequately.
See ICSC 1415 Coal-tar pitch.

ADDITIONAL INFORMATION

ARSENIC

0013
October 1999

CAS No: 7440-38-2
RTECS No: CG0525000
UN No: 1558
EC No: 033-001-00-X

Grey arsenic
As
Atomic mass: 74.9

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Combustible. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames. NO contact with strong oxidizers. NO contact with hot surfaces.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Risk of fire and explosion is slight when exposed to hot surfaces or flames in the form of fine powder or dust.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		**PREVENT DISPERSION OF DUST! AVOID ALL CONTACT! AVOID EXPOSURE OF (PREGNANT) WOMEN!**	**IN ALL CASES CONSULT A DOCTOR!**
Inhalation	Cough. Sore throat. Shortness of breath. Weakness. See Ingestion.	Closed system and ventilation.	Fresh air, rest. Artificial respiration may be needed. Refer for medical attention.
Skin	Redness.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower.
Eyes	Redness.	Face shield or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Abdominal pain. Diarrhoea. Nausea. Vomiting. Burning sensation in the throat and chest. Shock or collapse. Unconsciousness.	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING	
Evacuate danger area! Sweep spilled substance into sealable containers. Carefully collect remainder, then remove to safe place. Chemical protection suit including self-contained breathing apparatus. Do NOT let this chemical enter the environment.	T Symbol N Symbol R: 23/25-50/53 S: (1/2-)20/21-28-45-60-61 UN Hazard Class: 6.1 UN Pack Group: II	Do not transport with food and feedstuffs. Marine pollutant.

EMERGENCY RESPONSE	SAFE STORAGE
Transport Emergency Card: TEC (R)-61GT5-II	Separated from strong oxidants, acids, halogens, food and feedstuffs. Well closed.

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SEE IMPORTANT INFORMATION ON THE BACK.

IMPORTANT DATA

Physical State; Appearance
ODOURLESS, BRITTLE, GREY, METALLIC-LOOKING CRYSTALS.

Chemical dangers
Upon heating, toxic fumes are formed. Reacts violently with strong oxidants and halogens, causing fire and explosion hazard. Reacts with acids to produce toxic arsine gas (see: ICSC 0222).

Occupational exposure limits
TLV: 0.01 mg/m^3 as TWA; A1 (confirmed human carcinogen); BEI issued; (ACGIH 2004).
MAK: Carcinogen category: 1; Germ cell mutagen group: 3A; (DFG 2004).

Routes of exposure
The substance can be absorbed into the body by inhalation of its aerosol and by ingestion.

Inhalation risk
Evaporation at 20/C is negligible; a harmful concentration of airborne particles can, however, be reached quickly, when dispersed.

Effects of short-term exposure
The substance is irritating to the eyes, the skin and the respiratory tract. The substance may cause effects on the gastrointestinal tract, cardiovascular system, central nervous system and kidneys, resulting in severe gastroenteritis, loss of fluid, and electrolytes, cardiac disorders, shock, convulsions and kidney impairment. Exposure above the OEL may result in death. The effects may be delayed. Medical observation is indicated.

Effects of long-term or repeated exposure
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the mucous membranes, skin, peripheral nervous system, liver and bone marrow, resulting in pigmentation disorders, hyperkeratosis, perforation of nasal septum, neuropathy, liver impairment, anaemia. This substance is carcinogenic to humans. Animal tests show that this substance possibly causes toxicity to human reproduction or development.

PHYSICAL PROPERTIES

Sublimation point: 613/C
Density: 5.7 g/cm^3

Solubility in water: none

ENVIRONMENTAL DATA

The substance is toxic to aquatic organisms. It is strongly advised that this substance does not enter the environment.

NOTES

The substance is combustible but no flash point is available in literature.
Depending on the degree of exposure, periodic medical examination is suggested.
Do NOT take working clothes home.
Refer also to cards for specific arsenic compounds, e.g., Arsenic pentoxide (ICSC 0377), Arsenic trichloride (ICSC 0221), Arsenic trioxide (ICSC 0378), Arsine (ICSC 0222).
Card has been partly updated in October 2004. See sections Occupational Exposure Limits, EU classification, Emergency Response.
Card has been partly updated in October 2005 in section Effects of long-term or repeated exposure.

ADDITIONAL INFORMATION

BARIUM

1052
October 1999

CAS No: 7440-39-3
RTECS No: CQ8370000
UN No: 1400

Ba
Atomic mass: 137.3

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Flammable. Many reactions may cause fire or explosion.	NO open flames, NO sparks, and NO smoking. NO contact with water.	Special powder, dry sand, NO hydrous agents, NO water.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		**PREVENT DISPERSION OF DUST! STRICT HYGIENE!**	
Inhalation	Cough. Sore throat.	Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
Skin	Redness.	Protective gloves.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
Eyes	Redness. Pain.	Safety goggles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion		Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Sweep spilled substance into sealable containers. Carefully collect remainder, then remove to safe place. Chemical protection suit including self-contained breathing apparatus. Do NOT wash away into sewer.	UN Hazard Class: 4.3 UN Pack Group: II

EMERGENCY RESPONSE	STORAGE
Transport Emergency Card: TEC (R)-43G12	Separated from halogenated solvents, strong oxidants, acids. Dry. Keep under inert gas, oil or oxygen-free liquid.

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SEE IMPORTANT INFORMATION ON THE BACK.

IMPORTANT DATA

Physical State; Appearance
YELLOWISH TO WHITE LUSTROUS SOLID IN VARIOUS FORMS.

Physical dangers
Dust explosion possible if in powder or granular form, mixed with air.

Chemical dangers
The substance may spontaneously ignite on contact with air (if in powder form). The substance is a strong reducing agent and reacts violently with oxidants and acids. Reacts violently with halogenated solvents. Reacts with water, forming flammable/explosive gas (hydrogen - see ICSC 0001), causing fire and explosion hazard.

Occupational exposure limits
TLV: 0.5 mg/m^3 (as TWA) (ACGIH 1999).

Routes of exposure
The substance can be absorbed into the body by ingestion.

Effects of short-term exposure
The substance irritates the eyes, the skin and the respiratory tract.

PHYSICAL PROPERTIES

Boiling point: 1640°C
Melting point: 725°C
Density: 3.6 g/cm^3
Solubility in water: reaction

ENVIRONMENTAL DATA

NOTES

Reacts violently with fire extinguishing agents such as water, bicarbonate, powder, foam, and carbon dioxide.
Rinse contaminated clothes (fire hazard) with plenty of water.

ADDITIONAL INFORMATION

CHROMIUM

0029
October 2004

CAS No: 7440-47-3
RTECS No: GB4200000

Chrome
(powder)
Cr
Atomic mass: 52.0

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Combustible under specific conditions.	No open flames if in powder form.	In case of fire in the surroundings: use appropriate extinguishing media.
EXPLOSION		Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		**PREVENT DISPERSION OF DUST!**	
Inhalation	Cough.	Local exhaust or breathing protection.	Fresh air, rest.
Skin		Protective gloves.	Remove contaminated clothes. Rinse skin with plenty of water or shower.
Eyes	Redness.	Safety goggles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion		Do not eat, drink, or smoke during work.	Rinse mouth.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Personal protection: P2 filter respirator for harmful particles.	

EMERGENCY RESPONSE	SAFE STORAGE

IPCS
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IMPORTANT DATA

Physical State; Appearance
GREY POWDER

Physical dangers
Dust explosion possible if in powder or granular form, mixed with air.

Chemical dangers
Chromium is a catalytic substance and may cause reaction in contact with many organic and inorganic substances, causing fire and explosion hazard.

Occupational exposure limits
TLV: (as Cr metal, Cr(III) compounds) 0.5 mg/m^3 as TWA; A4; (ACGIH 2004).
MAK not established.

Inhalation risk
A harmful concentration of airborne particles can be reached quickly when dispersed.

Effects of short-term exposure
May cause mechanical irritation to the eyes and the respiratory tract.

PHYSICAL PROPERTIES

Boiling point: 2642/C
Melting point: 1900/C
Density: 7.15 g/cm^3
Solubility in water: none

ENVIRONMENTAL DATA

NOTES

The surface of the chromium particles is oxidized to chromium(III)oxide in air.
See ICSC 1531 Chromium(III) oxide.

ADDITIONAL INFORMATION

MERCURY

0056
April 2004

CAS No: 7439-97-6
RTECS No: OV4550000
UN No: 2809
EC No: 080-001-00-0

Quicksilver
Liquid silver
Hg
Atomic mass: 200.6

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Not combustible. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: use appropriate extinguishing media.
EXPLOSION	Risk of fire and explosion.		In case of fire: keep drums, etc., cool by spraying with water.

EXPOSURE		STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN! AVOID EXPOSURE OF ADOLESCENTS AND CHILDREN!	IN ALL CASES CONSULT A DOCTOR!
Inhalation	Abdominal pain. Cough. Diarrhoea. Shortness of breath. Vomiting. Fever or elevated body temperature.	Local exhaust or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
Skin	MAY BE ABSORBED! Redness.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
Eyes		Face shield, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion		Do not eat, drink, or smoke during work. Wash hands before eating.	Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING	
Evacuate danger area in case of a large spill! Consult an expert! Ventilation. Collect leaking and spilled liquid in sealable non-metallic containers as far as possible. Do NOT wash away into sewer. Do NOT let this chemical enter the environment. Chemical protection suit including self-contained breathing apparatus.	T Symbol N Symbol R: 23-33-50/53 S: (1/2-)7-45-60-61 UN Hazard Class: 8 UN Pack Group: III	Special material. Do not transport with food and feedstuffs.

EMERGENCY RESPONSE	STORAGE
Transport Emergency Card: TEC (R)-80GC9-II+III	Provision to contain effluent from fire extinguishing. Separated from food and feedstuffs. Well closed.

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International Programme on Chemical Safety

Prepared in the context of cooperation between the International Programme on Chemical Safety and the European Commission

IMPORTANT DATA

Physical State; Appearance
ODOURLESS, HEAVY AND MOBILE SILVERY LIQUID METAL.

Chemical dangers
Upon heating, toxic fumes are formed. Reacts violently with ammonia and halogens causing fire and explosion hazard. Attacks aluminium and many other metals forming amalgams.

Occupational exposure limits
TLV: 0.025 mg/m^3 as TWA; (skin); A4; BEI issued; (ACGIH 2004).
MAK: 0.1 mg/m^3; Sh; Peak limitation category: II(8); Carcinogen category: 3B; (DFG 2003).

Routes of exposure
The substance can be absorbed into the body by inhalation of its vapour and through the skin, also as a vapour!

Inhalation risk
A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20/C.

Effects of short-term exposure
The substance is irritating to the skin. Inhalation of the vapours may cause pneumonitis. The substance may cause effects on the central nervous system and kidneys. The effects may be delayed. Medical observation is indicated.

Effects of long-term or repeated exposure
The substance may have effects on the central nervous system and kidneys, resulting in irritability, emotional instability, tremor, mental and memory disturbances, speech disorders. May cause inflammation and discoloration of the gums. Danger of cumulative effects. Animal tests show that this substance possibly causes toxic effects upon human reproduction.

PHYSICAL PROPERTIES

Boiling point: 357/C
Melting point: -39/C
Relative density (water = 1): 13.5
Solubility in water: none
Vapour pressure, Pa at 20/C: 0.26
Relative vapour density (air = 1): 6.93
Relative density of the vapour/air-mixture at 20/C (air = 1): 1.009

ENVIRONMENTAL DATA

The substance is very toxic to aquatic organisms. In the food chain important to humans, bioaccumulation takes place, specifically in fish.

NOTES

Depending on the degree of exposure, periodic medical examination is indicated.
No odour warning if toxic concentrations are present.
Do NOT take working clothes home.

ADDITIONAL INFORMATION

NICKEL

0062
October 2001

CAS No: 7440-02-0 (powder)
RTECS No: QR5950000 Ni
EC No: 028-002-00-7 Atomic mass: 58.7

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Flammable as dust. Toxic fumes may be released in a fire.		Dry sand. NO carbon dioxide. NO water.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		**PREVENT DISPERSION OF DUST! AVOID ALL CONTACT!**	
Inhalation	Cough. Shortness of breath.	Local exhaust or breathing protection.	Fresh air, rest.
Skin		Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes		Safety spectacles, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion		Do not eat, drink, or smoke during work.	Rinse mouth.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Vacuum spilled material. Carefully collect remainder, then remove to safe place. Personal protection: P2 filter respirator for harmful particles.	Xn Symbol R: 40-43 S: (2-)22-36

EMERGENCY RESPONSE	SAFE STORAGE
	Separated from strong acids.

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IMPORTANT DATA

Physical State; Appearance
SILVERY METALLIC SOLID IN VARIOUS FORMS.

Physical dangers
Dust explosion possible if in powder or granular form, mixed with air.

Chemical dangers
Reacts violently, in powder form, with titanium powder and potassium perchlorate, and oxidants such as ammonium nitrate, causing fire and explosion hazard. Reacts slowly with non-oxidizing acids and more rapidly with oxidizing acids. Toxic gases and vapours (such as nickel carbonyl) may be released in a fire involving nickel.

Occupational exposure limits
TLV: (Inhalable fraction) 1.5 mg/m^3 as TWA; A5 (not suspected as a human carcinogen); (ACGIH 2004).
MAK: (Inhalable fraction); sensitization of respiratory tract and skin (Sah); Carcinogen category: 1; (DFG 2004).

Routes of exposure
The substance can be absorbed into the body by inhalation of the dust.

Inhalation risk
Evaporation at 20/C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.

Effects of short-term exposure
May cause mechanical irritation. Inhalation of fumes may cause pneumonitis.

Effects of long-term or repeated exposure
Repeated or prolonged contact may cause skin sensitization. Repeated or prolonged inhalation exposure may cause asthma. Lungs may be affected by repeated or prolonged exposure. This substance is possibly carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 2730/C
Melting point: 1455/C
Density: 8.9 g/cm^3
Solubility in water: none

ENVIRONMENTAL DATA

NOTES

At high temperatures, nickel oxide fumes will be formed.
Depending on the degree of exposure, periodic medical examination is suggested.
The symptoms of asthma often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential.
Anyone who has shown symptoms of asthma due to this substance should avoid all further contact with this substance.
Card has been partly updated in April 2005. See section Occupational Exposure Limits.

ADDITIONAL INFORMATION

SELENIUM

0072
April 1993

CAS No: 7782-49-2 (powder)
RTECS No: VS7700000 Se
EC No: 034-001-00-2 Atomic mass: 79.0

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Combustible. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames. NO contact with oxidants.	Powder, AFFF, foam, carbon dioxide. NO water.
EXPLOSION	Risk of fire and explosion on contact with oxidants.		
EXPOSURE		**PREVENT DISPERSION OF DUST! STRICT HYGIENE!**	
Inhalation	Irritation of nose. Cough. Dizziness. Headache. Laboured breathing. Nausea. Sore throat. Vomiting. Weakness. Symptoms may be delayed (see Notes).	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
Skin	Redness. Skin burns. Pain. Discolouration.	Protective gloves. Protective clothing.	Rinse skin with plenty of water or shower. Refer for medical attention. Remove and isolate contaminated clothes.
Eyes	Redness. Pain. Blurred vision.	Safety spectacles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Metallic taste. Diarrhoea. Chills. Fever. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING	
Do NOT wash away into sewer. Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Personal protection: P3 filter respirator for toxic particles.	T Symbol R: 23/25-33-53 S: (1/2-)20/21-28-45-61	Airtight. Do not transport with food and feedstuffs.

EMERGENCY RESPONSE	SAFE STORAGE
	Fireproof. Separated from strong oxidants, strong acids, food and feedstuffs. Dry.

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SEE IMPORTANT INFORMATION ON THE BACK.

IMPORTANT DATA

Physical State; Appearance
ODOURLESS SOLID IN VARIOUS FORMS. DARK RED-BROWN TO BLUISH-BLACK AMORPHOUS SOLID OR RED TRANSPARENT CRYSTALS OR METALLIC GREY TO BLACK CRYSTALS.

Chemical dangers
Upon heating, toxic fumes are formed. Reacts violently with oxidants strong acids. Reacts with water at 50/C forming flammable/explosive gas (hydrogen - see ICSC0001) and selenious acids. Reacts with incandescence on gentle heating with phosphorous and metals such as nickel, zinc, sodium, potassium, platinum.

Occupational exposure limits
TLV: 0.2 mg/m^3 as TWA; (ACGIH 2004).
MAK: (Inhalable fraction) 0.05 mg/m^3; Peak limitation category: II(4); Carcinogen category: 3B; Pregnancy risk group: C; (DFG 2004).

Routes of exposure
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

Inhalation risk
Evaporation at 20/C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.

Effects of short-term exposure
The substance is irritating to the eyes and the respiratory tract. Inhalation of dust may cause lung oedema (see Notes). Inhalation of fume may cause symptoms of asphyxiation, chills and fever and bronchitis. The effects may be delayed.

Effects of long-term or repeated exposure
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the respiratory tract, gastrointestinal tract, and skin, resulting in nausea, vomiting, cough, yellowish skin discolouration, loss of nails, garlic breath and bad teeth.

PHYSICAL PROPERTIES

Boiling point: 685/C
Melting point: 170-217/C
Relative density (water = 1): 4.8
Solubility in water: none
Vapour pressure, Pa at 20/C: 0.1

ENVIRONMENTAL DATA

NOTES

Do NOT take working clothes home.
Card has been partly updated in April 2005. See sections Occupational Exposure Limits, EU classification, Emergency Response.

ADDITIONAL INFORMATION

SILVER

0810
October 1997

CAS No: 7440-22-4
RTECS No: VW3500000
UN No:
EC No:

Argentium
C.I. 77820
Ag
Atomic mass: 107.9

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Not combustible, except as powder.		
EXPLOSION			

EXPOSURE		PREVENT DISPERSION OF DUST!	
Inhalation		Local exhaust or breathing protection.	Fresh air, rest.
Skin		Protective gloves.	Rinse skin with plenty of water or shower.
Eyes		Safety spectacles, or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion		Do not eat, drink, or smoke during work.	

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.	Symbol R: S:

EMERGENCY RESPONSE	STORAGE
	Separated from ammonia, strong hydrogen peroxide solutions, strong acids.

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SEE IMPORTANT INFORMATION ON THE BACK.

IMPORTANT DATA

Physical State; Appearance
WHITE METAL, TURNS DARK ON EXPOSURE TO OZONE, HYDROGEN SULFIDE OR SULFUR.

Chemical Dangers
Shock-sensitive compounds are formed with acetylene. Reacts with acids causing fire hazard. Contact with strong hydrogen peroxide solution will cause violent decomposition to oxygen gas. Contact with ammonia may cause formation of compounds that are explosive when dry.

Occupational Exposure Limits
TLV (metal): 0.1 mg/m^3 (ACGIH 1997).
MAK: 0.1 mg/m^3; (1996)

Routes of Exposure
The substance can be absorbed into the body by inhalation and by ingestion.

Inhalation Risk
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.

Effects of Short-term Exposure
Inhalation of high amounts of metallic silver vapours may cause lung damage with pulmonary edema.

Effects of Long-term or Repeated Exposure
The substance may cause a grey-blue discoloration of the eyes, nose, throat and skin (argyria/argyrosis).

PHYSICAL PROPERTIES

Boiling point: 2212°C
Melting point: 962°C
Relative density (water = 1): 10.5
Solubility in water: none

ENVIRONMENTAL DATA

This substance may be hazardous to the environment; special attention should be given to aquatic organisms.

NOTES

ADDITIONAL INFORMATION

ZINC POWDER

1205
October 1994

CAS No: 7440-66-6
RTECS No: ZG8600000
UN No: 1436 (zinc powder or dust)
EC No: 030-001-00-1

Blue powder
Merrillite
(powder)
Zn
Atomic mass: 65.4

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Highly flammable. Many reactions may cause fire or explosion. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking. NO contact with acid(s), base(s) and incompatible substances (see Chemical Dangers).	Special powder, dry sand, NO other agents. NO water.
EXPLOSION	Risk of fire and explosion on contact with acid(s), base(s), water and incompatible substances.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Prevent build-up of electrostatic charges (e.g., by grounding). Prevent deposition of dust.	In case of fire: cool drums, etc., by spraying with water but avoid contact of the substance with water.
EXPOSURE		**PREVENT DISPERSION OF DUST! STRICT HYGIENE!**	
Inhalation	Metallic taste and metal fume fever. Symptoms may be delayed (see Notes).	Local exhaust.	Fresh air, rest. Refer for medical attention.
Skin	Dry skin.	Protective gloves.	Rinse and then wash skin with water and soap.
Eyes		Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Abdominal pain. Nausea. Vomiting.	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Extinguish or remove all ignition sources. Do NOT wash away into sewer. Sweep spilled substance into containers. then remove to safe place. Personal protection: self-contained breathing apparatus.	F Symbol N Symbol R: 15-17-50/53 S: (2-)7/8-43-46-60-61 UN Hazard Class: 4.3 UN Subsidiary Risks: 4.2 Airtight.

EMERGENCY RESPONSE	SAFE STORAGE
Transport Emergency Card: TEC (R)-43GWS-II+III NFPA Code: H0; F1; R1	Fireproof. Separated from acids, bases oxidants. Dry.

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IMPORTANT DATA

Physical State; Appearance
ODOURLESS GREY TO BLUE POWDER.

Physical dangers
Dust explosion possible if in powder or granular form, mixed with air. If dry, it can be charged electrostatically by swirling, pneumatic transport, pouring, etc.

Chemical dangers
Upon heating, toxic fumes are formed. The substance is a strong reducing agent and reacts violently with oxidants. Reacts with water and reacts violently with acids and bases forming flammable/explosive gas (hydrogen - see ICSC0001). Reacts violently with sulfur, halogenated hydrocarbons and many other substances causing fire and explosion hazard.

Occupational exposure limits
TLV not established.

Routes of exposure
The substance can be absorbed into the body by inhalation and by ingestion.

Inhalation risk
Evaporation at 20/C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.

Effects of short-term exposure
Inhalation of fumes may cause metal fume fever. The effects may be delayed.

Effects of long-term or repeated exposure
Repeated or prolonged contact with skin may cause dermatitis.

PHYSICAL PROPERTIES

Boiling point: 907/C
Melting point: 419/C
Relative density (water = 1): 7.14
Solubility in water: reaction
Vapour pressure, kPa at 487/C: 0.1
Auto-ignition temperature: 460/C

ENVIRONMENTAL DATA

NOTES

Zinc may contain trace amounts of arsenic, when forming hydrogen, may also form toxic gas arsine (see ICSC0001 and ICSC0222).
Reacts violently with fire extinguishing agents such as water, halons, foam and carbon dioxide.
The symptoms of metal fume fever do not become manifest until several hours later.
Rinse contaminated clothes (fire hazard) with plenty of water.
Card has been partly updated in April 2005. See sections EU classification, Emergency Response.

ADDITIONAL INFORMATION

MANGANESE

0174
November 2003

CAS No: 7439-96-5
RTECS No: OO9275000

(powder)
Mn
Atomic mass: Atomic mass: 54.9

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Dry sand, special powder.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		**PREVENT DISPERSION OF DUST! AVOID EXPOSURE OF (PREGNANT) WOMEN!**	
Inhalation	Cough.	Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
Skin		Protective gloves.	Rinse and then wash skin with water and soap.
Eyes		Safety goggles, or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Abdominal pain. Nausea.	Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Sweep spilled substance into containers. Carefully collect remainder, then remove to safe place. (Extra personal protection: P2 filter respirator for harmful particles.)	

EMERGENCY RESPONSE	SAFE STORAGE
	Separated from acids. Dry.

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International Programme on Chemical Safety

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IMPORTANT DATA

Physical State; Appearance
GREY - WHITE POWDER

Physical dangers
Dust explosion possible if in powder or granular form, mixed with air.

Chemical dangers
Reacts slowly with water more rapidly with steam and acids forming flammable/explosive gas (hydrogen - see ICSC0001) causing fire and explosion hazard.

Occupational exposure limits
TLV: 0.2 mg/m^3 (as TWA) ; (ACGIH 2003).
MAK: 0.5 I mg/m^3; Pregnancy risk group: C; (DFG 2003).

Routes of exposure
The substance can be absorbed into the body by inhalation of its aerosol and by ingestion.

Inhalation risk
Evaporation at 20/C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.

Effects of short-term exposure
The aerosol is irritating to the respiratory tract.

Effects of long-term or repeated exposure
The substance may have effects on the lungs and central nervous system, resulting in increased susceptibility to bronchitis, pneumonitis and neurologic, neuropsychiatric disorders (manganism). Animal tests show that this substance possibly causes toxicity to human reproduction or development.

PHYSICAL PROPERTIES

Boiling point: 1962/C
Melting point: 1244/C
Density: 7.47 g/cm^3
Solubility in water: none

ENVIRONMENTAL DATA

This substance may be hazardous in the environment; special attention should be given to aquatic organisms.

NOTES

Depending on the degree of exposure, periodic medical examination is suggested.
The recommendations on this Card also apply to ferro manganese.

ADDITIONAL INFORMATION

SODIUM

0717
April 2006

CAS No: 7440-23-5
RTECS No: VY0686000
UN No: 1428
EC No: 011-001-00-0

Natrium
Na
Atomic mass: 23.0

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Highly flammable. Many reactions may cause fire or explosion. Gives off irritating or toxic fumes (or gases) in a fire.	NO contact with water, acid(s) and halogens. NO open flames, NO sparks, and NO smoking.	Special powder, dry sand, NO other agents.
EXPLOSION	Risk of fire and explosion. on contact with acid(s), halogens, water.		Combat fire from a sheltered position.
EXPOSURE			
Inhalation	Cough. Sore throat. Burning sensation.	Closed system and ventilation.	Fresh air, rest. Half-upright position. Artificial respiration may be needed. Refer for medical attention.
Skin	Pain. Blisters. Serious skin burns.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
Eyes	Severe deep burns. loss of vision.	Face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Burning sensation. Shock or collapse.	Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL

Evacuate danger area! Consult an expert! Chemical protection suit including self-contained breathing apparatus. Cover the spilled material with dry powder.

PACKAGING & LABELLING

EU classification
F Symbol
C Symbol
R: 14/15-34
S: (1/2)-5 -8-43-45
UN classification
UN Hazard Class: 4.3
UN Pack Group: I
GHS classification
Signal: Danger
Flam-Corr
In contact with water releases flammable gases which may ignite spontaneously
Causes severe skin burns and eye damage

Airtight. Unbreakable packaging; put breakable packaging into closed unbreakable container.

EMERGENCY RESPONSE

Transport Emergency Card: TEC (R)-43S1428a
NFPA Code: H3; F3; R2

SAFE STORAGE

Fireproof. Keep under mineral oil. Dry. Well closed.

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SEE IMPORTANT INFORMATION ON THE BACK.

IMPORTANT DATA

Physical State; Appearance
SILVERY SOLID IN VARIOUS FORMS

Chemical dangers
Reacts violently with water, causing fire and explosion hazard. The substance decomposes rapidly under the influence of air and moisture, forming flammable/explosive gas (Hydrogen - see ICSC0001).

Occupational exposure limits
TLV not established.
MAK not established.

Routes of exposure
Serious local effects by all routes of exposure.

Effects of short-term exposure
See ICSC 0360 (Sodium hydroxide)

PHYSICAL PROPERTIES

Boiling point: 880/C
Melting point: 97.4/C
Density: 0.97 g/cm^3

Solubility in water: reaction
Vapour pressure, Pa at 20/C: negligible
Auto-ignition temperature: 120-125/C

ENVIRONMENTAL DATA

NOTES

Sodium is always kept under mineral oil.
Reacts violently with fire extinguishing agents such as
water
and
carbon dioxide
.

ADDITIONAL INFORMATION

Safety data for magnesium

Click here for data on magnesium in student-friendly format, from the HSci project

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Glossary of terms on this data sheet.

The information on this web page is provided to help you to work safely, but it is intended to be an overview of hazards, not a replacement for a full Material Safety Data Sheet (MSDS). MSDS forms can be downloaded from the web sites of many chemical suppliers.

General

Synonyms: magnesium ribbon, magnesium wire, magnesium powder
Molecular formula: Mg
CAS No: 7439-95-4
EC No: 231-104-6

Physical data

Appearance: silver or grey rod, turnings or ribbon
Melting point: 650 C
Boiling point: 1107 C
Vapour density:
Vapour pressure: 1 mm at 621 C
Specific gravity: 1.73
Flash point: 634 C (closed cup)

Explosion limits:
Autoignition temperature: 510 C

Stability

Stable. Reacts violently with halogens, chlorinated solvents, chloromethane. Air and moisture sensitive. Incompatible with acids, acid chlorides, strong oxidizing agents. Highly flammable.

Toxicology

Harmful if swallowed or inhaled. Severe irritant. Vesicant.

Risk phrases

(The meaning of any risk phrases which appear in this section is given here.)
R11 R20 R22.

Transport information

(The meaning of any UN hazard codes which appear in this section is given here.)
Hazard class 4.1 Packing group III

Personal protection

Safety glasses.

Safety phrases

(The meaning of any safety phrases which appear in this section is given here.)
S16 S26 S33 S36 S37 S39.

[Return to Physical & Theoretical Chemistry Lab. Safety home page.]

This information was last updated on May 20, 2005. We have tried to make it as accurate and useful as possible, but can take no responsibility for its use, misuse, or accuracy. We have not verified this information, and cannot guarantee that it is up-to-date.

Appendix B
Activity Hazard Analyses

Project Identification 74 Wallabout IRM	**Location** Various	**Estimated Dates** TBD
Phase of Work Mobilization/ Demobilization	**Page 1 of 1**	**Analysis Approved by** Andy lockwood, PM/HSM
TASKS	**HAZARDS**	**CONTROL MEASURES**
1. Mobilization and demobilization of equipment site tools, personnel	Slips/trips/falls	• Maintain alertness to slip/trip/fall hazards; • Maintain good housekeeping; • Walk, do not run; • Wear footwear with soles that grip; • Unloading areas should be on even terrain; and • Mark and repair if possible tripping hazards.
	Manual lifting and material handling	• Instruct personnel on proper lifting techniques; • Use proper lifting techniques; and • Team lifting will be used for heavy loads or use mechanical lifting devices.
	Temperature extremes	• Drink plenty of fluids: • Train personnel of signs/symptoms of heat/cold stress; • Monitor air temperatures when extreme weather conditions are present; and • Stay in visual and verbal contact with your buddy.
	Vehicular traffic	• Spotters will be used when backing up trucks and heavy equipment and when moving equipment.
	Overhead hazards	• Personnel will be required to wear hard hats that meet ANSI Standard Z89.1; • Ground personnel will stay clear of suspended loads; • Equipment will be provided with guards, canopies or grills to protect the operator from falling or flying objects; and • Overhead hazards will be identified prior to commencing work operations.
	Noise	• Ear plugs or ear muffs shall be worn for operations that exceed 85 decibels.
	Electrocution	• Equipment will be equipped with GFCI; • A licensed electrician will conduct electrical work; • Equipment will stay a minimum of 15 feet from overhead-energized electrical lines and the electrified third rail (up to 50 kV). This distance will increase 0.4 inches for each 1 kV above 50 kV.
	Biological hazards	• Be alert to the presence of biological hazards; • Wear insect repellent; • Follow procedures in Section 4.2.2 for tick bites; • FTL/SHSO should be aware of on-site personnel with allergic reactions in insect bites and stings.

Project Identification 74 Wallabout IRM	**Location** Various	**Estimated Dates** TBD
Phase of Work Excavation	**Page 1 of 1**	**Analysis Approved by** Andy Lockwood, PM/HSM
TASKS	**HAZARDS**	**CONTROL MEASURES**
1. Excavate to required depths; soil handing and transport	Chemical hazards	• Wear appropriate PPE per Table 6-1; • Perform air monitoring per Community Air Monitoring Plan; • Practice contamination avoidance; • Follow proper decontamination procedures; and • Wash hands/face before eating, drinking or smoking.
	Hand and power tool usage	• Equip electrical equipment with GFCI's; • Inspect electrical equipment and tools prior to use; • Daily inspections will be performed; • Remove broken or damaged tools from service; • Use the tool for its intended purpose; • Use in accordance with manufacturer instructions; and Tag and remove defective equipment.
	Temperature extremes	• Drink plenty of fluids: • Train personnel of signs/symptoms of heat/cold stress; • Monitor air temperatures when extreme weather conditions are present; and, • Stay in visual and verbal contact with your buddy.
	Manual lifting and material handling	• Instruct personnel on proper lifting techniques; • Use proper lifting techniques; and • Team lifting will be used for heavy loads or use mechanical lifting devices.
	Fire/Explosion	• ABC type fire extinguishers shall be readily available; • No smoking in work area.
	Biological hazards	• Be alert to the presence of biological hazards; • Wear insect repellent; • Follow procedures in Section 4.2.2 for tick bites; • FTL/SHSO should be aware of on-site personnel with allergic reactions in insect bites and stings.
	Heavy equipment	• Ground personnel will stay clear of suspended loads; • Ground personnel will stay out of the swing radius; • Eye contact with operators will be made before approaching equipment; • Equipment will not be approached on blind sides; • Equipment will be equipped with backup alarms or spotters shall be used.
	Slips/Trips/Falls	• Maintain alertness to slip/trip/fall hazards; • Maintain good housekeeping; • Walk, do not run; • Wear footwear with soles that grip; • Unloading areas should be on even terrain; and mark and repair if possible tripping hazards are present.
	Electrocution	• Equipment will be equipped with GFCI; • A licensed electrician will conduct electrical work; • Equipment will stay a minimum of 15 feet from overhead-energized electrical lines and the electrified third rail (up to 50 kV). This distance will increase 0.4 inches for each 1 kV above 50 kV.

Project Identification 74 Wallabout IRM	**Location** Various	**Estimated Dates** TBD
Phase of Work Soil Sampling	**Page 1 of 1**	**Analysis Approved by** Andy Lockwood, PM/HSM
TASKS	**HAZARDS**	**CONTROL MEASURES**
1.Collect soil samples.	Chemical hazards	• Wear appropriate PPE per Table 6-1; • Practice contamination avoidance; • Follow proper decontamination procedures; and • Wash hands/face before eating, drinking or smoking.
	Temperature extremes	• Drink plenty of fluids: • Train personnel of signs/symptoms of heat/cold stress; • Monitor air temperatures when extreme weather conditions are present; and • Stay in visual and verbal contact with your buddy.
	Manual lifting and material handling	• Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
	Slips/Trips/Falls	• Maintain alertness to slip/trip/fall hazards; • Maintain good housekeeping; • Walk, do not run; • Wear footwear with soles that grip; • Unloading areas should be on even terrain; and • Mark and repair if possible tripping hazards.
	Electrocution	• Equipment will be equipped with GFCI; • A licensed electrician will conduct electrical work; • Equipment will stay a minimum of 15 feet from overhead-energized electrical lines and the electrified third rail (up to 50 kV). This distance will increase 0.4 inches for each 1 kV above 50 kV.
	Track Hazards	• Caution will be used when working in close proximity to the electrified third rail (see “Electrocution” above). • Workers are required to have completed NYCT Track Safety Training • Flag men will be used when necessary (e.g., working in limited access track areas).

Project Identification 74 Wallabout IRM	**Location** Various	**Estimated Dates** TBD
Phase of Work Decontamination	**Page 1 of 1**	**Analysis Approved by** Andy Lockwood, PM/HSM
TASKS	**HAZARDS**	**CONTROL MEASURES**
1.Decontaminate equipment	Chemical hazards	• Wear appropriate PPE per Table 6-1; • Practice contamination avoidance; • Follow proper decontamination procedures; and • Wash hands/face before eating, drinking or smoking.
	Temperature extremes	• Drink plenty of fluids: • Train personnel of signs/symptoms of heat/cold stress; • Monitor air temperatures when extreme weather conditions are present; and • Stay in visual and verbal contact with your buddy.
	Manual lifting and material handling	• Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
	Slips/Trips/Falls	• Maintain alertness to slip/trip/fall hazards; • Maintain good housekeeping; • Walk, do not run; • Wear footwear with soles that grip; • Unloading areas should be on even terrain; and • Mark and repair if possible tripping hazards.
	Electrocution	• Equipment will be equipped with GFCI; • A licensed electrician will conduct electrical work; • Equipment will stay a minimum of 15 feet from overhead-energized electrical lines and the electrified third rail (up to 50 kV). This distance will increase 0.4 inches for each 1 kV above 50 kV.
	Track Hazards	• Caution will be used when working in close proximity to the electrified third rail (see “Electrocution” above). • Workers are required to have completed NYCT Track Safety Training • Flag men will be used when necessary (e.g., working in limited access track areas).

Project Identification 74 Wallabout Street	**Location** 74 Wallabout Street	**Estimated Dates** TBD
Phase of Work Decontamination	**Page 1 of 1**	**Analysis Approved by** Andrew Lockwood, PM/HSM
TASKS	**HAZARDS**	**CONTROL MEASURES**
1.Decontaminate equipment	Chemical hazards	• Wear appropriate PPE per Table 6-1; • Practice contamination avoidance; • Follow proper decontamination procedures; and • Wash hands/face before eating, drinking or smoking.
	Temperature extremes	• Drink plenty of fluids: • Train personnel of signs/symptoms of heat/cold stress; • Monitor air temperatures when extreme weather conditions are present; and • Stay in visual and verbal contact with your buddy.
	Manual lifting and material handling	• Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
	Slips/Trips/Falls	• Maintain alertness to slip/trip/fall hazards; • Maintain good housekeeping; • Walk, do not run; • Wear footwear with soles that grip; • Unloading areas should be on even terrain; and • Mark and repair if possible tripping hazards.
	Electrocution	• Equipment will be equipped with GFCI; • A licensed electrician will conduct electrical work; • Equipment will stay a minimum of 15 feet from overhead-energized electrical lines (up to 50 kV). This distance will increase 0.4 inches for each 1 kV above 50 kV.

Appendix C
Heat/Cold Stress Protocols

HEAT STRESS

Heat Stress (Hyperthermia)

Heat stress is the body's inability to regulate the core temperature. A worker's susceptibility to heat stress can vary according to his/her physical fitness, degree of acclimation to heat, humidity, age and diet.

1. Prior to site activity, the field team leader may make arrangements for heat stress monitoring (i.e., monitoring heart rate, body temperature, and body water loss) during actual site work if conditions warrant. In addition, the FTL is to ensure that each team member has been acclimatized to the prevailing environmental conditions, that personnel are aware of the signs and symptoms of heat sickness, that they have been adequately trained in first aid procedures, and that there are enough personnel on-site to rotate work assignments and schedule work during hours of reduced temperatures. Personnel should not consume alcoholic or caffeinated beverages but rather drink moderate levels of an electrolyte solution and eat well prior to commencing site work.

2. Although there is no specific test given during a baseline physical that would identify a person's intolerance to heat, some indicators are tobacco or medication use, dietary habits, body weight, and chronic conditions such as high blood pressure or diabetes.

3. *Heat cramps*, caused by profuse perspiration with inadequate fluid intake and salt replacement, most often afflict people in good physical condition who work in high temperature and humidity. Heat cramps usually come on suddenly during vigorous activity. Untreated, heat cramps may progress rapidly to heat exhaustion or heat stroke. First aid treatment: remove victim to a cool place and replace lost fluids with water.

4. Thirst is not an adequate indicator of heat exposure. Drinking fluid by itself does not indicate sufficient water replacement during heat exposure. A general rule, the amount of water administered should replace the amount of water lost, and it should be administered at regular intervals throughout the day. For every half pound of water lost, 8 ounces of water should be ingested. Water should be replaced by drinking 2 – 4 ounce servings during every rest period. A recommended alternative to water is an electrolyte drink split 50/50 with water.

5. *Heat exhaustion* results from salt and water loss along with peripheral pooling of blood. Like heat cramps, heat exhaustion tends to occur in persons in good physical health who are working in high temperatures and humidity. Heat exhaustion may come on suddenly as dizziness and collapse. Untreated, heat exhaustion may progress to heat stroke.

6. *Treatment for heat exhaustion*: Move the victim to a cool environment (e.g. air-conditioned room/car), lay victim down and fan him/her. If the air-conditioning is not available, remove the victim to a shaded area, remove shirt, and fan. If symptoms do not subside within an hour, notify 911 to transport to hospital.

7. *Heat stroke* results from the body's inability to dissipate excess heat. A true medical emergency that requires immediate care, it usually occurs when one ignores the signs of heat exhaustion and continues strenuous activities. Working when the relative humidity exceeds 60% is a particular problem. Workers in the early phase of heat stress may not be coherent of they will be confused, delirious or comatose. Changes in behavior, irritability and combativeness are useful early signs of heat stroke.

8. *Treatment of heat stroke*: Move the victim to a cool, air-conditioned environment. Place victim in a semi-reclined position with head elevated and strip to underclothing. Cool victim as rapidly as possible, applying ice packs to the arms and legs and massaging the neck and torso. Spray victim with tepid water and constantly fan to promote evaporation. Notify 911 to transport to hospital as soon as possible.

TABLE 1

SYMPTOMS OF HEAT STRESS

Heat cramps are caused by heavy sweating with inadequate fluid intake. Symptoms include;

- Muscle cramps
- Cramps in the hands, legs, feet and abdomen

Heat exhaustion occurs when body organs attempt to keep the body cool. Symptoms include;

- Pale, cool moist skin
- Core temperature elevated 1-2^{o}
- Thirst
- Anxiety
- Rapid heart rate
- Heavy sweating
- Dizziness
- Nausea

Heat stroke is the most serious form of heat stress. Immediate action must be taken to cool the body before serious injury and death occur. Symptoms are;

- Red, hot, dry skin
- Lack of perspiration
- Seizures
- Dizziness and confusion
- Strong, rapid pulse
- Core temperature of 104^{o} or above
- Coma

TABLE 2

HEAT STRESS INDICATORS

Heat stress indicator	When to measure	If Exceeds…	Action
Heart rate (pulse)	Beginning of rest period	110 beats per minute	Shorten next work period by 33%
Oral temperature	Beginning of rest period	99°F (after thermometer is under tongue for 3 minutes) 100.6°F	Shorten next work period by 33% Prohibit work in impermeable clothing
Body weight	1. Before workday begins (a.m.) 2. After workday ends (p.m.)		Increase fluid intake

COLD STRESS

Cold stress (Hypothermia)

In hypothermia the core body temperature drops below 95°F. Hypothermia can be attributed to a decrease in heat production, increased heat loss or both.

Prevention

Institute the following steps to prevent overexposure of workers to cold:

1. Maintain body core temperature at 98.6°F or above by encouraging workers to drink warm liquids during breaks (preferably not coffee) and wear several layers of clothing that can keep the body warm even when the clothing is wet.
2. Avoid frostbite by adequately covering hands, feet and other extremities. Clothing such as insulated gloves or mittens, earmuffs and hat liners should be worn. To prevent contact frostbite (from touching metal and cold surfaces below 20°F), workers should wear gloves. Tool handles should be covered with insulating material.
3. Adjust work schedules to provide adequate rest periods. When feasible, rotate personnel and perform work during the warmer hours of the day.
4. Provide heated shelter. Workers should remove their outer layer(s) of clothing while in the shelter to allow sweat to evaporate.
5. In the event that wind barriers are constructed around an intrusive operation (such as drilling), the enclosure must be properly vented to prevent the buildup of toxic or explosive gases or vapors. Care must be taken to keep a heat source away from flammable substances.
6. Using a wind chill chart such as the one in Table 3, obtain the equivalent chill temperature (ECT) based on actual wind speed and temperature. Refer to the ECT when setting up work warm-up schedules, planning appropriate clothing, etc. Workers should use warming shelters at regular intervals at or below an ECT of 20°F. For exposed skin, continuous exposure should not be permitted at or below an ECT of -25°F.

Frostbite

Personnel should be aware of symptoms of frostbite/hypothermia. If the following symptoms are noticed in any worker, he/she should immediately go to a warm shelter.

Condition	Skin Surface	Tissue Under Skin	Skin Color
Frostnip	Soft	Soft	Initially red, then white
Frostbite	Hard	Soft	White and waxy
Freezing	Hard	Hard	Blotchy, white to yellow-gray to gray

1. *Frostnip* is the incipient stage of frostbite, brought about by direct contact with a cold object or exposure of a body part to cool/cold air. Wind chill or cold water also can be major factors. This condition is not serious. Tissue damage is minor and the response to care is good. The tip of the nose, tips of ears, upper cheeks and fingers (all areas generally exposed) are most susceptible to frostnip.

2. *Treatment of frostnip*: Care for frostnip by warming affected areas. Usually the worker can apply warmth from his/her bare hands, blow warm air on the site, or, if the fingers are involved, hold them in the armpits. During recovery, the worker may complain of tingling or burning sensation, which is normal. If the condition does not respond to this simple care, begin treatment for frostbite.

3. *Frostbite*: The skin and subcutaneous layers become involved. If frostnip goes untreated, it becomes superficial frostbite. This condition is serious. Tissue damage may be serious. The worker must be transported to a medical facility for evaluation. The tip of the nose, tips of ears, upper cheeks and fingers (all areas generally exposed) are most susceptible to frostbite. The affected area will feel frozen, but only on the surface. The tissue below the surface must still be soft and have normal response to touch. *DO NOT* squeeze or poke the tissue. The condition of the deeper tissues can be determined by gently palpating the affected area. The skin will turn mottled or blotchy. It may also be white and then turn grayish-yellow.

4. *Treatment of frostbite*: When practical, transport victim as soon as possible. Get the worker inside and keep him/her warm. Do not allow any smoking or alcohol consumption. Thaw frozen parts by immersion, re-warming in a 100^{o}F to 106^{o}F water bath. Water temperature will

drop rapidly, requiring additional warm water throughout the process. Cover the thawed part with a dry sterile dressing. Do not puncture or drain any blisters.

NOTE: Never listen to myths and folk tales about the care of frostbite. *Never* rub a frostbitten or frozen area. *Never* rub snow on a frostbitten or frozen area. Rubbing the area may cause serious damage to already injured tissues. Do not attempt to thaw a frozen area if there is any chance it will be re-frozen.

5. *General cooling/Hypothermia*: General cooling of the body is known as systemic hypothermia. This condition is not a common problem unless workers are exposed to cold for prolonged periods of time without any shelter.

Body Temperature	°C	Symptoms
99-96	37-35.5	Intense, uncontrollable shivering
95-91	35.5-32.7	Violent shivering persists. If victim is conscious, he has difficulty speaking.
90-86	32-30	Shivering decreases and is replaced by strong muscular rigidity. Muscle coordination is affected. Erratic or jerkey movements are produced. Thinking is less clear. General comprehension is dulled. There may be total amnesia. The worker is generally still able to maintain the appearance of psychological contact with his surroundings.
85-81	29.4-27.2	Victim becomes irrational, loses contact with his environment, and drifts into a stuporous state. Muscular rigidity continues. Pulse and respirations are slow and the worker may develop cardiac arrhythmias.
80-78	26.6-18.5	Victim becomes unconscious. He does not respond to the spoken word. Most reflexes cease to function. Heartbeat becomes erratic
Below 78	25.5	Cardiac and respiratory centers of the brain fail. Ventricular fibrillation occurs; probably edema and hemorrhage in the lungs; death.

6. *Treatment of hypothermia*: Keep worker dry. Remove any wet clothing and replace with dry clothes, or wrap person in dry blankets. Keep person at rest. Do not allow him/her to move around. Transport the victim to a medical facility as soon as possible.

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Strategic Environmental Engineering Solutions

TABLE 3[(1)]
COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS AN EQUIVALENT TEMPERATURE (UNDER CALM CONDITIONS)

Estimated wind Speed (in mph)	Actual Temperature Reading (^{o}F)P											
	50	40	30	20	10	0	10	20	30	40	50	60
	Equivalent Chill Temperature (^{o}F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	15	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-146
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER in < hr with dry skin. Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh within one minute			GREAT DANGER Flesh may freeze within 30 seconds.				
	Trench foot and imersion foot may occur at any point on this chart											

Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

(1) Reproduced from American Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1985-1986, p.01.

Appendix D
Medical Data Sheet

MEDICAL DATA SHEET

The brief medical data sheet shall be completed by on-site personnel and will be kept in the Support Zone by the HSO as a project record during the conduct of site operations. It accompanies any personnel when medical assistance is needed or if transport to a hospital is required.

Project:
Name: Home Telephone: _____
Address: _____
Age: _____ Height: _____ Weight: _____ Blood Type: _____

Name and Telephone Number of Emergency Contact: _____

Drug or Other Allergies: _____

Particular Sensitivities: _____

Do You Wear Contacts? _____

Provide A Check List Of Previous Illnesses: _____

What Medications Are You Presently Using?_____

Do You Have Any Medical Restrictions? _____

Name, Address, And Phone Number Of Personal Physician:

Appendix E
General Health and Safety Work Practices

GENERAL HEALTH AND SAFETY WORK PRACTICES

1. Site personnel must attend each day's Daily Briefing and sign the attendance sheet.

2. Any individual taking prescribed drugs shall inform the FTL/HSO of the type of medication. The FTL/HSO will review the matter with the HSM and the Corporate Medical Consultant (CMC), who will decide if the employee can safely work on-site while taking the medication.

3. The personal protective equipment specified by the FTL/HSO and/or associated procedures shall be worn by site personnel. This includes hard hats and safety glasses which must be worn in active work areas.

4. Facial hair (beards, long sideburns or mustaches) which may interfere with a satisfactory fit of a respirator mask is not allowed on any person who may be required to wear a respirator.

5. Personnel must follow proper decontamination procedures and shower as soon as possible upon completion of work shift.

6. Eating, drinking, chewing tobacco or gum, smoking and any other practice that may increase the possibility of hand-to-mouth contact is prohibited in the exclusion zone or the contamination reduction zone. (Exceptions may be permitted by the HSM to allow fluid intake during heat stress conditions).

7. Lighters, matches, cigarettes and other forms of tobacco are prohibited in the Exclusion Zone.

8. Signs and demarcations shall be followed. Such signs and demarcation shall not be removed, except as authorized by the FTL/HSO.

9. No one shall enter a permit-required confined space without a permit and appropriate training. Confined space entry permits shall be implemented as issued.

10. Personnel must follow Hot Work Permits as issued.

11. Personnel must use the Buddy System in the Exclusion Zone.

12. Personnel must follow the work-rest regimens and other practices required by the heat stress program.

13. Personnel must follow lockout/tagout procedures when working on equipment involving moving parts or hazardous energy sources.

14. No person shall operate equipment unless trained and authorized.

15. No one may enter an excavation greater than four feet deep unless authorized by the Competent Person. Excavations must be sloped or shored properly. Safe means of access and egress from excavations must be maintained.

16. Ladders and scaffolds shall be solidly constructed, in good working condition, and inspected prior to use. No one may use defective ladders or scaffolds.

17. Fall protection or fall arrest systems must be in place when working at elevations greater than six feet for temporary working surfaces and four feet for fixed platforms.

18. Safety belts, harnesses and lanyards must be selected by the Supervisor. The user must inspect the equipment prior to use. No defective personal fall protection equipment shall be used. Personal fall protection that has been shock loaded must be discarded.

19. Hand and portable power tools must be inspected prior to use. Defective tools and equipment shall not be used.

20. Ground fault interrupters shall be used for cord and plug equipment used outdoors or in damp locations. Electrical cords shall be kept out walkways and puddles unless protected and rated for the service.

21. Improper use, mishandling, or tampering with health and safety equipment and samples is prohibited.

22. Horseplay of any kind is prohibited.

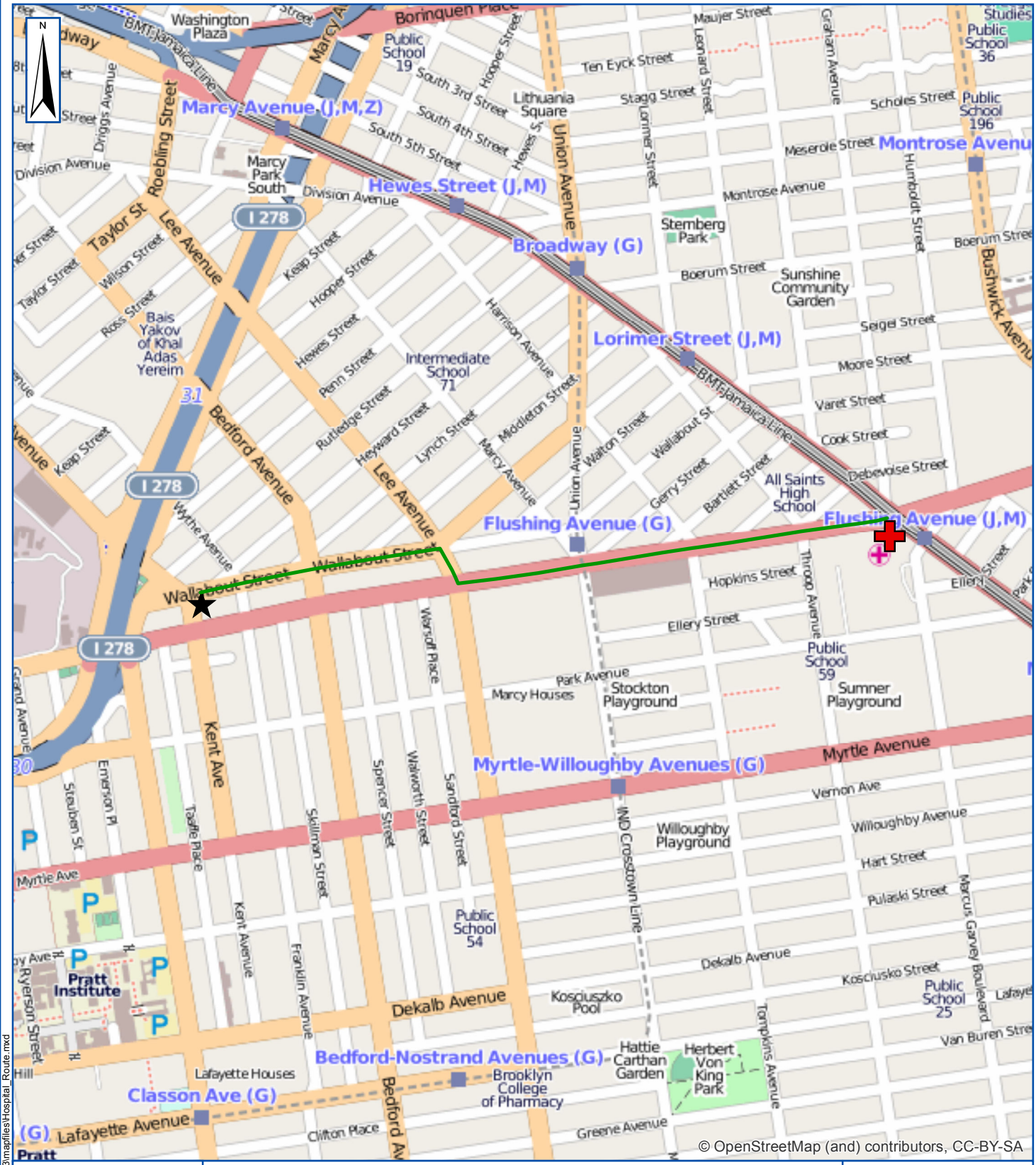
23. Possession or use of alcoholic beverages, controlled substances, or firearms on any site is forbidden.

24. Incidents, no matter how minor, must be reported immediately to the Supervisor.

25. Personnel shall be familiar with the Site Emergency Action Plan, which is contained in Section 12 of the HASP/EAP.

The above Health and Safety Rules are not all inclusive and it is your responsibility to comply with regulations set forth by OSHA, the client, PWGC Supervisors, and the FTL/HSO.

Appendix F
Hospital Route Map and Directions



HOSPITAL ROUTE

74 WALLABOUT
TO
WOODHULL HOSPITAL

0 0.15 0.3 0.45 0.6 Miles

PWGC
Strategic Environmental and Engineering Solutions
P.W. GROSSER CONSULTING ENGINEER AND HYDROGEOLOGIST, P.C.
630 Johnson Avenue, • Suite 7
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Project:	RAB1203
Date:	1/10/2013
Designed by:	BB
Drawn by:	BB
Approved by:	DE
Figure No:	1

Document Path: D:\GIS\Projects\M-R\RAB1203\mapfiles\Hospital_Route.mxd

Appendix G
Incident Report Form / Investigation Form

INCIDENT / NEAR MISS REPORT AND INVESTIGATION - PAGE 1 OF 2			
TYPE OF INCIDENT - CHECK ALL THAT APPLY			
☐ INJURY/ILLNESS	☐ VEHICLE DAMAGE	☐ PROPERTY DAMAGE	☐ FIRE
☐SPILL/RELEASE	☐ PERMIT EXCEEDENCE	☐ NEAR MISS	☐OTHER
GENERAL INFORMATION			
PROJECT NAME:	DATE OF REPORT:	REPORT NO.:	
DATE OF INCIDENT:	TIME:	DAY OF WEEK:	
LOCATION OF INCIDENT:			
WEATHER CONDITIONS:	ADEQUATE LIGHTING AT SCENE? ☐YES ☐NO ☐N/A		
DESCRIBE WHAT HAPPENED (STEP BY STEP - USE ADDITIONAL PAGES IF NECESSARY)			
AFFECTED EMPLOYEE INFORMATION			
NAME:	EMPLOYEE: ☐YES ☐NO		
HOME ADDRESS:			
SOCIAL SECURITY NO.:	HOME PHONE NO.:		
JOB CLASSIFICATION:	YEARS IN JOB CLASSIFICATION:		
HOURS WORKED ON SHIFT PRIOR TO INCIDENT:	AGE:		
DID INCIDENT RELATE TO ROUTINE TASK FOR JOB CLASSIFICATION? ☐YES ☐NO			
INJURY/ILLNESS INFORMATION			
NATURE OF INJURY OR ILLNESS:			
OBJECT/EQUIPMENT/SUBSTANCE CAUSING HARM:			
FIRST AID PROVIDED? ☐YES ☐NO			
IF YES, WHERE WAS IT GIVEN: ☐ON-SITE ☐OFF-SITE			
IF YES, WHO PROVIDED FIRST AID:			
WILL THE INJURY/ILLNESS RESULT IN: ☐RESTRICTED DUTY ☐LOST TIME ☐UNKNOWN			

INCIDENT / NEAR MISS REPORT AND INVESTIGATION - PAGE 2 OF 2 REPORT NO.
MEDICAL TREATMENT INFORMATION
WAS MEDICAL TREATMENT PROVIDED? ☐YES ☐NO
IF YES, WAS MEDICAL TREATMENT PROVIDED: ☐ON-SITE ☐DR.'S OFFICE ☐HOSPITAL
NAME OF PERSON(S) PROVIDING TREATMENT:
ADDRESS WHERE TREATMENT WAS PROVIDED:
TYPE OF TREATMENT:
VEHICLE AND PROPERTY DAMAGE INFORMATION
VEHICLE/PROPERTY DAMAGED:
DESCRIPTION OF DAMAGE:
SPILL AND AIR EMISSIONS INFORMATION:
SUBSTANCE SPILLED OR RELEASED: FROM WHERE: TO WHERE:
ESTIMATED QUANTITY/DURATION:
CERCLA HAZARDOUS SUBSTANCE? ☐YES ☐NO
REPORTABLE TO AGENCY? ☐YES ☐NO SPECIFY:
WRITTEN REPORT: ☐YES ☐NO TIME FRAME:
RESPONSE ACTION TAKEN:
PERMIT EXCEEDENCE
TYPE OF PERMIT: PERMIT #:
DATE OF EXCEEDENCE: DATE FIRST KNOWLEDGE OF EXCEEDENCE:
PERMITTED LEVEL OR CRITERIA:
EXCEEDENCE LEVEL OR CRITERIA:
REPORTABLE TO AGENCY? ☐YES ☐NO SPECIFY:
WRITTEN REPORT: ☐YES ☐NO TIME FRAME:
RESPONSE ACTION TAKEN:
NOTIFICATIONS
NAMES OF PERSONNEL NOTIFIED: DATE/TIME:
CLIENT NOTIFIED: DATE/TIME:
AGENCY NOTIFIED: DATE/TIME:
CONTACT NAME:
PERSONS PREPARING REPORT
EMPLOYEE'S NAME:(PRINT) SIGN:
SUPERVISOR'S NAME:(PRINT) SIGN:

INVESTIGATIVE REPORT			
DATE OF INCIDENT:	DATE OF REPORT:	REPORT NUMBER:	
INCIDENT COST: ESTIMATED: $_____	ACTUAL: $_____		
OSHA RECORDABLE(S): ☐YES ☐NO # RESTRICTED DAYS ____ # DAYS AWAY FROM WORK ____			
CAUSE ANALYSIS			
IMMEDIATE CAUSES - WHAT ACTIONS AND CONDITIONS CONTRIBUTED TO THIS EVENT?			
BASIC CAUSES - WHAT SPECIFIC PERSONAL OR JOB FACTORS CONTRIBUTED TO THIS EVENT?			
ACTION PLAN			
REMEDIAL ACTIONS - WHAT HAS AND OR SHOULD BE DONE TO CONTROL EACH OF THE CAUSES LISTED?			
ACTION	PERSON RESPONSIBLE	TARGET DATE	COMPLETION DATE
PERSONS PERFORMING INVESTIGATION			
INVESTIGATOR'S NAME: (PRINT)	SIGN:	DATE:	
INVESTIGATOR'S NAME: (PRINT)	SIGN:	DATE:	
INVESTIGATOR'S NAME: (PRINT)	SIGN:	DATE:	
MANAGEMENT REVIEW			
PROJECT MANAGER: (PRINT)	SIGN:	DATE:	
COMMENTS:			
H&S MANAGER: (PRINT)	SIGN:	DATE:	
COMMENTS:			

EXAMPLES OF IMMEDIATE CAUSES

Substandard Actions

1. Operating equipment without authority
2. Failure to warn
3. Failure to secure
4. Operating at improper speed
5. Making safety devices inoperable
6. Removing safety devices
7. Using defective equipment
8. Failure to use PPE properly
9. Improper loading
10. Improper placement
11. Improper lifting
12. Improper position for task
13. Servicing equipment in operation
14. Under influence of alcohol/drugs
15. Horseplay

Substandard Conditions

1. Guards or barriers
2. Protective equipment
3. Tools, equipment, or materials
4. Congestion
5. Warning system
6. Fire and explosion hazards
7. Poor housekeeping
8. Noise exposure
9. Exposure to hazardous materials
10. Extreme temperature exposure
11. Illumination
12. Ventilation
13. Visibility

EXAMPLES OF BASIC CAUSES

Personal Factors

1. Capability
2. Knowledge
3. Skill
4. Stress
5. Motivation
6. Work Standards
7. Wear and tear
8. Abuse or misuse

Job Factors

1. Supervision
2. Engineering
3. Purchasing
4. Maintenance
5. Tools/equipment

MANAGEMENT PROGRAMS FOR CONTROL OF INCIDENTS

1. Leadership and administration
2. Management training
3. Planned inspections
4. Task analysis and procedures
5. Task observation
6. Emergency preparedness
7. Organizational rules
8. Accident/incident analysis
9. Personal protective equipment
10. Health control
11. Program audits
12. Engineering controls
13. Personal communications
14. Group meetings
15. General promotion
16. Hiring and placement
17. Purchasing controls

Appendix H
Daily Briefing Sign-In Sheet

DAILY BRIEFING SIGN-IN SHEET

Date: _____ Project Name/Location: _____

Person Conducting Briefing: _____

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

_____

_____

_____

2. OTHER ISSUES (HASP/EAP changes, attendee comments, etc.)

_____

_____

_____

3. ATTENDEES (Print Name):

1.	21.
2.	22.
3.	23.
4.	24.
5.	25.
6.	26.
7.	27.
8.	28.
9.	29.
10.	30.
11.	31.
12.	32.
13.	33.
14.	34.
15.	35.
16.	36.
17.	37.
18.	38.
19.	39.
20.	40.

APPENDIX D – SITE WIDE INSPECTION FORM

74 Wallabout Street, Brooklyn , NY
Site Wide Inspection Form-Institutional and Engineering Controls

Date	
Time	
Weather	
Inspector	
Is this inspection being completed after a natural disaster or unforseen failure?	Yes ☐ No ☐

1. General Site Conditions

2. Basement Foundation Inspection (check for cracks, leaks)

3. Ground Cover Distrubance (including landscaping, gardening, etc.)

4. Visible trenches or excavation work

5. Changes from previous inspection

6. Additional Notes