Remedial Investigation Work Plan

Hornell Waste Site at Shawmut Yards
New York State Department of Environmental Conservation
Brownfield Cleanup Program
Site #C851027

Prepared for:

Hornell Site Development LLC
PO Box 356
Hornell, New York 14843

Prepared by:

Leader Professional Services, Inc.
271 Marsh Road, Suite 2
Pittsford, New York 14534

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856.001

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1.0 INTRODUCTION

The remedial investigation project is being completed in partial fulfillment of the Brownfield Site Cleanup Agreement (Index # B8-0711-05-12) between Hornell Site Development LLC and the New York State Department of Environmental Conservation ("NYSDEC"). This Work Plan has been prepared for the property located at Shawmut Yards, which is situated west of Seneca Street and encompassing real property having County of Steuben Tax Identification Numbers ("Tax Id. No.") 151.10-01-064.00 and 151.10-01-069.1. All properties are located in the City of Hornell, County of Steuben.

Leader Professional Services, Inc. ("Leader") has prepared this Work Plan to document the scope of work, procedures, goals and reporting responsibilities of this project.

2.0 BACKGROUND

2.1 Property Location

The property is located at Shawmut Yards in the City of Hornell, Steuben County, and was once composed of four parcels, but a recent consolidation of the parcels has occurred rendering the property in question with two tax parcels: 151.10-01-064.00 and 151.10-01-069.1. The property being investigated (hereafter is referred to as the "Site") is located within the area shown on Figure 1. To the north, the Site is bounded by the flood control structure paralleling the Canisteo River. To the west the Site is bounded by West Genesee Street. To the east the Site is bounded by commercial property and a former trailer park located along Seneca Street. A small portion of the Site fronts onto Seneca Street where the Site's access driveway is located. To the south there are residential homes on the north side of Adsit Street and on the south side there are athletic fields which are a part of the City of Hornell High School.

The Site area consists of approximately 16.8 acres and the property is zoned as I-2 (Heavy Industrial). To the south and east the offsite property is zoned for B-1 (Local Business) and B-2 (General Business). To the west the property is zoned for I-2 and B-1. To the north there is the flood control structure which is the property of the United States, Canisteo River, and business and residentially zoned properties are located further north of the river.

2.2 Site Description

The Site topographically is relatively flat and open. Trees and brush form a buffer between residential areas to the south and west, while to the east a tree and brush covered earthen berm separates the trailer park and commercial areas from the Site. Open areas of the Site were once used by Hornell Waste Materials Company, Incorporated ("Hornell Waste") for building space, processing metals and scrap metal storage. A gravel road provides access to the Site from Seneca Street.

The Site does not have any structures with the exception of several utility poles and concrete slabs from the former Hornell Waste buildings.

The Site has been used commercially since at least 1915 when the Site was a dairy and for railroad functions. It is unknown what natural features were present in the early 1900s, for example wetlands or drainage pathways. The Canisteo River once cut through the property, but was rerouted to the north sometime before 1938. The new land allowed for the expansion of outdoor operations and buildings. Since the time of rerouting the River, flood control levees and a four-lane road were built to the north and west of the Site. These changes also stopped drainage pathways from leaving the Site forcing any runoff to be absorbed into the Site soils.

The changes made to the Site in the 1930's with the re-routing of the Canisteo River have intuitively resulted in fill being placed into the old river bed and probably elsewhere on the property. The investigation of Site will attempt to characterize the interplay of the fill, the undisturbed soils, and groundwater. The USGS has mapped the surficial aquifer ("Geohydrology of the Surficial Aquifer in the Hornell Area in Steuben and Allegany Counties, 1988 by Miller, Warren and McPherson") and their maps suggest the surface and subsurface soils should consist of alluvium (stream deposits of silt, sand and gravel) to an estimated depth of 12 feet below the ground surface and overlying glacial outwash (consisting of predominately sand and gravel deposits). The glacial outwash is mapped by USGS to overly, at a depth of approximately 46 feet below the ground surface, a lacustrine series of fine sediment. The regional groundwater flow is expected to be to the south; however, the Canisteo River maybe a groundwater discharge point for the Site.

2.3 Site History

The Site has been an active industrial/commercial property since approximately 1915. Sanborn maps of the Site area support all of the following findings and are included as Appendix 1. In 1915, the Site was primarily used for railroad operations and a dairy. Railroad uses included a railroad spur, rail yard with aboveground tanks and maintenance facilities. The railroad spur entered the Site from the west and continued to the east where it serviced off-site businesses. At this same time, the Hornell Sanitary Dairy Company also occupied the property. Between 1926 and 1948, the Site was used as a bulk oil terminal by the Mahaffey Brothers Oil Corporation and later Atlantic Refining Company. A gasoline station operated off-site along Seneca Street, which may have been affiliated with the terminal. In this same time period, a refrigerated warehouse and potato storage building also occupied the property.

In 1948, the main use of the property was the operation of a metals processing facility. In 1952, Hornell Waste began its operation and the operation has been unchanged since.

2.4 Previous Environmental Investigations

A Phase I Environmental Site Assessment ("ESA") and a Phase II Environmental Site Investigation ("Phase II") was completed on the property in 2005. The Phase I ESA identified current operations on the property as a recognized environmental condition ("REC"), as well as the Site's past history where the railroad operations and bulk petroleum terminal raised concerns as well. The off-site gasoline service stations, both past and present, were also identified as RECs.

The Phase II investigation, including sampling surface and subsurface soils and installing and sampling of groundwater monitoring wells, found that chemicals of concern had impacted areas of the Site. The impact appears to be related to the past and current operations of the metal scrap yard, since areas that were sampled related to the former bulk petroleum storage area did not yield any significant impacts nor did there appear to be impacts from former or existing off-site sources of contamination, such as the gas stations. A copy of the Phase II report is provided in Appendix 2.

Eight soil samples and four groundwater samples were collected and analyzed for chemicals of concern. Table 1 (see Appendix 2) provides a summary of the soil sample results and Table 2 (see Appendix 2) provides a summary of the groundwater sample results. Only Benzene was found in the groundwater at a concentration of 0.926 micrograms per Liter ("µg/L"), in monitoring well W-7. The NYSDEC's groundwater quality standard for Benzene is 0.7 µg/L.

Review of Table 1 (Appendix 2) indicates that the results of one surface soil had exceedances of NYSDEC Part 375 Soil Cleanup Objectives ("SCOs") for Residential Property for the Protection of Public Health: PCBs, Arsenic, Barium, Cadmium, Chromium, Lead, and Mercury.

3.0 SCOPE OF WORK

The goals of the fieldwork are to characterize the Site's hydrology and geology, determine environmental chemical impacts to the Site and determine the extent of on-site contamination. Environmental media to be sampled during the field investigation will include: surface and subsurface soils, groundwater, and soil vapor. At this time there does not appear to be a pathway for contaminants to enter off-site drainage that might affect sediment and surface water. Based on the findings of the investigation, additional focused investigation phases may be required to define the limits of any identified impacts. In addition to sampling and analysis, the Site and all sampling locations will be surveyed to determine ground surface elevation and each location's northing and easting relative to the New York State Planimetric Coordinate System.

The Scope of Work is presented as a phased approach to accomplish three objectives:

1. To collect sufficient data to characterize the Site and identify areas which might be remediated first to support further remediation and development.

2. To minimize cost and spend financial resources wisely with the potential to start remediation as early as possible, either as an interim remedial measure ("IRM") or final remedial alternative (solution).

3. As deemed possible to defer extensive subsurface sampling to a point in time where it might be used to design a remedial alternative or confirm the remedial alternative has met the soil or groundwater cleanup objectives suitable for the proposed future use of the Site.

The discussion below identifies project phases and tasks which will be used during the completion of this project. The different tasks involved with the field investigation are discussed below.

3.1 Phase I Surface Soil and Groundwater Investigation

Phase 1 involves collecting sample data to begin characterizing the Site and identifying the type of contamination present (volatile organics, metals, PCBs, etc.) and to begin characterizing the surface soil conditions. Phase I will also investigate groundwater conditions, specifically depth, direction of groundwater flow, and the type of contaminants present.

Tasks to be completed during Phase 1 include:

3.1.1 Task 1: Property and Land Survey

A property line and topographic survey of the Site and surrounding area will be completed so a usable drawing can be made to illustrate the bounds of the Site. It will also provide the locations of important features and sampling locations. The topographic survey will be completed to determine the relative changes in the ground surface elevation across the Site and the elevation of existing floor slabs, pits and utilities. The topographic map will be drawn using two-foot contours, because the Site ground surface is flat. Once monitoring wells and soil vapor sampling points have been constructed, and samples (of all media) have been collected, and the ground surface elevations and northing and easting locations will surveyed so they can be added to a drawing of the Site.

Ground surface elevations and northings and eastings will be calculated using New York State's Planimetric Coordinate System.

3.1.2 Task 2: Surface Soil Investigation

The surface soil investigation will have two goals: identification of contaminants in the surface soils of the Site and to evaluate the potential for the contamination to impact the future use of the property and impact on and off-site receptors. Figure 2 shows the proposed sampling locations. Surface soil samples will be collected from the interval of 0 to approximately 2 inches below the surface. Sixteen surface soil samples will be collected during this task. Sample results will be compared to the Title 6 of New York State Codes, Rules and Regulations Part 375, SCOs residential property for the protection of public health.

Surface soil samples will be analyzed for Target Compound List ("TCL") semivolatile organic compounds ("SVOCs"), Target Analyte List ("TAL") metals including cyanide, Pesticides and Herbicides, and PCBs.

Sample locations were selected based the past use of the Site (scrap metal processing, material storage areas, etc.) and the proximity of residential areas adjacent to the Site.

During the collection of surface soil samples, an evaluation of the ground surface will be completed using three evaluation techniques: visual assessment, organic vapor analysis using a photoionization detector (“PID”) and flame ionization detector (“FID”) screening, and chemical analysis. If the soil in any of the locations contains visual pieces of metal, wood or plastic, that material will be excluded from analysis. If the soil is stained, emits volatile organic compounds (“VOCs”) that can be measured by the FID/PID or has noticeable odors these characteristics will be noted in the field notes and used in the Remedial Investigation Report.

3.1.3 Task 3: Subsurface Soil Investigation

The subsurface soil sampling will take place during Phase I only as a complement to the hydrogeologic investigation. Samples will be collected during the drilling of monitoring wells from the ground surface to a point below the water table where the monitoring well screen will be placed.

Samples will be used to attempt to describe the shallow geology and hydrogeology of the Site and to evaluate soil intervals for impacts from past and current operations. Targeted areas for soil sampling and monitoring well construction are identified on Figure 2. The depth of sampling and drilling of these boreholes will be based on achieving project goals: to define the shallow groundwater zone. During Phase I the soil borings will be drilled to at least a depth of 20-feet below the ground surface. But in the event that fill is present, groundwater is not encountered, or a confining layer has not been identified, then drilling will continue but the collection of soil samples will be altered as follows:

1. Soil samples will be collected continuously to the top of the groundwater zone, to the bottom of any fill or a depth of 20 feet whichever is deeper.

2. If groundwater is encountered and the soil boring is at a depth 20-feet, sampling will continue until at least 8-feet of groundwater zone has been sampled.

3. If stained material found or contaminated material is believed to be present because of PID/FID readings, but 8-feet of saturated soil has been identified, sampling will continue until the lower boundary of stained or contaminated material has been defined.

Soil samples will be collected using hollow stem auger drilling equipment mounted on a truck or all-terrain vehicle. Later phases where subsurface soil sampling is required may also rely on test pits. Generally, the same procedures will be used for characterization of the sample, field screening and determining when a sample will be collected for chemical analysis. At least one soil sample will be collected from each soil boring.

When a sample is retrieved, it will be screened with the PID/FID, and visually described. Portions of the sample that are of interest will be retained for additional headspace screening and possible chemical analysis. If the soil is stained, gives off VOCs that can be measured by the PID/FID or noticeable odors, the sample will be kept for possible analysis. Samples will be analyzed for TCL VOCs, TCL SVOCs, Pesticides and Herbicides, TAL metals including cyanide, and PCBs.

In the event that stains or Non-Aqueous Phase Liquids (“NAPL”) are found additional test pits or soil borings will be completed to define the stain or the NAPL.

After the excavation of the test pit or soil boring and samples have been placed in the appropriate contains and sample cooler, the location will be staked for locating purposes.

3.1.4 Task 4: Groundwater Investigation

The goal of the groundwater investigation is to identify the depth of the water table and to characterize the quality of the shallow zone. Based on USGS’ regional mapping for the surficial aquifer around Hornell the bottom of the aquifer may be at depths greater than 50 feet. Consequently, there may be different flow regimes which may come into play. The Canisteo River is assumed to play a significant role in the hydrogeology of the area by receiving discharge from the shallowest portions of groundwater zone. The Phase I groundwater investigation will therefore address the shallow groundwater zone.

The groundwater investigation will entail the installation and sampling of monitoring wells screened within the shallow groundwater zone. Six 2-inch monitoring wells are planned and the proposed locations are shown on Figure 2. The monitoring wells will be installed using hollow stem drilling equipment. The subsurface soil will be sampled continuously from the ground surface to point at least 8-feet below the water table where a monitoring well screen might be placed. If soil conditions are such that undisturbed silts or clay are present and no identifiable groundwater zone has been encountered, then the borehole will be advanced and sampled as identified in Section 3.1.3.

When a sample is retrieved, it will be screened with the PID/FID and visually described. Portions of the sample that are of interest will be retained for additional headspace screening and possible chemical analysis. If the soil is stained, gives off VOCs that can be measured by the PID/FID or noticeable odors, the sample will be kept for possible analysis. The sample with the highest of the headspace VOCs will be selected for analysis. Six subsurface soil samples will be collected during Phase I. In the event that stains or NAPL is found, additional soil borings and samples will be completed to define the stain or the NAPL

The monitoring wells will be constructed from 2 inch diameter PVC and use a 10 feet slotted monitoring well screen. The screen will be placed so it straddles the top of the water table (at least 2-feet above the static water level as interpreted by soil samples). The total depth of the monitoring wells will be limited to a depth of 20-feet unless 8-feet of saturated soil is not encountered then the monitoring wells will be set accordingly.

Once the monitoring well has been constructed and the protective casing placed, the monitoring well screen will be developed to remove sediment until a clear groundwater sample can be obtained. In addition, the monitoring well location will be surveyed and the casing elevation calculated. Within two weeks of completion of the monitoring well installation, each monitoring well will be sampled.

Sampling will involve the collection of field parameters as well as samples for chemical analysis. Field parameters will include: turbidity, oxidation reduction potential, dissolved oxygen, pH, temperature, and conductivity. Turbidity will be collected as the monitoring wells are purged. It will be the only parameter measured until a turbidity value is sustained at 50 nephelometric unit or below. When this value is reached the groundwater discharge will be directed to a flow through cell for the measurement of the remaining field parameters. These values will be measured at 10 minute intervals until they stabilized (20% of the preceding three values).

3.1.5 Task 5: Interim Report

Following review of the sample data, an interim report will be prepared for NYSDEC review. The report will provide summarized data tables and a summary of the findings, and a conceptual model for the Site's conditions. All sample locations will be identified on a figure. The report will also provide Hornell Site Development the opportunity to modify Phase II and more fully characterize on portion of the Site prior to completing the others.

3.2 Phase II - Additional Characterization

Phase 2 activities will be completed at the locations shown on Figure 3 and 4, and are subject to change based on the sampling conducted during Phase 1. Figure 4 shows proposed sampling locations for property owned by Hornell Site Development, but is not part of the BCP. Sampling will be conducted on this property as time permits to determine if hazardous substances have been disposed of in the past. At one time this parcel was connected via property taken for the construction of Route 21.

3.2.1 Task 1: Surface Soil Sampling

The results of the surface soil sampling will identify where additional samples are needed to define the extent of contamination such as defining hotspot limits. Since the locations of these samples could change significantly after the Phase I sample results are reviewed, the locations shown on Figure 3 should be viewed a preliminary proposal. Please note many of the surface sample locations are co-located with subsurface sampling locations. Surface soil samples will be collected using the same procedures identified in Task 2 of Phase I.

Surface soil samples will be analyzed for TCL SVOCs, TAL metals including cyanide, Pesticides and Herbicides, and PCBs.

3.2.2 Task 2: Subsurface Soil Sampling

Subsurface sampling will be completed during Phase II using test pits so a wider view of the overburden can be seen to assist in potentially defining the limits of fill or undisturbed natural materials and to assist in sample collection. There may also be a need for the completion of soil borings to sample below concrete slabs or if soil conditions are not suitable for test pitting; for example, collapsing pit walls.

Ten subsurface soil samples are planned for analysis using the following methods: TCL VOCs, SVOCs, TAL metals including cyanide, Pesticides and Herbicides, and PCBs. The 10 samples should be considered a minimum number of samples to be analyzed in the laboratory. The goal is sample when needed to characterize the conditions; differing waste types and waste characteristics. If surface soil samples and groundwater samples find a noticeable absence of a class of chemicals, Hornell Site Development may request a change in the Interim Report.

3.2.2.1 Test Pit Investigation

Test Pits will be excavated to evaluate the soil conditions from the ground surface to a depth of at least eight feet or the depth of the water table. During the excavation process, the exposed soil layers will be screened using PID and FID instruments. Written notes and photographs will be taken to describe the conditions found. Samples will be collected from the intervals based on the presence of stains, the presence of elevated measurements on the PID/FID, or Non-Aqueous Phase Liquids (“NAPL”). When a sample is retrieved a portion of the sample that is of interest will be retained for additional headspace screening and possible chemical analysis. If the soil is stained, gives off VOCs that can be measured by the PID/FID or give off other noticeable odors, the sample will be kept for possible analysis. The samples with the highest of the headspace VOCs will be selected for analysis. If stains or NAPL are found, additional test pits will be completed to define the extent of the stain or NAPL.

3.3.2.2 Soil Borings

Soil samples will be collected from the borings continuously from the ground surface to the water table. When a sample is retrieved, it will be screened with the PID/FID and visually described. Portions of the sample that are of interest will be retained for additional headspace screening and possible chemical analysis. If the soil is stained, gives off VOCs that can be measured by the PID/FID or noticeable odors, the samples will be kept for possible analysis. The sample with the highest of the headspace VOCs will be selected for analysis. In the event that stains or NAPL is found additional soil borings will be completed to define the stain or the NAPL

3.3.3 Task 3: Soil Vapor Investigation

The soil vapor investigation will locate sampling points to characterize the soil vapor constituents but also to determine if soil vapor is a potential threat to neighboring residential or commercial buildings. The proposed sample locations are shown in Figure 3.

Soil vapor sampling points will be installed using soil sampling procedures to a depth of approximately four feet below the ground surface. The sampling device will consist of a length PVC tubing (of the type used in potable water systems) surrounded by clean sand to a depth of approximately two feet below the ground surface. The remaining borehole will be filled with hydrated bentonite grout to the ground surface.

Following placement of the bentonite, the tubing will be evacuated using a low flow sampling pump or a PID with a filter attachment. The PID levels will be recorded. The tubing will then be capped until sampling.

When sampling is conducted the sample tubing will be resampled with a PID/FID and the measurements recorded. At this time the seal around the sample tubing will be tested to determine if the seal is stopping ambient air from leaking into the sample. Each sample location will be tested using a suitable gas and detector. The tubing will be connected to a Summa canister for sampling over a period of one hour. One sample location will be tested to determine if the bentonite seal is competent.

In addition to the soil vapor samples, one ambient air sample will be collected on the Site at a location which is upwind from the majority of the Site. The ambient air sample will be collected over the same one hour period which the soil vapor samples are collected.

Each sample location will be photographed and field notes collected recording air temperature, humidity, wind direction and velocity.

3.3.4 Task 4: Monitoring Well Testing

After the first round of sampling is completed and the Interim Report submitted three of the monitoring wells will be tested to determine an estimate of the groundwater zone's hydrologic conductivity. Prior to testing, the depth to groundwater will be measured so the elevation of the water table can be estimated and used to develop a contour map of the water table surface. The hydraulic conductivity testing will involve introducing a solid slug with a known volume into the well, allowing the water level to equilibrate, then rapidly pulling the slug out and measuring the rebound of the water elevation versus time.

3.3.5 Task 5: Final Report

The preparation of the final report is discussed in Section 6, if additional phases required to further characterize conditions for an IRM or remedial alternative, Hornell Site Development will communicate this desire to NYSDEC and potentially issue a Work Plan Amendment to address those sampling needs. Based on discussions with NYSDEC any further investigation may delay the final report or allow a second interim report to be prepared so all project stakeholders may share Phase 2 data or voice opinions on IRMs.

4.0 QUALITY ASSURANCE/QUALITY CONTROL PROTOCOLS

This section describes the protocols and procedures to be used for the collection, handling, analysis of samples and the documentation of standards of site activities. This section also provides the management of the project and the responsibilities of each person involved with the project. Leader's project Quality Assurance Project Plan is provided as Appendix A.

4.1 Project Management

NYSDEC Project Manager - Mr. Mathew Gillett, Division of Hazardous Waste Remediation, Region 8, located in Avon, New York (585) 226-2466. Mr. Gillett's responsibility is to manage the project and the NYSDEC personnel who are assigned to the project for technical review and oversight, and to ensure that all aspects of the Work Plan and remedial investigation are completed. Mr. Gillett will be notified prior to deviations from the protocols presented herein and if there has been a problem with the procedures or analyses because of Site-specific conditions.

Leader Professional Services, Inc. Principal-in-Charge - Mr. Michael Rumrill 271 Marsh Road, Suite 2, Pittsford, New York 14534 (585) 248-2413. Mr. Rumrill's responsibility is for overall quality control and to ensure that adequate resources are dedicated to this project.

Leader Professional Services, Inc. Project Quality Assurance Officer - Mr. Peter von Schondorf, 271 Marsh Road, Suite 2, Pittsford, New York 14534 (585) 248-2413. Mr. von Schondorf's responsibility is to ensure that the Work Plan is adhered to and to enforce any corrective actions needed. Mr. von Schondorf will be notified by Leader's Site Manager or by the analytical laboratory of any field problems with implementing the procedures or analyses because of Site-specific conditions, or deviations from the protocols presented herein or if there has been a problem

Leader Professional Services, Inc. Site Manager – Luke Spencer,. 271 Marsh Road, Suite 2, Pittsford, New York 14534, (585) 248-2413. Mr. Spencer's responsibility is to manage the remedial investigation and to ensure that aspects of the project are completed in accordance with the Work Plan.

4.2 Procedures for the Collection of Samples

Four types of samples will be collected during the course of the remedial investigation: soil vapor samples, headspace samples, soil samples and groundwater samples. Soil samples will be collected with two different types of equipment; Geoprobe sampling tools and, or split spoon samplers. Each tool has slight differences in their use, but the handling of the sample is relatively the same. Procedures for the collection of soil vapor samples, soil samples and groundwater samples are provided in Appendix A.

4.3 Analytical Requirements

An ELAP laboratory will be used to analyze all samples. Each sample will be analyzed for at least one of the following chemical groups: VOCs plus 10 tentatively identified compounds ("TIC"), SVOCs, TAL metals including cyanide, Pesticides and Herbicides, and PCBs. In general, all soil and groundwater samples will be analyzed using ASP methods. All results will prepared with Category B deliverables. Table 1 provides a list of analyses for each media.

4.4 Quality Assurance Samples

Quality assurance samples will be collected and analyzed as a part of the project to determine if cross contamination is problematic, to verify laboratory results (consistency between samples), to evaluate homogeneity of the sample, and to evaluate if the sample matrix is causing interference with the analytical methods. To accomplish these goals, four types of quality assurance samples will be collected: trip blanks, sample tool rinse samples, duplicates, and matrix spike samples and matrix spike duplicates. Table 2 provides a list of the samples, analyses and the frequency of the sample collection.

Trip blanks are samples composed of distilled and deionized water, which have been placed into 40-milliliter vials used for the analysis of VOCs. These samples have been historically analyzed for VOCs, because volatile organic vapors can migrate into samples. One trip blank sample will be placed into one of the sample shipment coolers with each shipment to the analytical laboratory.

Sample tool rinse samples are samples composed of distilled and deionized water poured over a clean sampling tool. The sample is analyzed for all parameters the normal sample is analyzed for to evaluate the decontamination procedures and their impact on the samples. One rinse sample will be collected with each tool used for sampling.

Duplicate samples are samples collected by physically splitting the sample into equal portions or collecting a portion from the sample in a sampling device (groundwater bailer for example). These samples are collected to evaluate the homogeneity of the sample and the consistency or reproducibility of the analytical procedures.

Matrix and Matrix spike duplicates are duplicate samples collected and prepared in the field and submitted to the laboratory. The laboratory then introduces a chemical spike into the samples to determine how the spike reacts with the sample media and the consistency of the analysis.

In general, split samples, duplicates, and matrix spike samples will be collected and analyzed at a frequency of one sample per ten samples analyzed.

5.0 HEALTH AND SAFETY

Leader has developed a site specific Health and Safety Plan (“HASP”) in general accordance with 29 CRF 1910.120 and using Leader's experience with similar investigation activities. Attachment B provides a copy of the HASP. This plan will be implemented by the project’s health and safety coordinator (“H&SC”). The H&SC will provide and implement the health and safety procedures for all project employees and any subcontractors (“Team”) who may be working on the Site. Prior to beginning the field activities, field Team members are required to read and sign this HASP. All Site contractors will be responsible for their employee’s health and safety while on-Site.

The HASP has been developed to provide a mechanism for establishing safe working conditions during investigation activities at the Site. The safety organization, procedures, and protective equipment have been established based upon an analysis of potential hazards. Specific hazard control methodologies have been evaluated and selected with the goal of eliminating the potential of accident or injury. The content of the HASP may change based upon additional information made available to health and safety personnel, monitoring results, or changes in the technical scope of work. Changes to the HASP will be made by adding an addendum.

6.0 Community Air Monitoring Plan

In addition to having a HASP for the project there will also be a site specific Community Air Monitoring Plan (“CAMP). The CAMP will work in cooperation with the HASP to monitor air quality at the perimeter of the unique work areas (i.e. drilling location, test pit spot, etc.) to the perimeter of the exclusion and beyond. The goal of the CAMP is to protect air quality in areas where residents and passerby’s might be impacted. Attachment C provides a CAMP for the project.

7.0 REPORTING

Three written reports will be prepared for documenting the remedial investigation: monthly reports, data usability reports, data files for uploading into the NYSDEC’s EQUIS database, and the project final report.

7.1 Monthly Reports

Monthly reports will be prepared during the course of the remedial investigation and feasibility study so all parties are kept informed of the project’s progress.

7.2 Data Usability Report

The Data Usability Report will be prepared once the data is obtained to determine if there are any problems with the data. Data problems most likely stem from improper preservation, sample holding times have been exceeded, or analytical problems such as instrument calibration problems. These problems may cause some of the data to be unusable or qualified special notes for their use, requiring re-analyzed or re-collected for analysis. This report will be prepared before the remedial investigation report so the data is not misused.

7.3 EQUIS Database

All sample and borehole data will be put into a file format that is acceptable to upload the data into the NYSDEC’s EQUIS database.

7.4 Characterization Report and Remedial Alternatives Report

The characterization and remedial alternatives reports are final reports for the initial two phases of the project. The characterization report, in general, will discuss the findings of the investigation. But in addition to discussing the findings, the report also summarizes site history, the physical setting of the project and the surrounding area, and also the potential future use of the property. The report will also discuss the project's proposed fieldwork compared to the actual completed fieldwork and analyses. In the event significant changes have occurred, how these changes occurred and their impact to the project goals will be discussed.

The project's findings will be discussed in terms of the project setting, the site history, and the site's future use. During this discussion, the results will be compared to the applicable environmental quality standards, criteria, and guidance values to determine where potential contaminant source areas are located, the extent of contamination, and which exposure pathways are completed. The report will also include conclusions. All data will be presented in table format and on a drawing of the site using a usable scale such as one inch equals 40 feet or less.

The remedial alternatives report has two main purposes: to specifying the goals of the remedial program and to select a remedial alternative(s). The goal of the remedial program will be to restore the site to the extent possible and feasible, to eliminate or mitigate significant environmental and human health threats and to make the site suitable for the intended use. To accomplish these goals, a decision making process is used to develop remedial alternatives.

There are seven steps in the decision making process:

1. Establish remedial goals
2. Establish remedial action objectives
3. Identify response actions to address contaminants or contaminated media
4. Identify and screen technologies for each of the response actions
5. Assemble technologies in operable units or site wide alternatives
6. Analyze the alternatives pursuant to specific criteria:
    a. Overall protection of health and environment
    b. Compliance with standards, criteria and guidance
    c. Long term effectiveness and performance
    d. Reduction of toxicity, mobility, or volume
    e. Short-term effectiveness
    f. Implementability
    g. Cost
    h. Community Acceptance
7. Consider the potential for natural resource damage
8. Recommend a remedy

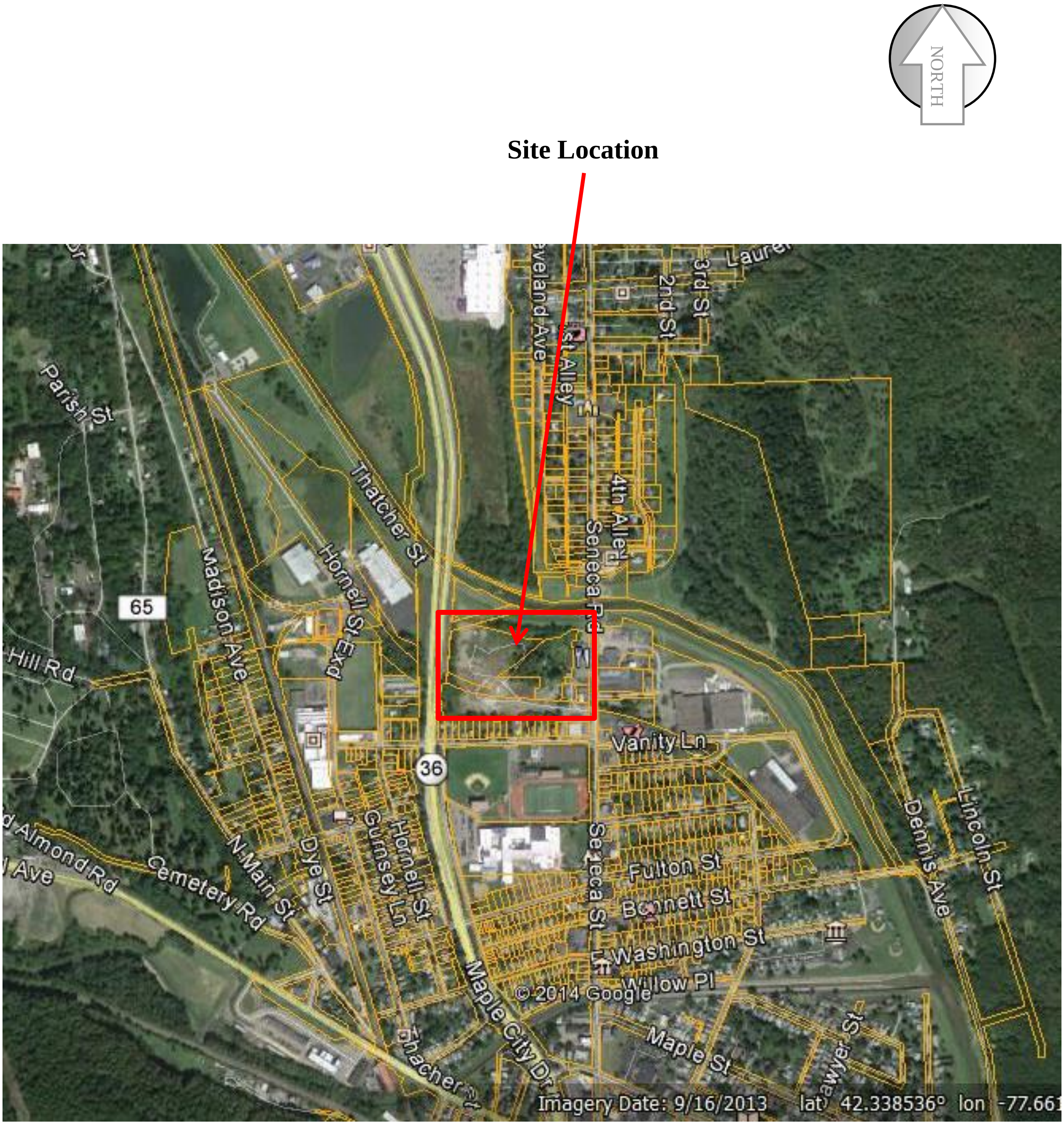
The remedial alternatives report will be presented with 7 main sections:

1. Executive summary
2. Purpose
3. Site description and history
4. Summary of remedial investigation and exposure/risk assessment
5. Remedial goals and remedial action objectives
6. Development and analysis of alternatives
7. Recommended remedy and why it was selected

The remedial alternatives report will be signed and stamped by a New York State licensed Professional Engineer employed by Leader.

8.0 SCHEDULE

Upon receiving approval of the Work Plan, Leader and Hornell Site Development will begin to schedule site activities. It is anticipated that this process will take approximately two weeks. Completion of the fieldwork is anticipated to take an additional two to three weeks. The remedial investigation report will be submitted to NYSDEC approximately three weeks after receipt of all analytical data.


Site Location

Title: Site Location Map
Hornell Waste Site – Site #C851027
Hornell, New York

Prepared For: Hornell Site Development LLC
PO Box 356
Hornell, New York

LEADER

Leader Professional Services, Inc
271 Marsh Road-Suite 2
Pittsford, New York 14534
(585) 248-2413
Fax (585) 248-2834

Project 856.001

Date November 3, 2014

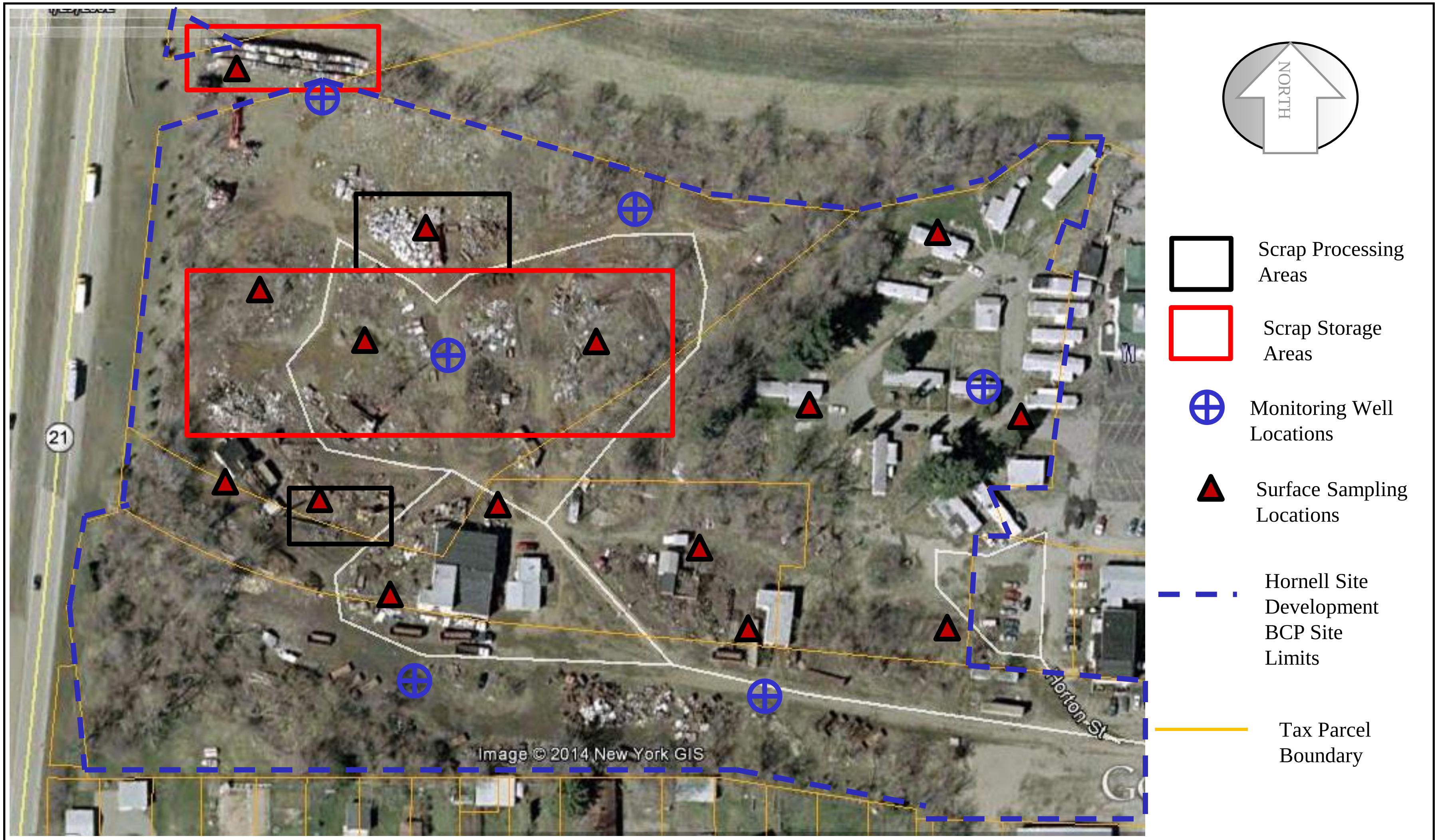
Scale NTS

Drawn PVS

Checked MPR

File Name Site Location

Figure 1

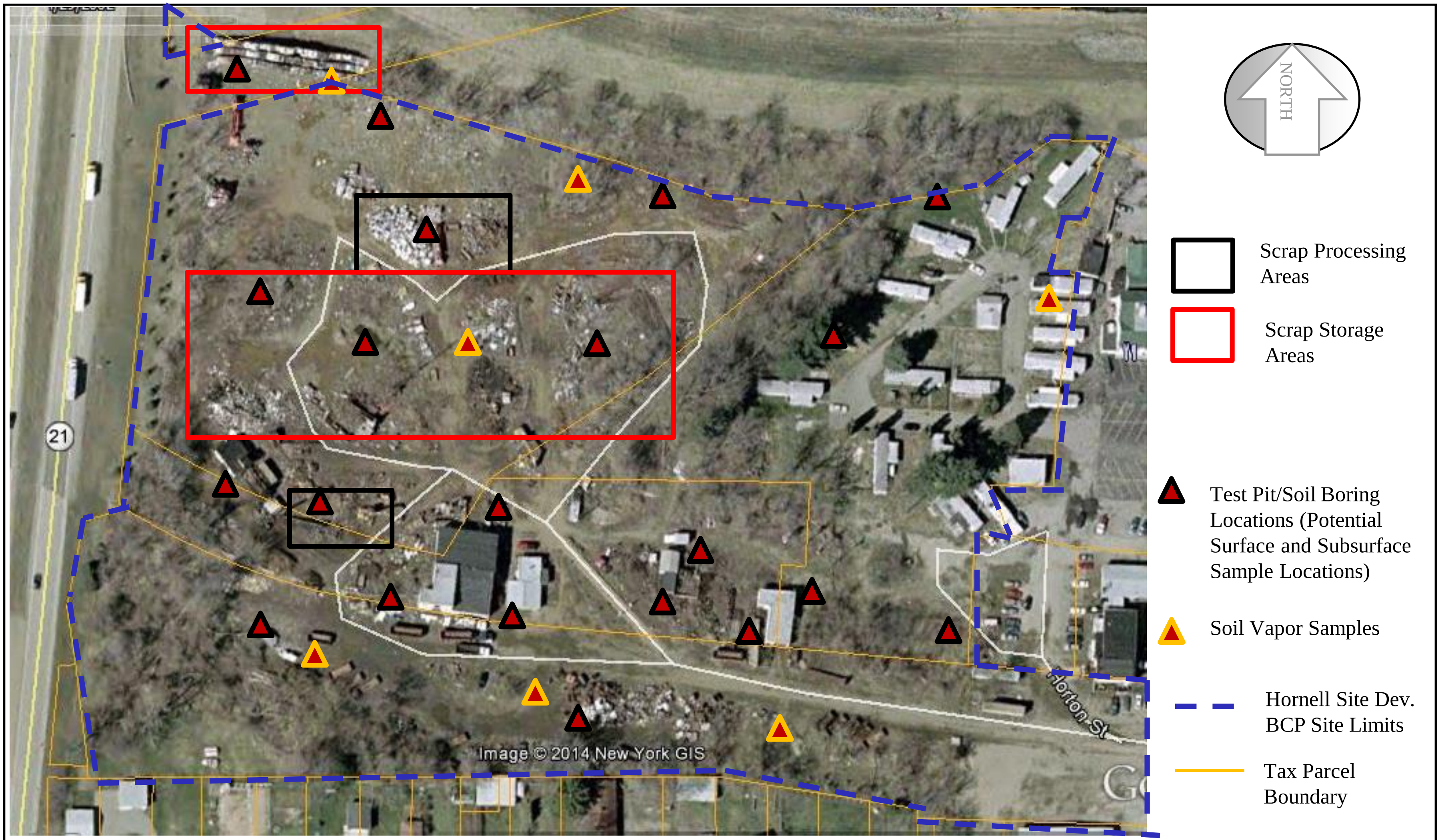


Title	Proposed Phase 1 Sampling Locations Hornell Site Development LLC Brownfield Cleanup Program Site C851027 Hornell, New York
Prepared For	Hornell Site Development LLC PO Box 356 Hornell, New York

LEADER

Leader Professional Services, Inc
271 Marsh Road-Suite 2
Pittsford, New York 14534
(585) 248-2413
FAX (585) 248-2834

Project	863.001
Date	October 13, 2014
Scale	Approx. 1” = 150’
Drawn	PVS
Checked	
File Name	Site Plan
Figure	2



Title
Proposed Phase 2 Sampling Locations
Hornell Site Development LLC
Brownfield Cleanup Program Site C851027
Hornell, New York

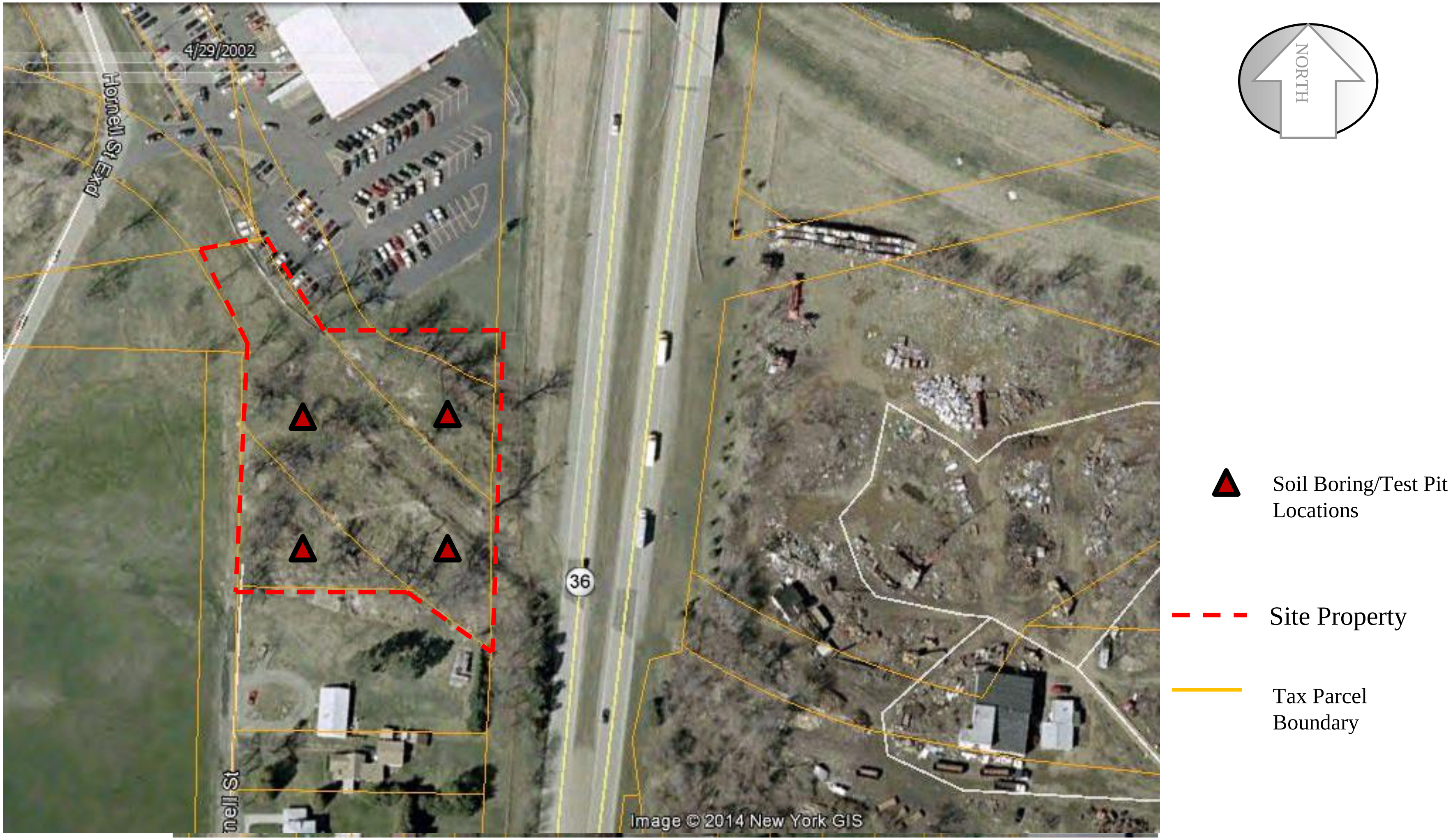
Prepared For
Hornell Site Development LLC
PO Box 356
Hornell, New York

LEADER
Leader Professional Services, Inc
271 Marsh Road-Suite 2
Pittsford, New York 14534
(585) 248-2413
FAX (585) 248-2834

Project 863.001
Date October 13, 2014
Scale Approx. 1" = 150'

Drawn PVS
Checked
File Name Site Plan

Figure 3



Title
Proposed Off-Site West Side Sampling Locations
Hornell Site Development LLC
Brownfield Cleanup Program Site C851027
Hornell, New York

Prepared For
Hornell Site Development LLC
PO Box 356
Hornell, New York

LEADER
Leader Professional Services, Inc
271 Marsh Road-Suite 2
Pittsford, New York 14534
(585) 248-2413
FAX (585) 248-2834

Project	863.001
Date	October 13, 2014
Scale	Approx. 1” = 170’
Drawn	PVS
Checked	
File Name	Site Plan
Figure	4

TABLE 1
Sample Analytical Requirements

	Headspace With FID/PID	VOC + 10 TICs (ASP-95-01)	VOC using TO-15	SVOCs (ASP –95-02)	Pesticides and Herbicides	TAL Metals (ASP for TAL Metals)	PCBs ASP 95-XX
Soil Vapor			√				
Soil	√	√		√	√	√	√
Groundwater		√		√	√	√	√

TABLE 2
Quality Assurance Samples

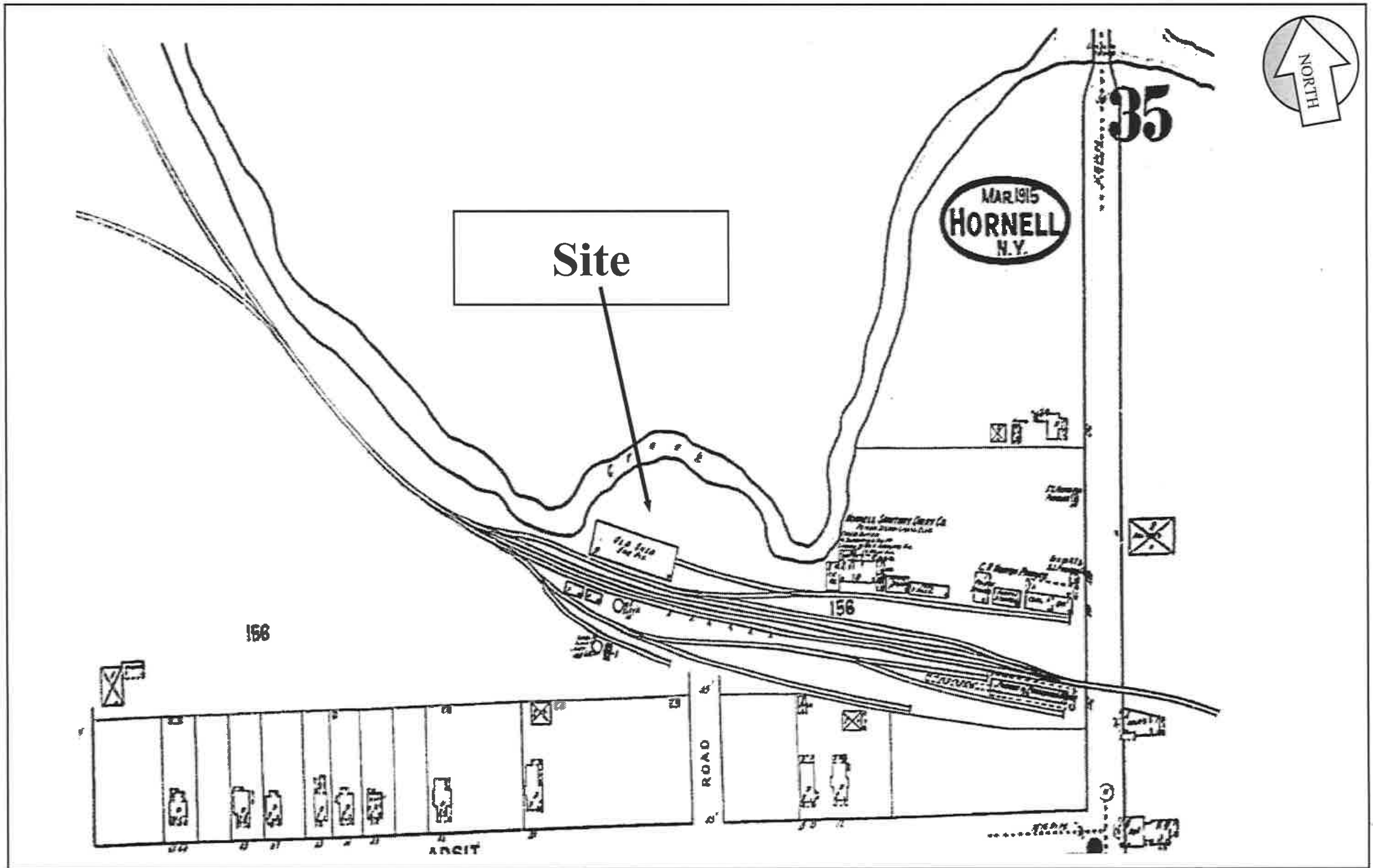
	Trip Blank[1]	**Equipment Rinse Samples**[2]	**Duplicates Samples**[2]	**Matrix Spike**[2]	**Matrix Spike Duplicates**[2]
Soil Vapor	N/A	N/A	N/A	N/A	N/A
Soil Samples	1 per sample shipment	1 per sampling tool	1:10	1:10	1:10
Groundwater Samples	1 per sample shipment	1 per sampling tool	1:10	1:10	1:10

N/A = not applicable

1. VOCs only.
2. All analyzed parameters.

APPENDIX 1

Sanborn Maps



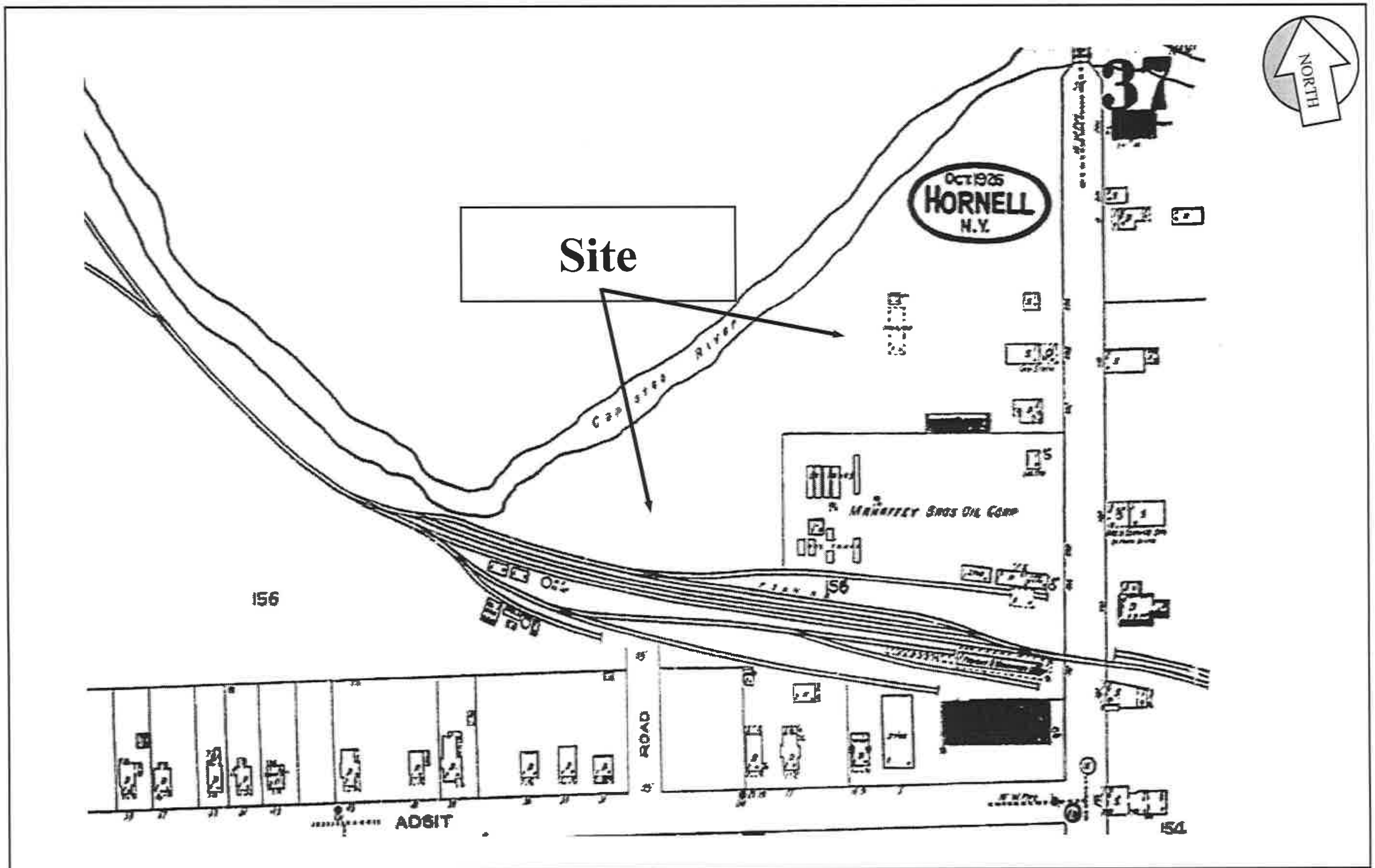
Title
1915 Sanborn Map
Scrap Metal Processing Property
Shawmut Yards, Seneca Street, Hornell, NY 14843

Prepared For
Hornell Waste Materials Company, Inc.
Shawmut Yards, Seneca Street
Hornell, NY 14843

LEADER
Leader Professional Services, Inc.
271 Marsh Road, Suite 2
Pittsford, NY 14534
(585) 248-2413
FAX (585) 248-2834

Project 490.001
Date 6/05
Scale NTS

Drawn PVS
Checked MPR
File Name 1915 Sanborn

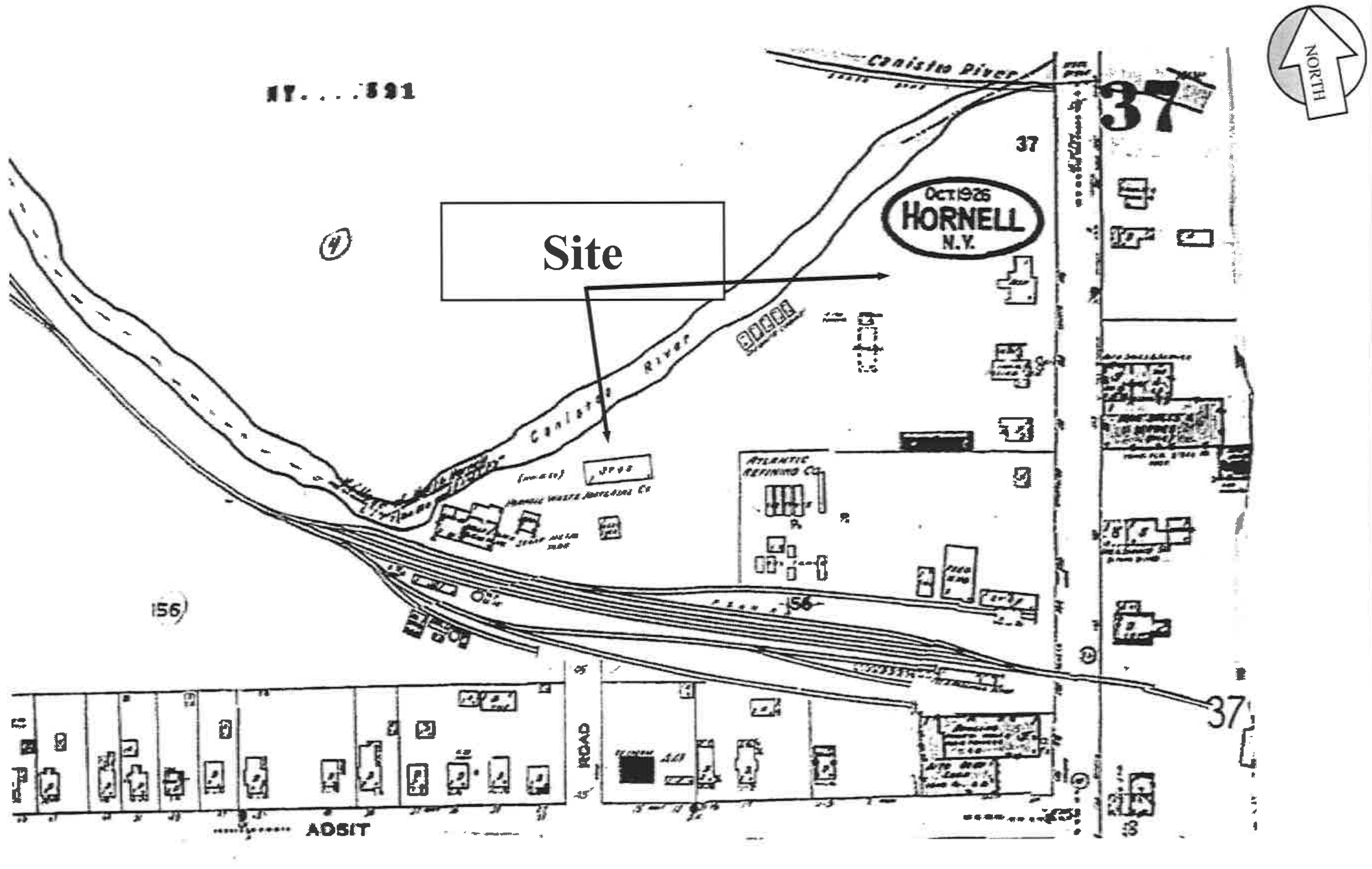


Title	1926 Sanborn Map Scrap Metal Processing Property Shawmut Yards, Seneca Street, Hornell, NY 14843
Prepared For	Hornell Waste Materials Company, Inc. Shawmut Yards, Seneca Street Hornell, NY 14843

LEADER
Leader Professional Services, Inc.
271 Marsh Road, Suite 2
Pittsford, NY 14534
(585) 248-2413
FAX (585) 248-2834

Project 490.001
Date 6/05
Scale NTS

Drawn PVS
Checked MPR
File Name 1926 Sanborn

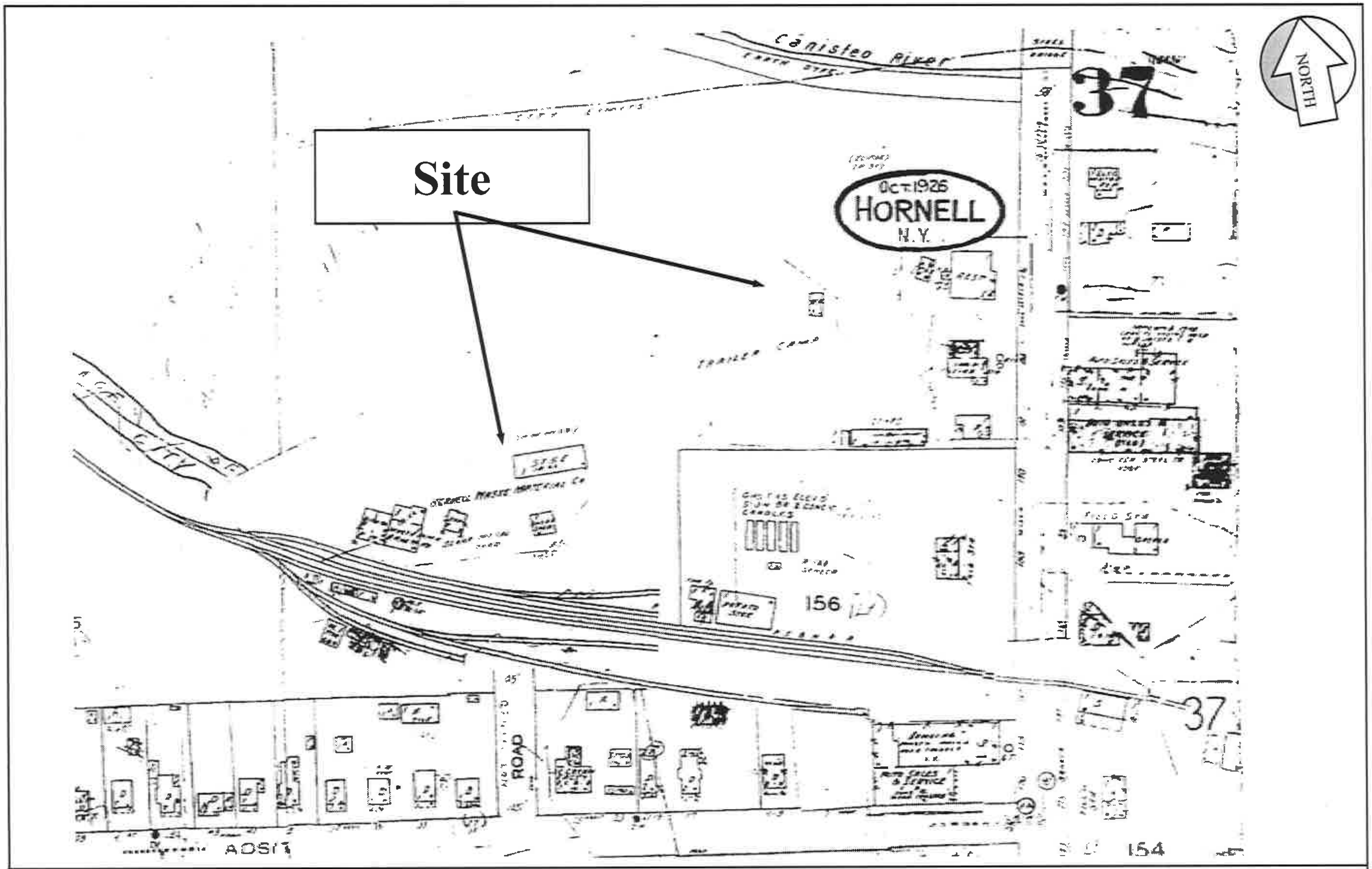


Title	1948 Sanborn Map Scrap Metal Processing Property Shawmut Yards, Seneca Street, Hornell, NY 14843
Prepared For	Hornell Waste Materials Company, Inc. Shawmut Yards, Seneca Street Hornell, NY 14843

LEADER
Leader Professional Services, Inc.
271 Marsh Road, Suite 2
Pittsford, NY 14534
(585) 248-2413
FAX (585) 248-2834

Project 490.001
Date 6/05
Scale NTS

Drawn PVS
Checked MPR
File Name 1948 Sanborn



Title	1961 Sanborn Map Scrap Metal Processing Property Shawmut Yards, Seneca Street, Hornell, NY 14843
Prepared For	Hornell Waste Materials Company, Inc. Shawmut Yards, Seneca Street Hornell, NY 14843

LEADER
Leader Professional Services, Inc.
271 Marsh Road, Suite 2
Pittsford, NY 14534
(585) 248-2413
FAX (585) 248-2834

Project	490.001
Date	6/05
Scale	NTS
Drawn	PVS
Checked	MPR
File Name	1961 Sanborn

APPENDIX 2

Phase II Investigation Report

490.003

September 23, 2005

Mr. Dan Spitulnik
Hornell Waste Materials Co., Inc.
PO Box 356
Hornell, NY 14843

Re: Limited Phase II Site Assessment Report
Hornell Waste Material Company, Inc.
Shawmut Yard, Hornell, New York

Dear Mr. Spitulnik:

Leader Professional Services, Inc. ("Leader") has completed the Limited Phase II Site Assessment and is hereby providing you with this report of our findings and conclusions.

PURPOSE

Leader's Phase I Environmental Site Assessment ("ESA") found that the use of the property as a scrap yard and metal recycling facility since the 1940's and its former use as a railroad yard, petroleum storage facility, and various other commercial and industrial activities, warranted a Phase II investigation be completed. In addition to these on-site concerns, several gasoline stations were located along Seneca Street and share the property line with the site. Based on the ESA's findings, a limited Phase II site investigation was conducted to sample surface soils, subsurface soils and groundwater.

Leader selected sampling locations based on site conditions and the review of Sanborn fire insurance maps in an effort to investigate areas of probable contamination. Samples of soil and groundwater were collected and analyzed for USEPA Target Compound List volatile organic compounds, NYSDEC's STARS listed semi-volatile organic compounds, RCRA heavy metals, and PCBs.

The goal of this project was to investigate areas of probable soil and groundwater contamination prior to moving forward with a proposed redevelopment of the property. Since not all areas of the property were investigated and not all types of contamination analyzed, additional future investigation is warranted.

FINDINGS

Eight soil borings were sampled using direct push sampling tools collecting continuous 4-foot samples to a depth ranging from 16 to 20 feet below the ground surface. Figure 1 shows where soil borings were completed and monitoring wells were installed. Groundwater monitoring wells were installed and sampled at four locations. Groundwater was encountered at a depth ranging from approximately 11 to 16 feet below ground surface. Each soil sample was screened with a portable organic vapor analyzer using a 10.6 electron volt photoionization detector ("PID"), which is capable of measure a wide range of organic chemicals. The soils were inspected for stains and classified into soil types.

In general, a layer of fill soil or soils impacted from years of industrial use overlays the area. These soil impacts include many pieces of metal and stone. The fill was characterized by the presence of stone, soil, or construction debris over the former topsoil surface (dark soils with plant matter). Below the fill and topsoil, silt and clay soils were found to a depth of approximately 8 to 12 feet where sand and gravel were encountered. During the soil sampling none of the samples were found to have measurable amounts of organic compounds using the PID. Soils found at boring location B-3, B-4 and B-5 had a slight organic odor. At sample location B-5, one sample at approximately 4 feet had a petroleum-like odor. Soil samples from borings B-3, B-4, and B-5, where odors were found, were also analyzed for volatile and semi-volatile organic compounds.

Eight soil samples and four groundwater samples were collected and analyzed for chemicals of concern. Table 1 provides a summary of the soil sample results and Table 2 provides a summary of the groundwater sample results. Only one compound was detected in one monitoring well. Benzene was found at a concentration of 0.926 micrograms per Liter ("µg/L") in monitoring well W-7, above the NYSDEC groundwater quality criteria of 0.7 µg/L.

Review of Table 1 indicates that there were several chemicals of concern identified at levels which exceed NYSDEC soil cleanup objectives, including Acetone, PCBs, Arsenic, Barium, Cadmium, Chromium, Lead, and Mercury. In general, Acetone was prevalent in the subsurface samples, but the other chemicals of concern were identified only in the surface soils. Since Acetone was found in every soil sample analyzed for volatile organic compounds and at a similar concentration, Acetone may be the result of laboratory contamination. PCBs were an exception, because only surface soil was analyzed for this compound.

Acetone was identified in each of the subsurface samples, but only in the samples from borehole B-3, B-4 and B-6 were the concentrations greater the NYSDEC's cleanup objective of 200 micrograms per kilogram ("µg/Kg") or parts per billion. Acetone concentrations which exceed NYSDEC's requirements range from 272 to 451 µg/Kg.

PCBs were found in only one of three samples taken, at sample location "Far East Surface Soil;" at a level of 3.79 milligrams per kilogram ("mg/Kg") or parts per million. The NYSDEC soil clean up objective is 1 mg/Kg for surface soils.

Heavy metals were found at concentrations which exceed NYSDEC's clean up objectives in four of five samples, and were found at higher concentrations in the surface soil compared to the subsurface soil samples.

Arsenic was found in two of five soil samples at levels which exceed NYSDEC's clean up objective of 7.5 mg/Kg. Both samples were surface soil samples and include: "West Surface Soil Sample" at a concentration of 20.5 mg/Kg and "East Surface Soil Sample" at a concentration of 26.9 mg/Kg.

Barium was found in two of five soil samples at levels which exceed NYSDEC's clean up objective of 300 mg/Kg. Both samples were surface soil samples and include: "East Surface Soil Sample" at a concentration of 334 mg/Kg and "West Surface Soil Sample" at a concentration of 554 mg/Kg.

Cadmium was found in three of five soil samples at levels which exceed NYSDEC's clean up objective of 1 mg/Kg. The samples include: B-5 (subsurface sample at a concentration of 1.09 mg/Kg, "East Surface Soil Sample" at a concentration of 15.1 mg/Kg and "West Surface Soil Sample" at a concentration of 27.4 mg/Kg.

Chromium was found in three of five soil samples at levels which exceed NYSDEC's clean up objective of 10 mg/Kg. The samples include: B-5 (subsurface sample) at a concentration of 29 mg/Kg, "East Surface Soil Sample" at a concentration of 115 mg/Kg and "West Surface Soil Sample" at a concentration of 248 mg/Kg.

Lead was found in two of five soil samples at levels which exceed NYSDEC's clean up objective of 500 mg/Kg. Both samples were surface soil samples and include: "East Surface Soil Sample" at a concentration of 1,160 mg/Kg and "West Surface Soil Sample" at a concentration of 1,190 mg/Kg.

Mercury was found in three of five soil samples at levels which exceed NYSDEC's clean up objective of 0.1 mg/Kg. The samples include: B-4 (subsurface sample) at a concentration of 0.1944 mg/Kg, "East Surface Soil Sample" at a concentration of 1.184 mg/Kg and "West Surface Soil Sample" at a concentration of 7.195 mg/Kg.

CONCLUSIONS

Certain areas of the property are impacted by chemicals of concern. The impact appears to be related to the past and current operations of the metal scrap yard, since areas that were sampled and related to the former bulk petroleum storage area did not yield any significant impacts, nor does there appear to be impacts from former or existing off-site sources of contamination, such as the gas stations.

However, minor amounts of petroleum contamination were found in soil sample B-5 and in groundwater sample W-4. The presence and concentration of Acetone may be the result of laboratory contamination.

The presence of PCBs in the surface soil represents a potential issue of concern. Although the PCBs appear to be restricted to the surface soil and at a relatively low concentration, the amount of data is limited and it is difficult to predict without further sampling.

Heavy metals appear to be restricted to the surface and near surface soils in the scrap yard. The presence of these metals was expected because of the property's former and current use.

In conclusion, significant impacts from the chemicals and metals of concern have been identified that require remediation. The levels of PCB, Barium, Cadmium, Chromium, Lead and Mercury in the surface and near surface soils will be simpler to remediate than deeper soil contamination or groundwater contamination. Additional investigation is warranted to define the extent of contamination of the petroleum contamination in the soil and groundwater, and the PCB and heavy metal contamination in the surface and near surface soils. While investigation work is being completed, areas of PCBs and heavy metals contamination should be evaluated to characterize the soil.

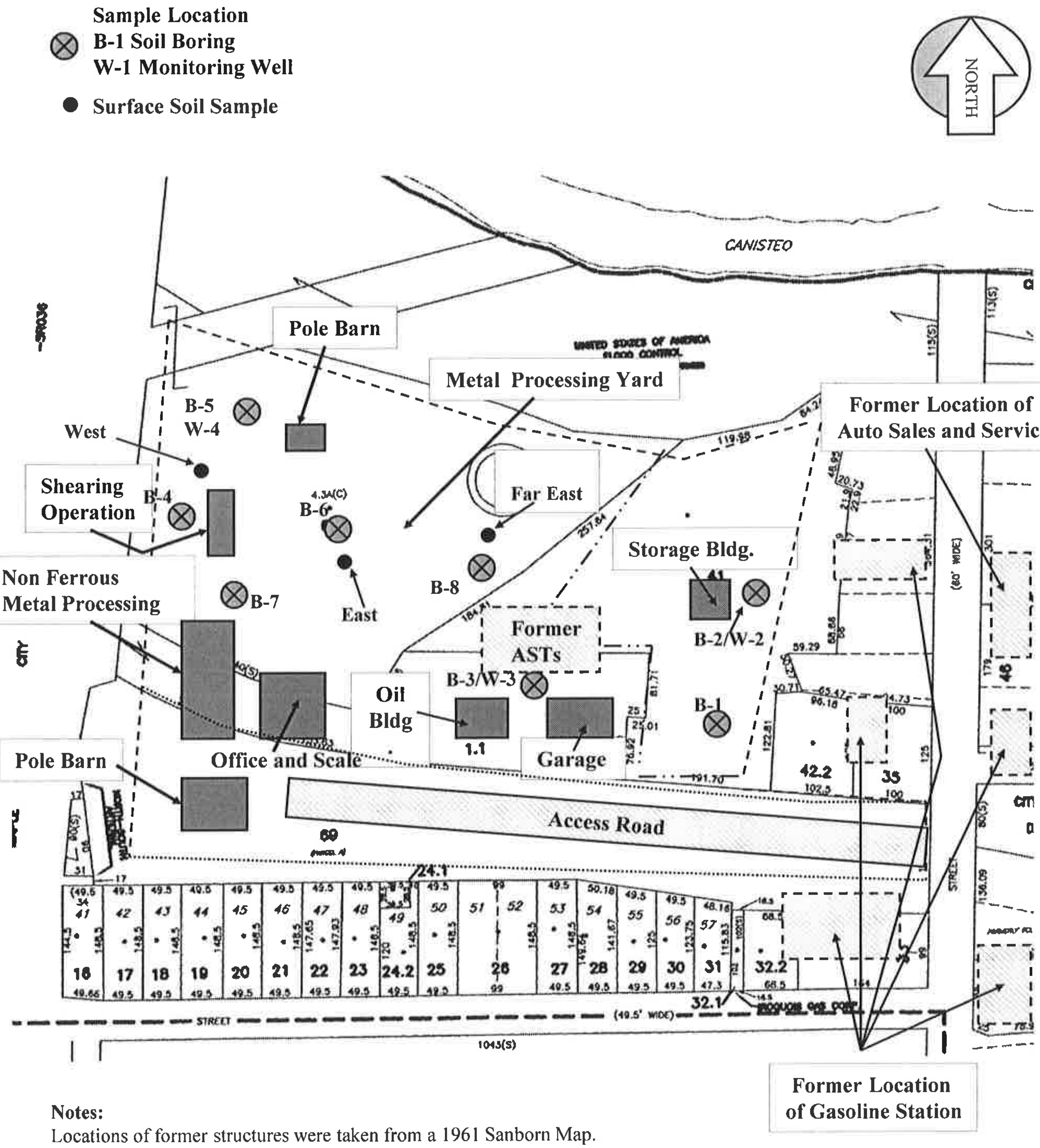
Please feel free to call us at (585) 248-2413 if you have any questions or comments.

Very truly yours,
LEADER PROFESSIONAL SERVICES, INC.

Peter von Schondorf
Senior Project Manager

Michael P. Rumrill
President

Enclosures as noted



Notes:
Locations of former structures were taken from a 1961 Sanborn Map.

Title	Approximate Soil and Groundwater Sample Locations Shawmut Yards, Seneca Street, Hornell, NY 14843
Prepared For	Hornell Waste Materials Company, Inc. Shawmut Yards, Seneca Street Hornell, NY 14843

LEADER
Leader Professional Services
271 Marsh Road-Suite 2
Pittsford, New York 14534
(585) 248-2413
FAX (585) 248-2834

Project 490.003	Drawn PVS	Figure
Date 9/05	Checked MPR	1
Scale (Approx.) NTS	File Name Site Plan	

TABLE 1

SUMMARY OF SOIL SAMPLE RESULTS

(Results are shown in concentration units specified by the compound)

	NYSDEC Soil Cleanup Objectives	B-3 4 to 8 ft	B-4 0 to 4 ft.	B-5 0 to 4 ft.	B-6 4 to 8 ft.	B-7 4 to 8 ft.	East Surface Soil	Far East Surface Soil	West Surface Soil
Acetone	**200 ppb**	361	272	132	451	183	NA	NA	NA
Ethylbenzene	**5,500 ppb**	ND	ND	30.0	ND	ND	NA	NA	NA
Toluene	**1,500 ppb**	ND	ND	11.4	ND	ND	NA	NA	NA
M,p-Xylene	**1,200* ppb**	ND	ND	88.2	ND	ND	NA	NA	NA
o-Xylene	**1,200* ppb**	ND	ND	26.5	ND	ND	NA	NA	NA
Carbon disulfide	**2,700 ppb**	ND	ND	ND	ND	135	NA	NA	NA
Fluoranthene	**50,000 ppb**	ND	360	ND	NA	NA	NA	NA	NA
Pyrene	**50,000 ppb**	ND	362	ND	NA	ND	NA	NA	NA
PCBs	**1 ppm Surface 10 ppm Subsurface**	NA	ND	ND	NA	NA	NA	3.79	NA
Arsenic	**7.5 ppm**	3.75	8.46	8.87	NA	NA	26.9	NA	20.5
Barium	**300 ppm**	88.5	111	58.2	NA	NA	334	NA	554
Cadmium	**1 ppm**	<0.593	<0.567	1.09	NA	NA	15.1	NA	27.4
Chromium	**10 ppm**	7.08	10.4	29.0	NA	NA	115	NA	248
Lead	**500 ppm**	6.87	10.2	48.6	NA	NA	1160	NA	1190
Mercury	**0.1**	<0.0228	0.1944	<0.0176	NA	NA	1.184	NA	7.195
Selenium	**2 ppm**	<0.593	<0.567	<0.493	NA	NA	<0.463	NA	<0.523
Silver	**<8 ppm**	<1.18	<1.13	<0.986	NA	NA	<4.63	NA	<5.23

= Cleanup level shown is for the sum of all Xylene isomers.
ND = Not detected
NA = Not Analyzed

TABLE 2
GROUNDWATER SAMPLE RESULTS

(All results shown in units of parts per billion)

	NYSDEC GA Groundwater Quality Criteria	W-1	W-2	W-3	W-4
Benzene	**0.7 ppb**	ND	ND	ND	0.926

All parameters normally analyzed during the analysis of TCL volatile organic compounds were found below detection limits except for Benzene in monitoring well W-4.

ATTACHMENT A

Quality Assurance/Quality Control Plan

QUALITY ASSURANCE/QUALITY CONTROL PROJECT PLAN FOR PLANNED SAMPLING ACTIVITIES

Brownfield Cleanup Program
Hornell Site Development
Hornell, Steuben County, New York

NYSDEC Site #C851027

Prepared For:

Hornell Site Development LLC
PO Box 356
Hornell, New York 14843

Prepared By:

Leader Professional Services, Inc.
271 Marsh Road, Suite 2
Pittsford, New York 14534

October 2014

856.001

Contents

Figures

Appendices

1.0 INTRODUCTION

This Quality Assurance and Quality Control (“QA/QC”) Project Plan contains the information pertaining to the collection, handling, analysis and documentation of standards of site activities. The sample test results will be used to prepare a Site Characterization Report and Remedial Alternatives Report of the Hornell Waste property located in Hornell, New York.

2.0 PROJECT DESCRIPTION

This QA/QC Project Plan was prepared to support the sampling of soil and groundwater samples for characterization of the physical conditions and environmental quality of the Hornell Waste property (“Site”) by providing procedures for the collection, handling, analysis, and documentation standards of Site activities.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The management of this project is presented in Figure 1 - “Project Management Organization.” The responsibilities of each individual shown on Figure 1 are described below:

NYSDEC Project Manager - Mr. Matthew Gillette, Division of Hazardous Waste Remediation, Region 8, located in Avon, New York (585) 226-5308. Mr. Gillette’s responsibility is to manage the project and the NYSDEC personnel who are assigned to the project for technical review and oversight, and to ensure that all aspects of the project are completed. Mr. Gillette will be notified prior to deviations from the protocols presented herein and if there has been a problem with the procedures or analyses because of Site-specific conditions.

Leader Professional Services, Inc. Principal-in-Charge - Mr. Michael Rumrill, 271 Marsh Road, Suite 2, Pittsford, New York 14534 (585) 248-2413. Mr. Rumrill’s responsibility is for overall quality control and to ensure that adequate resources are dedicated to this project.

Leader Professional Services, Inc. Project Quality Assurance Officer/Project Manager - Peter von Schondorf, P.G. 271 Marsh Road, Suite 2, Pittsford, New York 14534, (585) 248-2413. Mr. von Schondorf’s responsibility is to ensure that the project and QA/QC Project Plan are adhered to and to enforce any corrective actions needed and be a point of contact for all technical issues regarding the project. Mr. von Schondorf will be notified by Leader’s Site Supervisor or by the analytical laboratory of any deviations from the protocols presented herein or if there has been a problem with implementing the procedures or analyses because of Site-specific conditions

Leader Professional Services, Inc. Site Surpervisor – Luke Spencer 271 Marsh Road, Suite 2, Pittsford, New York 14534, (585) 248-2413. Mr. Spencer’s responsibility is to manage the project for Hornell Waste and to ensure that aspects of the project are completed in accordance with the work plan, and to manage the field investigation and the project budget.

4.0 SAMPLING PLAN DESIGN AND RATIONALE

The design of the sampling program was based on a site walk with NYSDEC, existing data, and the intended use of the data. Sampling locations and rationale are described in detail in the Work Plan.

5.0 TARGET PARAMETERS

5.1 LABORATORY PARAMETERS

Soil and groundwater samples will be analyzed for Chemicals of Potential Concern (COPC). The COPC are defined as Target Compound List (TCL), volatile organic compounds (VOCs), TCL semi-volatile organic compounds (SVOCs), TCL pesticides/polychlorinated biphenyls (PCBs), and Target Analyte List (TAL) inorganics plus cyanide. Soil vapor (air) samples will be analyzed for VOCs measured by USEPA Method TO-15.

Metals in water results will be reported as totals. Percent solid determinations will be performed for all soil samples. All soil samples will be reported on a dry weight basis. Air samples will be collected in 1-liter summa canisters.

A summary of the parameters for each medium is provided in Table 1.1.

5.2 FIELD PARAMETERS

Field parameters measured during groundwater sampling will include the following: conductivity, pH, temperature, dissolved oxygen, oxidation-reduction potential and turbidity. These field parameters will be measured during groundwater sampling with the aid of a flow through cell.

6.0 DATA QUALITY OBJECTIVES

Target analytical reporting limits were developed in part by consideration of the data quality objectives (DQOs) to be achieved. The results of soil samples collected during the investigation will be compared to the NYSDEC Part 375 Soil Cleanup Objectives. The results of the groundwater samples collected during the investigation will be compared to the NYSDEC TOGS 1.1.1 Ambient Water Quality Standards and Groundwater Effluent Values. Soil vapor sample results will be compared to NYSDOH and USEPA guidance values as appropriate. Any modeling of the soil vapor values to estimate a potential indoor air quality concentration will use the latest edition of USEPA’s Johnson Ettinger Model.

7.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

Specific procedures for sampling, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventive maintenance, and corrective action are described below.

8.0 PROCEDURES FOR THE COLLECTION OF ENVIRONMENTAL SAMPLES

The procedures in this document have been standardized to make them applicable to the Site's field conditions. It must be recognized that under certain conditions, the procedures discussed herein may not be appropriate to the Site conditions at the time of sample collection. In such cases, it will be necessary to adapt the procedures given to the specific conditions of the Site and the sampling objective.

8.1 Surface Soil Sampling

All surface sampling will be completed in the proposed sampling locations shown on Figures 2, 3, and 4 of the Work Plan, but may be expanded into adjacent areas to delineate observed conditions. The sampling procedures to be used are detailed in Appendix A of this plan, but limited to the upper two inches of soil. The purpose of limiting the depth of investigation is to obtain data on the immediate environmental and health risks associated with the surface soil.

Information pertinent to the sampling procedures used and observations of the environmental conditions at the time of sampling will be entered into a field logbook with an indelible ink marker. The samples will be inspected to evaluate organic vapor readings, staining, color, texture following the Unified Soil Classification System, location of stains and the location of saturated soil.

8.2 Subsurface Soil Sampling

Subsurface sampling will be completed at the proposed sampling locations shown on Figures 2, 3, and 4 of this plan. The sampling procedures to be used are detailed in Appendix B. The purpose of the subsurface soil sampling is to obtain data on the extent of soil contamination and to characterize the soil and groundwater zone conditions.

Information pertinent to the sampling procedures used and observations of the environmental conditions at the time of sampling will be entered into a field logbook with an indelible ink marker. The samples will be inspected to evaluate organic vapor readings, color, staining, and texture following the Unified Soil Classification System, location of stains and the location of saturated soil. The information for each soil boring or test pit location will be placed on to a Soil Boring Log, see Appendix B.

8.3 Procedures for the Installation of Monitoring Wells

The construction of monitoring wells will be completed in two parts: drilling and sampling of test borings; and the construction of the monitoring wells. Prior to the start of the drilling process, all equipment will be decontaminated to limit the introduction of contaminants into the environment and to limit the carryover of contaminants from one location to the other.

The drilling of test borings will be started by the split spoon sampling of the surface soil followed by the augering of the soil from the ground. Split spoon sampling will be completed in consecutive sequence from the ground surface to a point approximately eight below the water table; to a depth of the bottom of the fill; or a depth of 20-feet below the ground surface, whichever is deeper. The goal will be to penetrate any fill and have a monitoring well that can sample the shallow groundwater zone and straddle the water table to monitor for floating product.

Split spoon samples will be collected continuously until to a point approximately eight below the water table; to a depth of the bottom of the fill; or a depth of 20-feet below the ground surface, whichever is deeper. Soil sampling will be done in accordance with the procedures found in Appendix B. Augering will be completed as needed based on the sampling tools being used (i.e., geoprobe or split spoon sampler) to following each two foot, four or five foot sample interval. Information from the examination of soil samples will be placed in the field logbook and on a Soil Boring Log, see Appendix B.

Once the target depth is reached, the Drilling Contractor will begin the well installation process following Appendix C. The monitoring wells will be constructed using 2-inch diameter monitoring well screen and risers. The monitoring wells will be constructed using a conventional monitoring well design following the well construction figure in Appendix C. Monitoring wells will be constructed to produce a representative sample of the groundwater and will use a screen no longer than ten feet. The location of the screen will depend on the thickness of the groundwater zone, the presence of a semi or impermeable layer, the presence of stains, non-aqueous phased liquids, or volatile organic vapors. Ideally the screen will positioned to intersect the water table surface. The specific information for each monitoring well will be written into the field logbook and also placed on a Monitoring Well Construction Log, found in Appendix C.

Following construction, the monitoring wells will be developed to remove silt and clay and to produce a water sample with a turbidity value of less than 50 NTU. Each monitoring well will also be surveyed to located the monitoring well's position and to calculate its elevation. Appendix C also has a form which can be used to record development information for each monitoring well. Development information will also be written into the field logbook.

8.4 Groundwater Sampling Procedures

Groundwater sampling (for chemical substances) will be completed in the proposed monitoring wells as shown on Figure 2. The sampling procedures to be used are detailed in Appendix D of this plan. The purpose of the groundwater sampling is to obtain data on the groundwater quality, but also include the direction of groundwater flow and groundwater hydraulic conductivity. Procedures for measuring hydraulic conductivity are provided as Appendix F.

Information pertinent to the sampling procedures used and observations of the environmental conditions at the time of sampling will be entered into a field logbook with an indelible ink marker and on the monitoring well development form presented in Appendix C. The parameters to be measured will include: water level depth below ground surface, dissolved oxygen, pH, turbidity, specific conductance, oxidation-reduction potential, temperature, and the presence of sheens and non-aqueous phase liquids.

8.5 Soil Vapor Sampling

The construction and sampling of soil vapor samples will be conducted at the locations identified on Figure 3 of this plan. The construction and sampling procedures to be used are detailed in Appendix E of this plan. The purpose of the soil vapor sampling is to obtain data on the type and extent of soil vapor impacts and to evaluate the potential for vapor intrusion impacts to future onsite buildings and structures, and to offsite receptors.

Information pertinent to the sampling procedures used and observations of the environmental conditions at the time of sampling will be entered into a field logbook with an indelible ink marker. The information will also be written on a sampling log also found in Appendix E. The soil samples collected during the drilling of the boreholes for construction of the soil vapor sampling point will be inspected to evaluate organic vapor readings, color, staining, and texture following the Unified Soil Classification System, location of stains and the location of saturated soil.

8.6 Hydraulic Conductivity Testing

After each monitoring well has been developed and sampled, the monitoring wells will be tested to measure water level changes in response to rapid water additions and removals. The timed water level response to these tests will be used to estimate the groundwater zone's hydraulic conductivity. Hydraulic conductivity values are used in calculations to estimate the velocity of groundwater flow and contaminant migration. Testing procedures for hydraulic conductivity testing is provided as Appendix F. Data obtained from the testing will be written on a form provided in Appendix F or in a data output file obtained from a data logger, if used during the testing. A groundwater zone consisting of sand and gravel may react too fast for manual measurements to be taken accurately; therefore, an electronic pressure transducer will be used for testing purposes.

8.7 Field Equipment Cleaning

All non-disposable equipment used for the collection, preparation, and preservation of the environmental samples must be cleaned prior to their use. Unless the equipment and materials used are disposable, or have sufficient number so as not to be reused during any one sample period, cleaning will have to be conducted in the field. Field cleaning can be inefficient and lead to cross contamination problems compared to cleaning in a controlled environment. If possible, attempts will be made to minimize field cleaning. To avoid cross contamination between sampling points, dedicated disposable sampling equipment will be used when possible.

The materials needed for sample equipment cleaning are dependent upon the nature of the equipment. The following is a generalized list of materials to be used during cleaning:

- Cleaning solutions. Non-phosphate detergents, nitric acid and methanol will be used to clean sampling re-usable equipment.

- Water. In some cases, tap water may be adequate for initial or intermediate rinses. The final rinses, however, will be with deionized/distilled water.
- Buckets and washbasins. For use in the washing and rinsing of equipment.
- A drying rack. All materials and equipment must be dried prior to additional use. Paper towels will be used when necessary for drying equipment.

Drilling equipment and the excavator bucket used for test pitting during sample collection will be decontaminated between sample locations. The decontamination methods used will include: use of potable water obtained from either the Town's hydrant or a potable water source; high pressure spray wash using hot water from a steam generator; and drying of equipment.

Split spoons or geoprobe soil sampling tools used for the collection of soil samples will be decontaminated using the same process used for drilling equipment or hand washed using soap and water and a stiff brush. The tools will be then rinsed with potable water and dried.

Cleaning of the equipment will be done in a dedicated bermed area lined with two layers of plastic to facilitate the collection of waste water. Waste water generated from the cleaning process will be drummed along with any solid material.

8.8 Waste Handling

The handling of investigation derived waste and any remediation waste generated from an Interim Remedial Measure will be handed following the procedures identified in Appendix G. All wastes will be will be secured in drums, roll-off boxes or on top of and covered with plastic sheeting so the waste is controlled at all times. Each container will be labeled to identify the waste, the location of generation (borehole or monitoring well number), and the date of generation. Before the end of a field secession the wastes will be sampled and analyzed for characterization. If the waste is determined to be hazardous then each of those containers, boxes or piles will be appropriately labeled. All hazardous will be removed from the site within 90-days of its generation.

8.9 Documentation and Chain of Custody Procedures

8.9.1 Packaging and Shipping Procedures

Once the samples have been collected, the samples will be prepared and preserved in accordance with applicable procedures found in the work plan and this plan, and packaged for shipment and/or delivery to the laboratory as soon as possible. Chain-of-custody procedures will be followed to insure the proper handling and possession of the samples until the analytical laboratory has received the samples. This section outlines procedures for the packing and shipping of environmental samples, and general chain-of-custody procedures.

All individual sample containers will be placed in a durable shipping container. It is recommended that for this purpose, an insulated plastic cooler be used. The following is an outline of the packing and shipping procedures to be followed:

- The drain plug at the bottom of the cooler will be sealed to ensure that water from sample container breakage or ice melting does not leak from the outside container.
- Line the bottom of the cooler with a layer of absorbent material such as vermiculite.
- Check screw caps for tightness and mark the sample volume level on the outside of large containers.
- For large containers, packing peanuts may be used to keep containers in place and to prevent breakage.
- When samples must be kept at 4 degrees C, ice sealed in plastic bags or cool packs will be placed in the cooler.
- Documents accompanying the samples will be sealed in a plastic bag attached to the inside of the cooler lid.
- The lid of the cooler will be closed and fastened.
- Duct tape or reinforced shipping tape will be wrapped around the cooler several times to insure that the lid will not open if the latch becomes unfastened.
- The following information will be attached to the outside of the cooler: name and address of receiving laboratory, return address of the sampling team, arrows indicating "This End Up" on all four sides, and a "This End Up" label on the top of the lid.
- A custody seal will be affixed and signed across the lid of the cooler.

Samples will be shipped by air for next day delivery at the specified laboratory. Personnel will be prepared to open and reseal the cooler for inspection if the courier requires it.

8.9.2 Chain-of-Custody Procedures

The primary objective of these procedures is to create an accurate written record, which can be used to trace the possession and handling of the sample from the moment of its collection, through analysis and to its introduction as evidence.

The number of persons involved in collecting and handling samples should be kept to a minimum. Detailed field records will be kept in the project field logbook and will contain the following information:

- Sample identification and source (including sampler's name, sample location, and sample media).
- Dates and times of sample procurement, preparation, and shipping.
- Preservative used.
- Analyses required.
- Pertinent field data (pH, DO, ORP, specific conductance, temperature, etc).

To help eliminate possible problems in the chain-of-custody procedures, one person will be appointed Field Custodian for each task. For tasks where sampling teams are used, all samples are to be turned over to the Field Custodian by the team members who collected the samples. The Field Custodian will then document each sampling event and the sample will remain in his/her custody until it is shipped to the laboratory. The Field Custodian is responsible for properly packaging and dispatching samples to the laboratory. The responsibility includes filling out, dating and signing the appropriate portion of the chain-of-custody record.

Labels will be firmly affixed to each sample container. The labels on each sample bottle will be filled out with waterproof ink prior to sample collection. Sample reference numbers identical to that recorded on the labels will be recorded on the chain-of-custody.

When transferring the samples, the individual relinquishing the samples will sign and record the date and time on the chain-of-custody record. Every person who takes custody will fill in the appropriate section of the chain-of-custody record form, and their affiliated company. To minimize custody records, the number of custodians in the chain-of-possession should be minimized.

9.0 SAMPLE ANALYTICAL PROCEDURES

9.1 FIELD ANALYTICAL PROCEDURES

Field measurements will be conducted in accordance with the Work Plan.

9.2 LABORATORY ANALYTICAL PROCEDURES

Chemical analyses in support of soil, groundwater, and air data will be performed by NYSDOH ELAP certified laboratories. The laboratories will maintain current SOPs for extraction, cleanup, and analysis of soil, water, and air matrices and must have on file current MDL studies to demonstrate their ability to meet the project required reporting limits within these matrices. The MDLs must be performed by the laboratories on a yearly basis to ensure their ongoing ability to perform the methods, as specified. The MDLs will be performed in accordance with EPA guidance described in 40 CFR 136, 1986, Appendix B, "Definition and Procure for the Determination of the Method Detection Limit -Revision 1.11".

9.2.1 SOIL, AIR, AND GROUNDWATER METHODS

Using the methods summarized in Table 4.1, the laboratories will perform analysis of soil, air, and groundwater. The corresponding analytes of interest and project required reporting limits are listed in Table 1.1.

9.3 SAMPLE DOCUMENTATION IN THE LABORATORY

Upon receipt at the laboratory, the designated sample custodian will inspect the shipping cooler/container and the custody seal. The sample custodian will note the condition of the cooler/container and the custody seal on the Chain-of-Custody record sheet.

The sample custodian will record the temperature of one sample (or temperature blank) from each cooler and the temperature will be noted on the Chain-of-Custody. If the shipping cooler seal is intact, the sample containers will be accepted for analyses. The sample custodian will document the date and time of receipt of the container, and sign the form.

If damage or discrepancies are noticed (including sample temperature exceedances), they will be recorded in the remarks column of the record sheet, dated, and signed. Any damage or discrepancies will be reported to the lab supervisor who will inform the lab manager and QA Officer before samples are processed.

10.0 CALIBRATION

Both field instrumentation and laboratory analytical instrumentation are to be used to provide project data. Both systems will require regular calibration in order to provide comparable and accurate information.

On-Site field data concerning VOCs will be obtained using an organic vapor analyzer monitoring instrument. Other instruments needing calibration include: the water quality meter providing DO, ORP, field conductivity, turbidity meters, pH and temperature probes. Since this instrument will be obtained directly from Ashtead Technology Rental ("Ashtead") and used for only one day, Leader will rely on Ashtead to provide calibrated equipment, but Leader will also have the manufacturer's calibration instructions in the event that field calibration is required.

10.1 Field Instruments

10.1.1 Portable Organic Vapor Analyzer Calibration

The PID has a calibrated range of 0 to 2000 parts per million volume ("ppmv") total hydrocarbons and can collect instantaneous and 15 minute average concentrations. It is typically calibrated using isobutylene. A 10.2-eV lamp will be used, which ionizes many of the common air contaminants. The PID is highly sensitive to aromatic compounds such as benzene or toluene.

Calibration will be performed prior to taking the instrument into the field. Certified isobutylene-in-air (100 ppm) and zero-air standard gases are used for calibration, according to the manufacturer's specifications. Calibration checks will be made daily (at a minimum) using the isobutylene calibration gas. If needed, the instrument will be re-calibrated when the calibration check falls below 10-percent of the isobutylene concentration of the calibration gas.

10.1.2 Conductivity, pH Meter, Do, Turbidity, Temperature Calibration

The Horiba 22 Water Quality Monitor is a multi-probe instrument that can measure all of the required parameters using one hand-held instrument. The instrument will be provided by Ashstead along with operating manuals and calibration equipment. The calibration of the specific conductance, pH, dissolved oxygen ("Do"), turbidity, and temperature will be checked prior to beginning work and again at the completion of sampling following the manufacturer's operating procedures, or if results do not make sense based on Leader's history with the site.

10.2 Laboratory Equipment Calibration

All instruments used to perform chemical measurements must be properly calibrated prior and during use to ensure acceptable and valid results. The accuracy and traceability of all calibration standards used must be properly documented.

The methodologies selected for use in this investigation specify the types and frequency of calibrations. The specific methods to be used are provided in Table 4.1.

Accessory analytical equipment such as refrigerators, balances and ovens required for the storage and preparation of samples must be calibrated and/ or monitored with the following guidelines:

Equipment must be checked daily and these records kept in a logbook or calibration-specific log.

The laboratory must document clearly the acceptance criteria for all such equipment (e.g., refrigerator temperature must be 4°C ± 2°C) and corrective actions must be taken for any out-of-control situation as described in the laboratory's Quality Manual

The equipment must not be used after corrective action until it has been recalibrated or verified through the successful analysis of a check standard

Calibrations of other miscellaneous analytical equipment (e.g., automatic pipettes) must be performed according to manufacturer's recommendations

Implementation of the laboratory calibrations will be the responsibility of the Laboratory Manager and the analysts performing the procedures.

The procedures described in this QAPP are to be used in conjunction with specific instrument manufacturer's instructions, applicable analytical methodology requirements, and specific laboratory field procedures for instrument operation. These are referenced in the methods detailed in Table 4.1, and the laboratory and field SOPs derived from these methods.

10.2.1 LABORATORY INSTRUMENT PREVENTATIVE MAINTENANCE

As part of the laboratory QA/QC program, a routine preventative maintenance program is conducted by the laboratory to minimize the occurrence of instrument failure and other system malfunctions. Designated laboratory employees regularly perform routine scheduled maintenance and repair of (or coordinate with the vendor for the repair of) all instruments. All laboratory instruments are maintained in accordance with manufacturer's specifications. The preventive maintenance program should include:

- An inventory of replacement and spare parts for instruments that are maintained.
- Maintenance logbooks for each instrument with information on routine and non-routine procedures. The logbook records must include the instrument number, description of malfunction or problem, date of maintenance activity, the type of activity performed and final resolution.
- Training of laboratory staff in the maintenance requirements of the instruments. Preventive maintenance schedules and activities will be outlined in the laboratory SOPs.

10.2.2 Inductively Coupled Plasma Spectroscopy

The Inductively Coupled Plasma (ICP) Spectrometer should be maintained under service contract with the manufacturer. Routine preventive maintenance should include:

- Checking pump tubing and replacing when necessary
- Checking nebulizer for even "spray" and cleaning, as necessary
- Checking the torch for plasma height and shape and cleaning, as necessary
- Checking sensitivity of photomultiplier and replacing, as necessary

10.2.3 GAS CHROMATOGRAPH INSTRUMENTS

The GC and GC/MS systems will be maintained on a service contract or undergo in-house maintenance to provide routine preventive maintenance. Spare parts for the GC and GC/MS systems should include: filaments, electron multiplier, source parts, o-rings, ferrules, septa, injection port liners, and columns. Routine preventive maintenance for the systems should include:

- Checking the data systems (disk drives, tape readers, etc.) and servicing, as necessary
- Changing oil and traps on mechanical and turbo pumps
- Conditioning of moisture traps, every two months or when the gas source is changed
- Carrier gas evaluation and leak checking of electron capture detector when the gas or column is changed
- Servicing the MS source through cleaning, replacement of filaments and other source parts, as necessary
- Replacement of injection port septa and liners, as necessary

- Clipping the front end of GC column or replacement of GC column, as necessary

10.2.4 ATOMIC ABSORPTION INSTRUMENTS

The atomic absorption (AA) systems will be maintained on a service contract or undergo in-house maintenance to provide routine preventive maintenance. Routine preventive maintenance procedures should include:

- Checking the plumbing connections
- Checking the auto-sampler and tubing

10.2.5 Thermometers

Thermometers for refrigerators and ovens are calibrated yearly against National Institute of Standards and Technology (NIST) certified thermometers. The Laboratory QA Officer will be responsible for the safekeeping of the NIST thermometers, and for the documentation asserting the accuracy of their measurements.

10.2.6 Analytical Balances

Virtually every analytical procedure requires the use of side-loading and/or top-loading balances. Many of these requirements involve standards preparation and are, therefore, crucial to accurate determination. Balances should be maintained on a service contract. A calibration status label is affixed to each balance after calibration during servicing.

11.0 INTERNAL QUALITY CONTROL CHECKS

11.1 Field Measurements

The type and frequency of field-generated QC samples are summarized in Table 4.1. Primarily, rinse blanks, trip blanks, and field duplicates are employed to verify the field sampling approach.

11.2 Laboratory Analysis

The type and frequency of laboratory generated QC samples are summarized in Table 4.1. Criteria that the laboratory must meet are presented in the analytical methods.

11.2.1 Laboratory Quality Control

Specific procedures related to internal laboratory QC samples are detailed in the analytical methods. The following QC samples will be analyzed and the results will be used to assess overall analytical accuracy and precision.

11.2.2 Reagent (Method) Blanks

Laboratory glassware and sample containers used to store and transport samples will be cleaned in accordance with method protocols.

A reagent blank will be analyzed by the laboratory at a frequency of one blank per analytical batch. The reagent blank, an aliquot of analyte-free water or sand, will be carried through the entire sample preparation and analytical procedure, including all cleanup procedures. The reagent blank is used to document contamination resulting from the analytical process.

11.2.3 Laboratory Control Samples (LCS)/ Blank Spike Analyses

The LCS or blank spike serves as a monitor of the overall performance of all steps in the analysis, including the sample preparation. LCS or blank spikes will be analyzed for each method using the same sample preparation and analytical procedures employed for the investigative samples.

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

An MS/MSD sample will be analyzed for organic parameters will be analyzed for inorganic parameters at a minimum frequency of one per 20 investigative samples. For each matrix, percent recoveries will be used to evaluate analytical accuracy while the RPD between MS/MSD analyses will be used to assess analytical precision.

11.2.5 Surrogate Analysis

Surrogates are organic compounds which are similar to the analytes of interest, but which are not normally found in environmental samples. Surrogates are added to samples to monitor the effect of the matrix on the accuracy of the analysis. Every blank, standard, and environmental sample analyzed by GC or GC/MS, including MS/MSD samples, will be spiked with surrogate compounds prior to sample preparation.

The compounds that will be used as surrogates and the levels of recommended spiking are specified in the methods. Surrogate spike recoveries must fall within the laboratory control limits. If surrogate recoveries are excessively low (<10 percent), the laboratory will contact the QA/QC Officer for further instructions.

Dilution of samples to bring the analyte concentration into the linear range of calibration may dilute the surrogates out of the quantification limit. Reanalysis of these samples is not required. Assessment of analytical quality in these cases will be based on the MS/MSD sample analysis results.

11.2.6 Retention Time Window Determination

For organic analyses, determination of the target analyte retention time window will be made, based on the procedure specified in the methods of analysis. Positive identification of an analyte will be made when its retention time falls within the window established during calibration.

11.3 Internal Standards

To ensure that changes in GC/MS response and sensitivity do not affect sample analysis results, internal standard compounds are added to all samples, blanks, and spike samples prior to VOC and SVOC analyses. All results are calculated as a ratio of the internal standard response. The criteria by which the internal standard results are assessed will be as follows:

- Internal standard area counts must not vary by more than a factor of two (-50 percent to +100 percent) from the associated calibration standard.
- The retention time of the internal standard must not vary more than ±30 seconds from the associated calibration standard.

11.4 Cleanup Check Samples

Whenever a cleanup technique is employed to eliminate interferences that may prevent accurate determination of the targets of interest at the project required reporting limits, the cleanup procedure must be verified through the analysis of check standards. A standard containing some or all of the target analytes must be processed through the cleanup procedure and analyzed. The recovery of the target analytes in this check will indicate if the cleanup procedure was effective in elimination of interferences without impacting the target compounds of interest.

11.5 Sample Collection QC

Field QA/QC sample quantities are summarized in Table 4.1. Field duplicates will be submitted at a frequency of one per 20 investigative samples or one per sampling event. The duplicate results will be used to assess overall sampling and analytical precision and will be assessed against acceptance criteria of 50 percent RPD for water samples and 100 percent for soil samples.

Trip blanks for VOCs will be prepared by the laboratory using analyte-free water and submitted with the water sample collection containers. The trip blanks will be kept unopened in the field with sample bottles. One trip blank will be transported to the laboratory with each batch of aqueous VOC samples. The laboratory will analyze trip blanks as samples.

Rinse blanks will be used to assess decontamination procedures of collection equipment used for multiple samples. The rinse blank will be prepared using analyte-free deionized water when non-dedicated equipment is used in the field. The rinse blanks will be analyzed by the laboratory as samples. Rinse blanks will be prepared at a frequency of one per 20 investigative samples per equipment type.

12.0 DATA REDUCTION, VALIDATION, AND REPORTING

All data generated through field activities or by the laboratory operation shall be reduced and validated prior to reporting in accordance with the methods and the following procedures.

12.1 Data Reduction

12.1.1 Field Data Reduction Procedures

Field data reduction procedures will be minimal in scope compared to those implemented in the laboratory setting. Only direct read instrumentation will be employed in the field. The pH, conductivity, temperature, dissolved oxygen, and turbidity readings collected in the field will be generated from direct read instruments following calibration per manufacturer's recommendations. Such data will be written into field logbooks immediately after measurements are taken and/or recorded on field forms. If errors are made, results will be legibly crossed out, initialed, and dated by the field member, and corrected in a space adjacent to the original entry. Later, when the results forms required for this study are being filled out, the Field QA Officer will proof the forms to determine whether any transcription errors have been made by the field crew.

12.1.2 Laboratory Data Reduction Procedures

For this project, the equations that will be employed in reducing data are found in the appropriate chapters of SW-846, Third Edition. All calculations are checked at the conclusion of each operating day. Errors are noted, corrections are made, but the original notations are crossed out legibly. Analytical results for soil samples shall be calculated and reported on a dry weight basis.

Quality control data (e.g., laboratory duplicates, surrogates, matrix spikes, and matrix spike duplicates) will be compared to the method acceptance criteria. Data considered to be acceptable will be entered into the laboratory computer system. Data summaries will be sent to the Laboratory QA Officer for review. If approved, data are logged into the project database format. Unacceptable data shall be appropriately qualified in the project report. Case narratives will be prepared which will include information concerning data that fell outside acceptance limits, and any other anomalous conditions encountered during sample analysis.

12.2 Data Validation

Data validation will be conducted in accordance with "U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review," EPA-540/R-99/008, October 1999, and the "U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," EPA-540/R-94-013, February 1994. The data assessment will include a review of all technical holding times, instrument performance check sample results, initial and continuing calibration results, and all batch and matrix QC including rinse blanks, field duplicates, MS/MSD, matrix duplicates, surrogate recoveries, method blanks, LCS results, continuing and initial calibration checks, and the identification and quantitation of specific analytes of interest. Assessment of analytical and in-house data will include checks on data consistency by looking for comparability of duplicate analyses, adherence to accuracy and precision control criteria detailed in this QAPP, and anomalously high or low parameter values. The results of these data validations will be reported to the project manager and the contract laboratory, noting any discrepancies and their effect upon acceptability of the data.

Data validation reports will summarize the samples reviewed, parameters reviewed, any nonconformance with the established criteria, validation actions (including data qualifiers). Data qualifiers will be consistent with the validation guidelines and will consist of the following:

J) The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

UJ) The analyte was not detected above the sample reporting limit; however, the reporting limit is approximate

U) The sample was analyzed for, but was not detected above the sample-reporting limit

R) The sample result is rejected due to serious deficiencies. The presence or absence of the analyte cannot be verified

12.3 Laboratory Data Reporting

The Laboratory will provide at least two hard copies of each laboratory data report, an original and a copy for data validation. The data hard copies will include all NYSDEC Analytical Services Protocol ("ASP") Category B deliverables. Equis electronic deliverables will also be required for the project database.

12.4 Data Reconciliation with Requirements for Usability

The goal of this project is to produce data to be used in comparison to soil and groundwater quality cleanup criteria. As such, the data generated must meet the data user's needs as defined in the project DQOs in Section 1.6 of this QAPP. In summary, the primary objectives for assessing the usability of the data are:

1. To collect data that is representative of site conditions and comparable with prior data;
2. To produce data that meets the project reporting limit requirements; and
3. To produce data of the highest quality possible in order to accurately and precisely characterize the site.

Data validation personnel will apply the standard data validation qualifiers to data to indicate the level of uncertainty in the associated result. In general, for the purposes of this investigation, data that are left unqualified, data qualified "U" (non-detected), data qualified "J" (detected as an estimated result), and data qualified "UJ" (non-detected at an estimated reporting limit) are considered valid and usable for project objectives. Data that are qualified "R" (rejected) will be considered invalid and unusable.

The goal of this program is to generate valid, usable data. However, in environmental sampling and analysis, some data may be lost due to sampling location logistics, field or laboratory errors, or matrix effects that may cause the rejection of results for some compounds. The overall completeness goal for collection of valid data is 90 percent. If this goal is not met, data gaps may exist that may compromise the intended use of the data.

13.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits of both field and laboratory activities may be conducted in accordance with the Work Plan and this QAPP, to verify that sampling and analysis are performed in accordance with the procedures established.

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the QAPP and analytical methods. The audits of field and laboratory activities will include two independent parts: internal and external audits.

13.1 Field Performance and System Audits

13.1.1 Internal Field Audit Responsibilities

Internal audits of field activities include the review of sampling and field measurements conducted by the Field QA Officer. The audits will verify that all procedures are being followed. Internal field audits will be conducted once during each phase of the sampling and at the conclusion of the project. The audits will include examination of the following:

- i) field sampling records, screening results, instrument operating records
- ii) sample collection
- iii) handling and packaging in compliance with procedures
- iv) maintenance of QA procedures
- v) chain-of-custody reports

Follow up audits will be conducted to correct deficiencies and to verify that procedures are maintained throughout the investigation.

13.1.2 External Field Audit Responsibilities

External audits may be conducted by the NYSDEC or designee at any time during the field operations. These audits may or may not be announced and are at the discretion of the NYSDEC.

13.2 Laboratory Performance and System Audits

13.2.1 Internal Laboratory Audit Responsibilities

For the purpose of internal evaluation, performance evaluation check samples are analyzed periodically by the laboratory. Internally, the evaluation of data from these samples is done on a continuing basis over the duration of a given project.

The project QA Officer may carry out performance and/ or systems audits to insure that data of known and defensible quality are consistently produced during this program.

Systems audits are qualitative evaluations of all components of laboratory quality control measurement systems. They determine if the measurement systems are being used appropriately. The audits may be carried out before all systems are operational, during the program, or after completion of the analytical report by the laboratory. Such audits typically involve a comparison of the activities given in the QA/QC plan described herein, with activities actually scheduled or performed. A special type of systems audit is the data management audit. This audit addresses only data collection and management activities, and can be used to track data generation and manipulation through the lab.

The performance audit is a quantitative evaluation of the measurement systems used for a monitoring program. It requires testing the measurement systems with samples of known composition or behavior to quantitatively evaluate precision and accuracy. A performance audit may be carried out by or under the auspices of the project QA Officer without the knowledge of the analyst during this program.

It should be noted, however, that any additional QA audits would only be performed if deemed necessary.

13.2.1 External Laboratory Audit Responsibilities

External audits will be conducted as required, by appropriate QA personnel of the NYSDOH.

13.3 Specific Routine Procedures to Assess Data Precision, Accuracy, Representativeness, and Completeness ("PARC")

The laboratory and the project QA/QC officer will evaluate data precision, accuracy, and completeness.

The purpose of this Section is to define the goals for the level of QA effort; namely, accuracy; precision and sensitivity of analyses; and completeness, representativeness, and comparability of measurement data from the analytical laboratories. QA objectives for field measurements are also discussed.

DQOs have been established to ensure that the database developed during the monitoring activities meet the objectives and quality necessary for its intended use.

13.3.1 Precision

Precision is a measure of degree to which two or more measurements are in agreement.

$$\textit{Precision} = (D_2 - D_1)/(D_1 + D_2)/2 \times 100$$

D_1 = original result

D_2 = duplicate result

1.3.3.1.1 Precision Objectives

The method(s) precision (reproducibility between duplicate analyses) will be determined based on the duplicate analysis of matrix spike samples for organic parameters and duplicate sample analyses for inorganic parameters. Precision will be reported as Relative Percent Difference (RPD) between duplicate analyses. Sampling precision will be addressed through the collection and measurement of field duplicates at a rate of one per 20 investigative samples or one per sampling event, whichever is greater. Precision will be evaluated using the laboratory control limits.

13.3.2 Accuracy

Accuracy is the degree of agreement between an observed or measured value and an accepted reference or true value.

$$\textit{Accuracy} = [(A-B)/C] \times 100$$

A = The analyte determined experimentally from the spike sample.

B = The background level determined by a separate analysis of the unspiked sample.

C = The amount of spike added.

13.3.2.1.1 Accuracy Objectives

Accuracy will be determined for both field and laboratory activities through the use of field blanks and matrix spike samples.

Rinsate (field) blank samples will be collected and analyzed as a check on the efficiency of the sampling device cleansing protocols and to determine if the field, sample transporting procedures, preservatives, and environments have contaminated the sample. Rinse blanks will be collected at a frequency of one per 20 samples per equipment type.

The method accuracy (percent recovery) for water and soil samples will be determined by spiking selected samples (matrix spikes) with all representative spiking compounds, as specified in the analytical methods. Accuracy will be reported as the percent recovery of the spiking compound(s), and will be evaluated using the laboratory control limits.

13.3.3 Completeness

Completeness is a measure of the amount of valid (usable) data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions.

Completeness = (Number of useable data/Number of useable data planned) X 100

13.3.3.1 Completeness Objective

Completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. Laboratory completeness for this project will be 90 percent or greater.

13.3.4 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition or an environmental condition within a defined spatial and/or temporal boundary.

13.3.4.1 Representativeness Objective

Sampling protocols have been presented for the collection of a variety of samples exhibiting specific characteristics or conditions (i.e., the presence of stains or elevated PID readings or when field parameters collected during groundwater sampling stabilize). These conditions may not be representative of the site conditions, but possibly the worst case so the data might reflect what could potentially be on the site and drive risk assessment and eventual cleanup. In these cases, the term representativeness has a very small characteristic population and very small spatial area. Generically, representativeness may suggest a meaning of "typical" or "average" when in fact the sample was biased toward the worst case extreme.

13.3.5 Corrective Actions

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or outlying QC performance that can affect data quality and usability. Corrective actions, if necessary, will be implemented in accordance with the procedures presented below and the laboratory SOPs.

Corrective actions may be required for two classes of problems: analytical and equipment problems and noncompliance problems. Analytical and equipment problems may occur during sampling and sample handling, sample preparation, laboratory instrumental analysis and data review.

For noncompliance problems, for example, non-compliance with EPA methods or QC defined in this QAPP, a formal corrective action will be implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the Project Manager. A description of the problem and the corrective action implemented will be confirmed in writing via e-mail, facsimile, or technical memorandum.

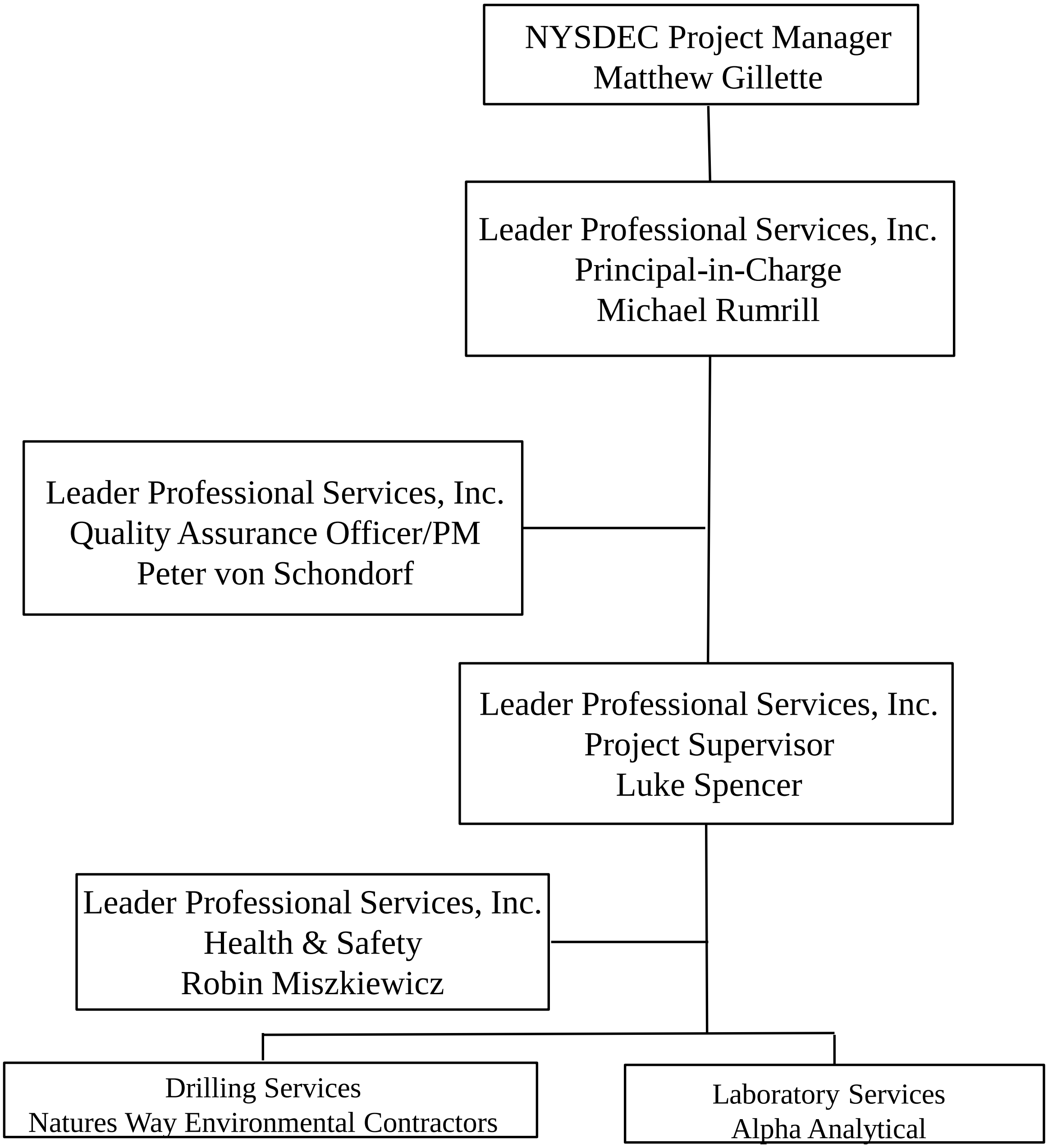
Any nonconformance with the established QC procedures in this QAPP will be identified and corrected.

14.0 FIELD NOTES

Field notes will be maintained during all field activities. The overall chronology of field activities as well as sampling details will be recorded in a bound logbook with an indelible ink marker. Each page will be consecutively numbered and signed by the Site Manager at the end of the workday. The following information, as appropriate, will be documented in the field notes:

- Date
- Weather conditions
- Personnel on or visiting Site
- Subcontractors on-Site
- Worked performed
- Changes to planned work as discussed with NYSDEC
- Time at which work, sampling or analysis was performed
- Equipment calibration methods and time
- Problems with personnel or machinery
- Sample identification numbers
- Sampling sequence

- Types of sample containers used
- Parameters requested
- Field analysis methods and data
- Field observations during the sampling event
- Name of sampler



Title: Project Organzation
Hornell Waste Site – Site #C851027
Hornell, New York

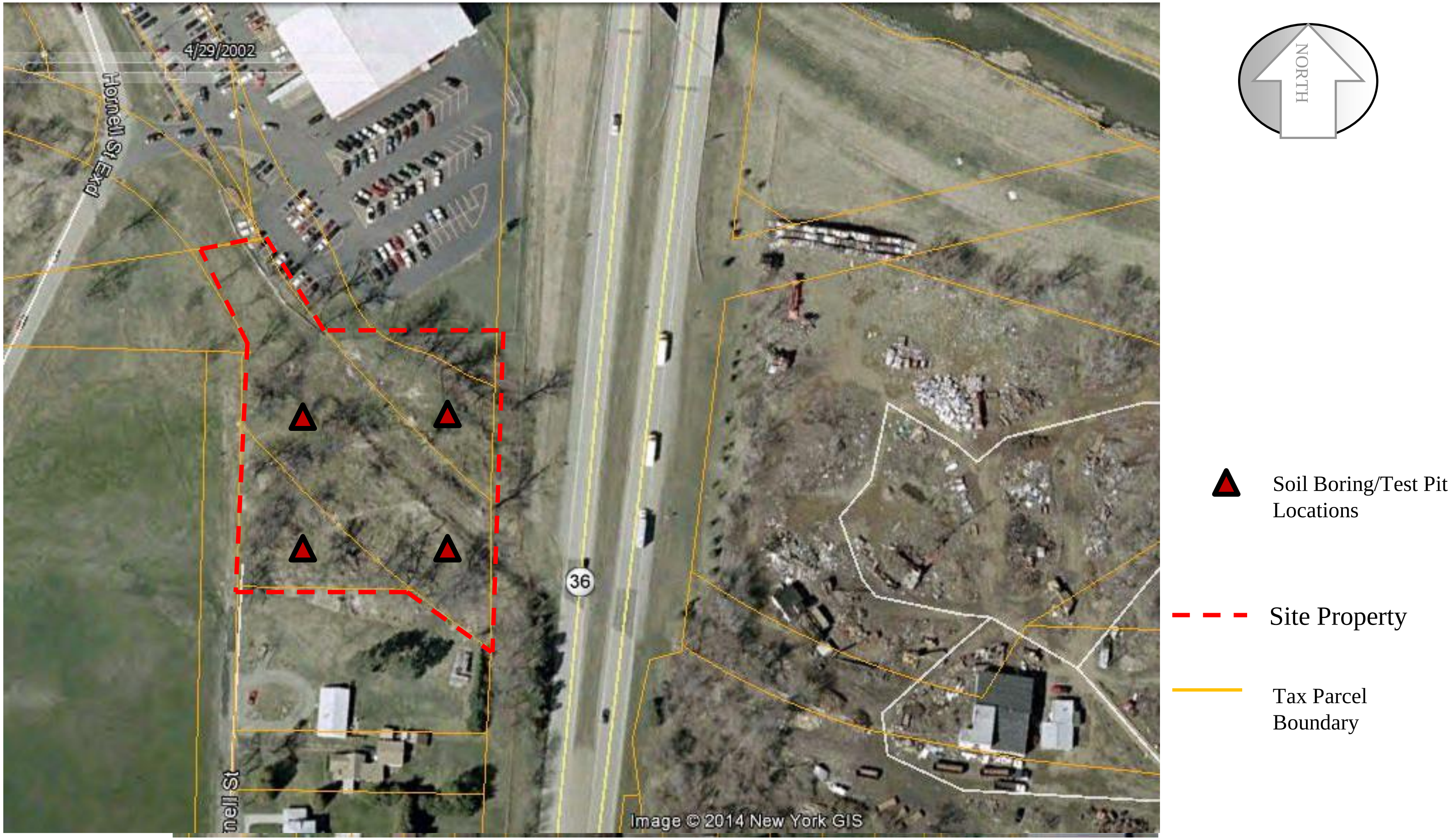
Prepared For: Hornell Site Development LLC
PO Box 356
Hornell, New York

Leader Professional Services, Inc
271 Marsh Road-Suite 2
Pittsford, New York 14534
(585) 248-2413
Fax (585) 248-2834

Project 856.001
Date November 3, 2014
Scale NTS

Drawn PVS
Checked MPR
File Name Site Location

Figure 1

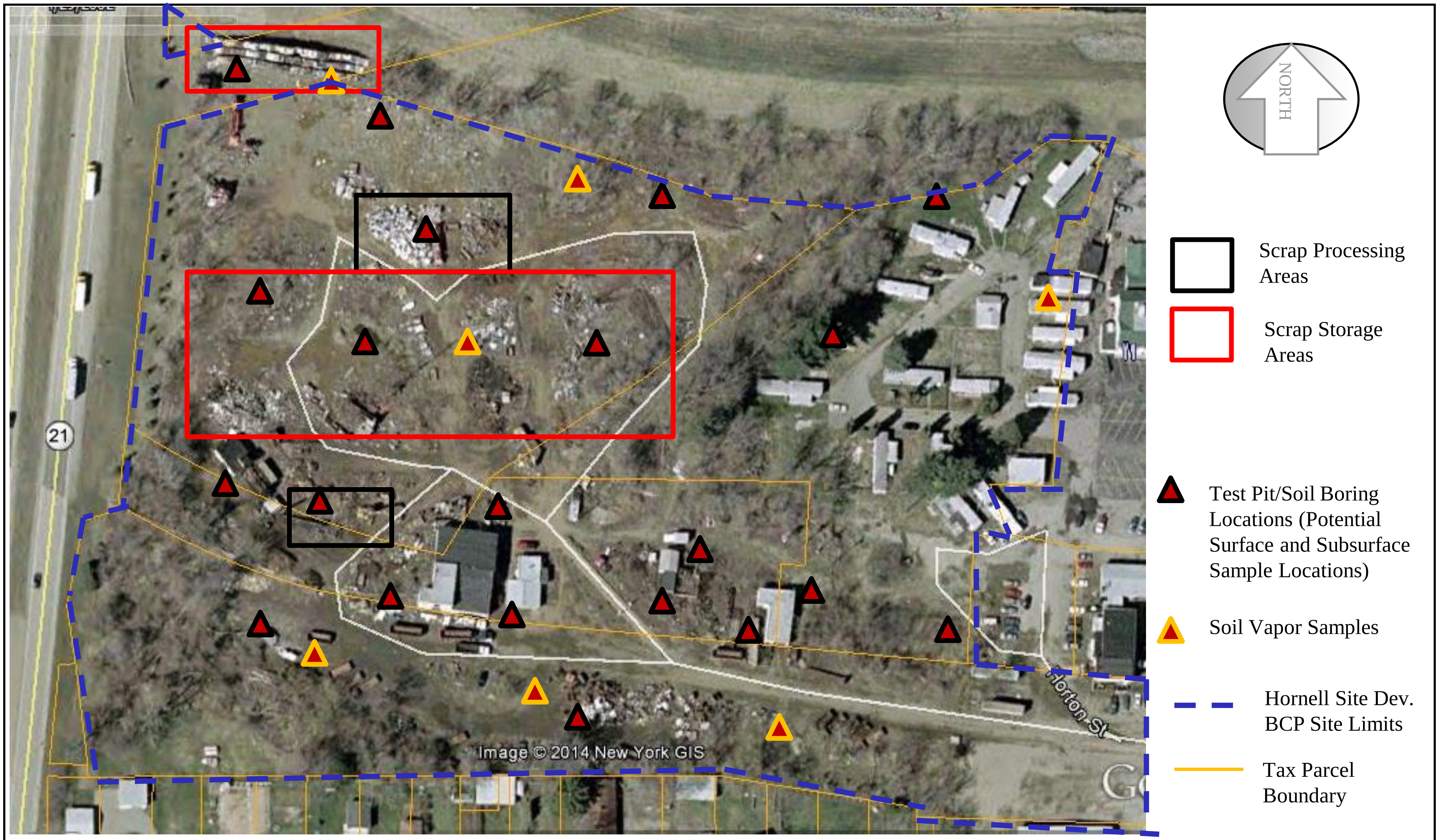


Title	Proposed Off-Site West Side Sampling Locations Hornell Site Development LLC Brownfield Cleanup Program Site C851027 Hornell, New York
Prepared For	Hornell Site Development LLC PO Box 356 Hornell, New York

LEADER

Leader Professional Services, Inc
271 Marsh Road-Suite 2
Pittsford, New York 14534
(585) 248-2413
FAX (585) 248-2834

Project	863.001
Date	October 13, 2014
Scale	Approx. 1" = 170'
Drawn	PVS
Checked	
File Name	Site Plan
Figure	4



Title
Proposed Phase 2 Sampling Locations
Hornell Site Development LLC
Brownfield Cleanup Program Site C851027
Hornell, New York

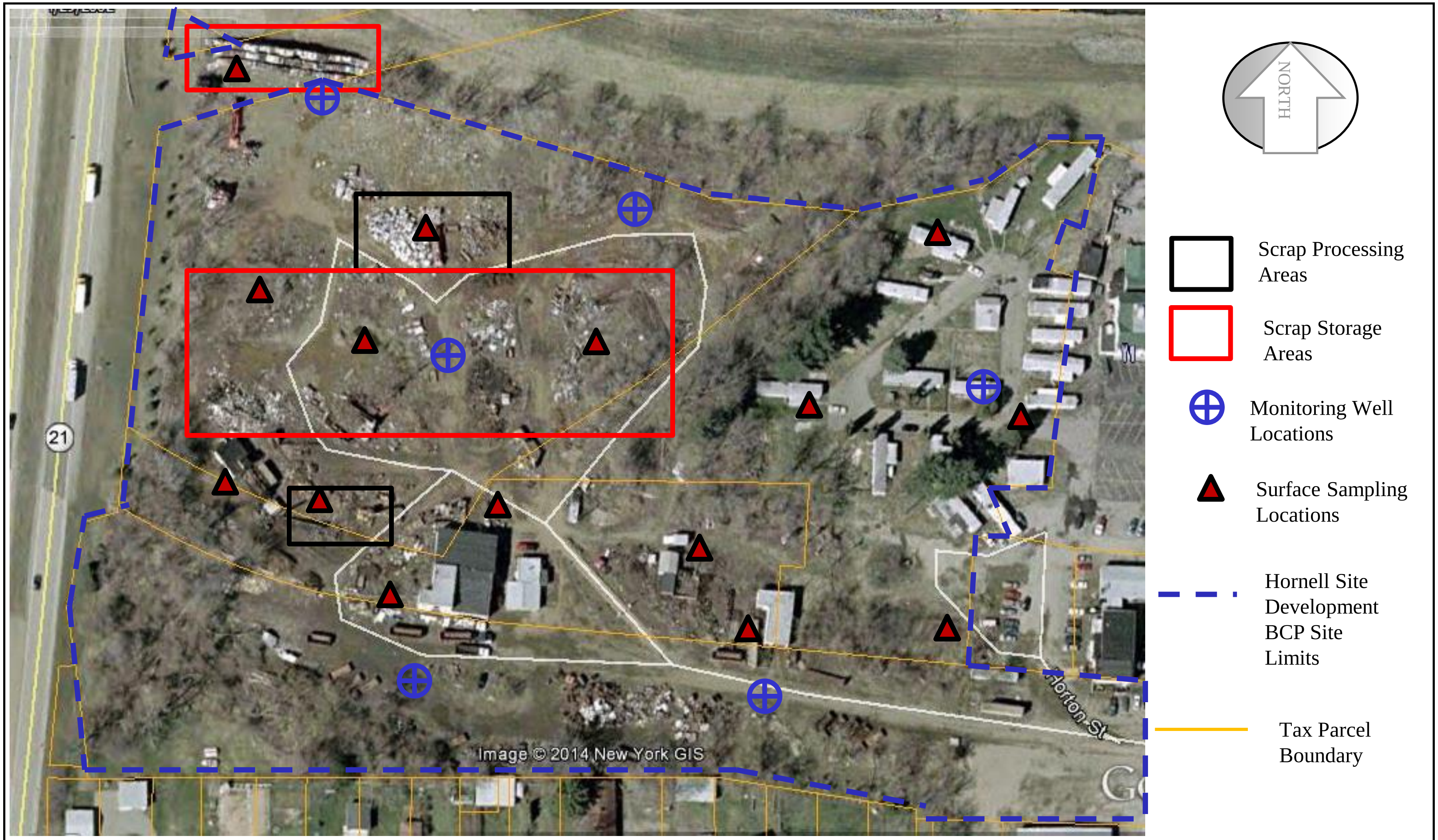
Prepared For
Hornell Site Development LLC
PO Box 356
Hornell, New York

LEADER
Leader Professional Services, Inc
271 Marsh Road-Suite 2
Pittsford, New York 14534
(585) 248-2413
FAX (585) 248-2834

Project 863.001
Date October 13, 2014
Scale Approx. 1” = 150’

Drawn PVS
Checked
File Name Site Plan

Figure 3



Title
Proposed Phase 1 Sampling Locations
Hornell Site Development LLC
Brownfield Cleanup Program Site C851027
Hornell, New York

Prepared For
Hornell Site Development LLC
PO Box 356
Hornell, New York

LEADER

Leader Professional Services, Inc
271 Marsh Road-Suite 2
Pittsford, New York 14534
(585) 248-2413
FAX (585) 248-2834

Project: 863.001
Date: October 13, 2014
Scale: Approx. 1" = 150'

Drawn: PVS
Checked:
File Name: Site Plan

Figure: 2

TABLE 1
SAMPLE ANALYTICAL PROCEDURES AND SAMPLE PRESERVATION REQUIREMENTS

Sample Type	Analysis	Type and Size Container	# of Containers per Sample	Preservation	Holding Time
Soil	TCL Volatiles	Glass, 2-ounce jar with Teflon lined cap	2	Cool to 4-deg. C	10 days
	TCL Semivolatile Organics	Glass, 4-ounce jar with Teflon lined cap	1	Cool to 4-deg. C	10 days
	PCBs/Pesticides and Herbicides	Glass, 4-ounce jar with Teflon lined cap	1	Cool to 4-deg. C	10 days
	TAL Metals + Cyanide	Glass, 4-ounce jar with Teflon lined cap	1	Cool to 4-deg. C	180 days, Mercury 26 days
	Cyanide	Glass, 4-ounce jar with Teflon line cap	1	Cool to 4-deg. C	12 Days
Groundwater	TCL Volatiles	40-ml vial with Teflon septum	3	ph<2 adjusted with HCL Acid, Cool to 4 deg. C	10 days
	TCL Semivolatile Organics	Glass, 1-Liter amber bottle with Teflon lined cap	1	Cool to 4	5 days
	PCBs/Pesticides and Herbicides	Glass, 1-Liter amber bottle with Teflon lined cap	2	Cool to 4	5 Days
	TAL Metals	Plastic, 1-Liter bottle with Teflon lined cap	1	pH<2 adjusted with Nitric Acid, Cool to 4	180 days, Mercury 26 Days
	Cyanide	Plastic, 500-ml with Teflon lined cap	1	pH >12 NaOH	12 days
Soil Vapor	TO-15 VOCs	1 Liter Summa canisters	1	None	30 days from day of collection

TABLE 2
SAMPLE ANALYSIS SCHEDULE

Sample Location	Volatile Organic Compounds with TICs	Semi-Volatile Organic Compounds	PCBs	Target Analyte Metals + Cyanide	TO-15 VOCs
Surface Soils		√	√	√	
Subsurface Soils >2-inches, stains and with odors or elevated PID/FID	√	√	√	√	
Groundwater	√		√	√	
Soil Vapor					√

TABLE 3
SCHEDULE OF QUALITY ASSURANCE SAMPLES AND THEIR USE

	Soil	**Groundwater**	**Use**
Trip Blank	√	√	**Submitted with each sample shipment and analyzed for volatile organic compounds to determine if cross contamination has occurred between the samples and the laboratory equipment.**
Matrix Spike and Matrix Spike Duplicate	√	√	**Two samples submitted once per 20 samples for each matrix and analyzed for the same analytical parameters as the typical environmental sample. Is used to determine accuracy of analytical equipment and evaluate sample matrix interference problems.**
Duplicates	√	√	**One sample is submitted for 10 samples analyzed and analyzed for the same analytical parameters as the typical environmental sample. Is used to determine homogeneity of the sample and accuracy of analytical method and equipment.**
Equipment Rinse Blank Samples	√	√	**One sample is submitted for every sample tool used. Sample is analyzed for the same analytical parameters as the typical environmental sample. Is used to determine if decontamination procedures are impacting the sample or if procedures are cleaning the equipment.**

APPENDIX A
SURFACE SOIL SAMPLING

Surface Soil Sampling Procedures

The collection of surface soil samples will be required to fulfill a variety of objectives including physical description, field screening, and laboratory chemical analysis. The task specific work plan specifies the data objective, location, depth, and analytical parameters for the soil sample program. The purpose of this field operation procedure is to describe the methods to be used during each of these activities.

This procedure will be used for the collection of surface soil samples. Surface soil samples will be collected using a direct push sampling tool or a sample trowel to collect a sample. All samples will be collected from the upper 2-inches of overburden. In the event vegetation is growing in the sampling area, either a bare spot close to the original location will be selected for sampling or the vegetation will be removed and only the overburden material sampled. The data to be obtained will be used to assess the environmental quality of the ground surface and any impacts that may result from the contaminants that are present.

Field Screening for Volatile Organics

Soil samples collected for field screening will undergo the following handling procedures:

- The sample sleeve will be removed from the DP sampling tool or split spoon sampler will be opened and the soil screened with the PID and or FID.
- The observed organic vapor concentration will be recorded for future reference.
- The sample will be visually inspected for soil classification, moisture content, and the presence of debris, stains or waste like materials (sludge, non-aqueous phase liquids).
- The representative portions of the sample will be placed in a glass jars with screw on lids for chemical analysis following the parameter list for surface soil samples.

Physical Description

For each sample interval will be visually examined and described in accordance with the Unified Soil Classification System. This information, together with a record of the length of the recovered portion of the interval, will be entered into the field logbook. Information to be included follows:

- Date;
- Boring Location Number;
- Sample Number;
- Depth Interval;
- Orientation; and
- Job Number.

Soil Samples for Laboratory Analysis

The Project's Work Plan and, or Quality Assurance Plan specifies the sample containers to be used and the parameters to be analyzed. Samples to be analyzed shall be placed in the containers as quickly as possible. Furthermore, all samples for laboratory analysis shall be preserved and transported in accordance with the following procedures. All samples to be sent to the laboratory for chemical analysis must be maintained in a condition that is as close as possible to in situ conditions. The first consideration is the proper selection of containers, preservation, and associated holding times. Other considerations include proper field notes, proper chain-of-custody procedures, and proper labeling of the samples.

Containers

The Quality Assurance Plan specifies the containers to be used.

Preservation

The general purpose of preservation is to maintain the original characteristics (and thus validity) of the sample during the time required for shipping of the sample to the laboratory. For soil, the only preservation technique is cooling the sample to approximately 4°C. This will be done in the field using ice or cold packs in coolers. Samples which are visually (highly) contaminated will be kept in individual sample coolers prior to and during transportation to the laboratory.

Sample Custody Procedures

The goal of implementing chain-of-custody procedures is to ensure that the sample is traceable from the time it is collected until it, or its derived data, are used. Samples would be considered in "custody" under the following conditions:

1. It is in personal possession.
2. It is in personal view after being in personal possession.
3. It was in personal possession when it was property secured.
4. It is in a designated secure area.

When transferring and/or shipping from the field, samples will be accompanied by the chain-of-custody record. The form includes the signatures of the relinquishers and the receiver as well as the date and time of the exchange, and any pertinent remarks. Since all samples will be immediately placed in coolers, shipment will also be made using these coolers. The samplers will complete the appropriate portion of the chain-of-custody form and deliver the cooler to the laboratory or to the shipping company. The receiving party will complete the remainder of the form and a copy will be retained by the sampler and kept with the field data sheets for that round of sampling. Each cooler will also be sealed using chain-of-custody tape.

Labels

The sample to be sent to the laboratory for chemical analysis will be identified with the following information:

- Date and time of collection;
- Location number;
- Sample number; and
- Sampler's name and affiliation.

Equipment Cleaning Methods

Equipment in actual contact with a laboratory sample will be cleaned prior to and between each use. The equipment will then be temporarily placed on clean racks, off the ground until it is used. Equipment such as DP samplers, sample trowels and soil knives will be cleaned with the following materials:

- Trisodium phosphate dissolved in clean water;
- Clean water rinse;
- Five percent nitric acid rinse;
- Distilled/deionized water rinse;
- Pesticide Grade Methanol rinse;
- Distilled/deionized water rinse; and
- Air dry.

APPENDIX B
SUBSURFACE SOIL SAMPLING

Soil Sampling Procedures

The collection of samples will be required to fulfill a variety of objectives including physical description, field screening, and laboratory chemical analysis. The task specific work plan specifies the data objective, location, depth, and analytical parameters for the soil sample program. The purpose of this field operation procedure is to describe the methods to be used during each of these activities.

This procedure will be used for the collection of subsurface samples. Soil samples will be collected using either a 4-foot-long by 2-inch-diameter direct push ("DP") sampling tool, a 2 to 3-inch diameter split spoon sampler, or grab samples from the sidewall of an excavation. A Geoprobe sampling rig will be used to advance DP tooling and a truck mounted drilling rig, using hollow stem augers, will be used to advance the split spoon sampler. The DP sampling tool will collect the samples within a clear acrylic sleeve. Grab samples will be taken directly from the undisturbed soil using a clean trowel or from disturbed soil from the backhoe bucket. Samples taken from the backhoe bucket will only collect samples which are less likely to have been impacted by the bucket. Taking the sample from undisturbed soil clumps. The selection of material for sampling will follow the procedures identified below.

Field Screening for Volatile Organics

Soil samples collected for field screening will undergo the following handling procedures:

- The sample sleeve will be removed from the DP sampling tool or split spoon sampler will be opened and the soil screened with the PID and or FID.
- The observed organic vapor concentration will be recorded for future reference.
- The sample will be visually inspected for soil classification, moisture content, and the presence of debris, stains or waste like materials (sludge, non-aqueous phase liquids).
- The representative portions of the sample will be placed in a glass jars with screw on lids.

Physical Description

For each sample interval will be visually examined and described in accordance with the Unified Soil Classification System. This information, together with a record of the length of the recovered portion of the interval, will be entered into the field logbook. Information to be included follows:

- Date;
- Boring Location Number;
- Sample Number;
- Depth Interval;
- Orientation; and
- Job Number.

Soil Samples for Laboratory Analysis

The Project's Work Plan and, or Quality Assurance Plan specifies the sample containers to be used and the parameters to be analyzed. Samples to be analyzed shall be placed in the containers as quickly as possible. Furthermore, all samples for laboratory analysis shall be preserved and transported in accordance with the following procedures. All samples to be sent to the laboratory for chemical analysis must be maintained in a condition that is as close as possible to in situ conditions. The first consideration is the proper selection of containers, preservation, and associated holding times. Other considerations include proper field notes, proper chain-of-custody procedures, and proper labeling of the samples.

Containers

The Quality Assurance Plan specifies the containers to be used.

Preservation

The general purpose of preservation is to maintain the original characteristics (and thus validity) of the sample during the time required for shipping of the sample to the laboratory. For soil, the only preservation technique is cooling the sample to approximately 4°C. This will be done in the field using ice or cold packs in coolers. Samples which are visually (highly) contaminated will be kept in individual sample coolers prior to and during transportation to the laboratory.

Sample Custody Procedures

The goal of implementing chain-of-custody procedures is to ensure that the sample is traceable from the time it is collected until it, or its derived data, are used. Samples would be considered in "custody" under the following conditions:

1. It is in personal possession.
2. It is in personal view after being in personal possession.
3. It was in personal possession when it was property secured.
4. It is in a designated secure area.

When transferring and/or shipping from the field, samples will be accompanied by the chain-of-custody record. The form includes the signatures of the relinquishers and the receiver as well as the date and time of the exchange, and any pertinent remarks. Since all samples will be immediately placed in coolers, shipment will also be made using these coolers. The samplers will complete the appropriate portion of the chain-of-custody form and deliver the cooler to the laboratory or to the shipping company. The receiving party will complete the remainder of the form and a copy will be retained by the sampler and kept with the field data sheets for that round of sampling. Each cooler will also be sealed using chain-of-custody tape.

Labels

The sample to be sent to the laboratory for chemical analysis will be identified with the following information:

- Date and time of collection;
- Boring number;
- Sample number; and
- Sampler's name and affiliation.

Equipment Cleaning Methods

Equipment in actual contact with a laboratory sample will be cleaned prior to and between each use. The equipment will then be temporarily placed on clean racks, off the ground until it is used. Equipment such as DP samplers, split spoon samplers and soil knives will be cleaned with the following materials:

- Trisodium phosphate dissolved in clean water;
- Clean water rinse;
- Five percent nitric acid rinse;
- Distilled/deionized water rinse;
- Pesticide Grade Methanol rinse;
- Distilled/deionized water rinse; and
- Air dry.

Non-dedicated drilling equipmen, backhoe buckets, and sampling equipment in contact with soil or waste materials will be cleaned prior to use and between each boring location. Decontamination of this equipment will be accomplished using a brush and trisodium phosphate dissolved in clean water to remove large solid particles, followed by steam cleaning with clean water. The equipment will be placed on top of open bins, drums, or "luggers" which will collect all wash water. When full, the contents will be pumped into closed drums and left on the Site for a disposal contractor. The drilling rig will be steam-cleaned prior to site entry and prior to leaving the site.

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Environmental Engineers & Scientists

BORING #:

Page 1 of 1

LOG OF BORING

Project
Location
Permit #:
Date Drilled
Drilling Co.:
Job #:
Total Depth
Method Used:
Inspector
Organic Vapor Inst:
Water elv:

Depth (feet)	Sample No.	Blows/6" 140 lbs.	Sample Inter.	Adv/Rec (feet)	Org. Vap (ppm)	Sample Description	Unified Class.	Permeability

APPENDIX C
MONITORING WELL CONSTRUCTION

Monitoring Well Construction Procedure

The purpose of this document is to explain the procedures that will be followed during the construction and installation of monitoring wells. The purpose of the monitoring well construction is to provide representative samples of the groundwater. Monitoring well construction should be designed based on conditions of the groundwater zone. Since those conditions are relatively unknown at this time, some changes to the design may be required.

According to the USGS, the Hornell Aquifer (Canisteo River Valley) in the site area, is composed of three units: an outwash sand and gravel matrix, lacustrine silt, sand and gravel and a kame deposit lower unit composed of sand and gravel. The upper most sand and gravel unit is suspected to be approximately 20 feet thick and terminate at a depth of approximately 30 feet below the ground surface. The proposed monitoring wells will be located in the sand and gravel zone or upon a less permeable layer, which may be located at a higher elevation.

Monitoring Well Construction

The drilling of test borings will be started by the split spoon sampling of the surface soil followed by the augering of the soil from the ground. Split spoon sampling will be completed in consecutive sequence from the ground surface to a point approximately five feet below the water table. From this point forward, split spoon samples will be collected in 5-foot intervals. Soil sampling will be done in accordance with the procedures found in Appendix A. Augering will be completed as needed following each two foot or five foot sample interval. Drilling will continue until the bottom of the groundwater zone is found or to a point approximately 20-feet below the ground surface.

One the field geologist has confirmed the bottom of the planned monitoring well, the Drilling Contractor will fill the interior portions of the hollow stem auger with water to place a positive pressure on the seal of the auger plug. If sand heaving is a problem the Drilling Contractor may add pure Bentonite clay to the water or drive casing with a disposable casing plug.

As the hollow stem auger flights are being filled the Drilling Contractor will construct the monitoring well using 2-inch diameter, clean PVC screen and riser. The monitoring well screen will be composted of slotted PVC with a minimum of 0.001-inch width slots. The slotted pipe will be approximately the length of the exposed groundwater zone thickness plus 2 feet, but will have a length of no more than 10-feet. The Drilling Contractor will then attach a sufficient length of 2-inch diameter PVC riser to extend the top of the monitoring well approximately 2-feet above the ground surface. Monitoring well sections will be joined using a threaded coupling.

Once the monitoring well is completed the Drilling Contractor will then remove the auger plug and insert the completed monitoring well. If the monitoring well does not reach the bottom of the hole, the Drilling Contractor will either push lightly onto the top of the monitoring well to force it into place or remove the monitoring well and re-drill that section of the test boring hole.

Once the monitoring well is in place the Drilling Contractor and field geologist will measure the monitoring well to ensure the depth of the bottom. Prior to removing the auger flights, the Drilling Contractor will slowly add sand to the annulus of the monitoring well to form a sand pack surrounding the monitoring well screen. With the addition of sand the Drilling Contractor will slowly begin removing the auger flights. During this process the Drilling Contractor and field geologist will monitor the thickness of the sand pack and monitoring well depth. Sand will be added to the annulus of the monitoring well until the sand reaches a point two feet above the monitoring well screen, see Figure 8.

At this point the Drilling Contractor will remove approximately 5 to 10 gallons of water from the monitoring well to settle the sand pack. After the water has been removed the sand pack will be re-measured and if consistent with previous measurement, the Drilling Contractor will be directed to add Bentonite clay pellets or granular clay to the annulus to form a seal above the sand pack. The Bentonite will be added in the same manner as the sand, adding a small amount of material and lifting or removing an auger flight. If the seal is above the water table, the Drilling Contractor will be directed to add potable water to the annulus to help hydrate Bentonite clay. The seal will have a thickness of at least two feet.

The Drilling Contractor will be directed to tamp the surface of the Bentonite with a weight tape or rod to compact the clay before adding the grout mixture. The grout mixture will consist of one sack (90-pounds of Portland cement), 3-pounds Bentonite clay powder, and six gallons of potable water. The grout will be mixed until a smooth consistency is formed. The grout will be placed into the annulus using a Tremie pipe placed approximately 2-feet above the clay. The slurry will be pumped into the annulus until the annulus is filled to a point approximately 2.5 feet below the ground surface.

The grout will be allowed to solidify before installing a protective casing or developing the monitoring well. The type of protective casing will be dependent on the location of the monitoring well. High traffic areas will require flush mounted curb boxes while remote areas will be fitted with casing that stick up from the ground surface approximately 2.5 feet. Each casing type will have locking mechanism; either a keyed lock or bolted cover. Each monitoring well will be given a locking plug.

Well Development

Monitoring well development will be started at least 1 day after the monitoring well is completed. Development will be completed by surging and pumping or bailing groundwater from the monitoring well to remove sediment from the monitoring well screen and well bore. Development will continue until the turbidity of the groundwater is less than 50 NTU. During the development process, the field geologist will monitoring the pumped groundwater for water quality (presence of sheens) and monitor the ambient air and groundwater for the presence of volatile organic compounds.

Records

The field geologist will be responsible for taking notes on all samples collected during the sampling process and all measurements and quantities used during the construction and development of the monitoring well. At the completion of the field activities, boring logs and constructions logs will be prepared for the final report, development records will be kept and water level measurements recorded.

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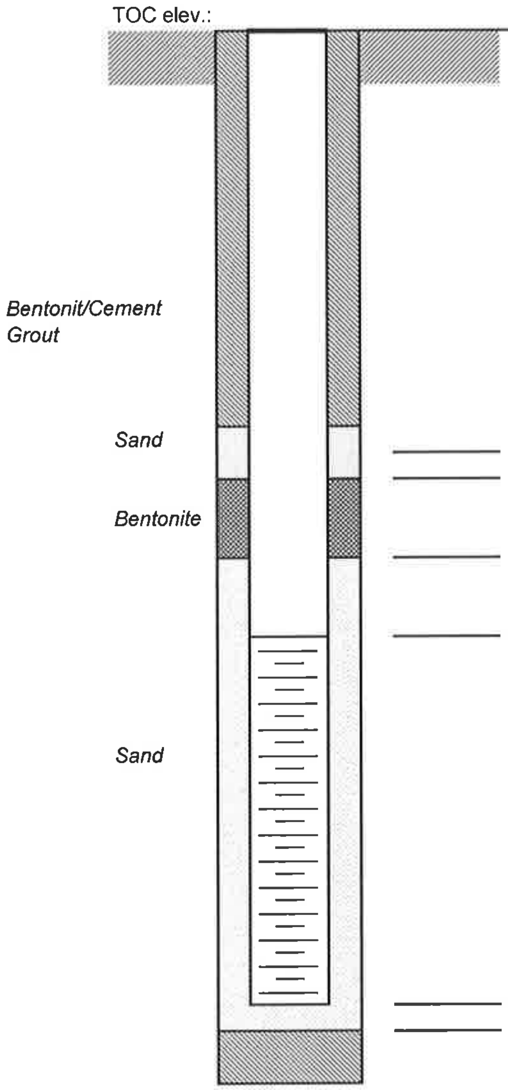
Environmental Engineers & Scientists

WELL CONSTRUCTION SUMMARY

Project: __________ Location: __________ Well No.: __________
Permit No.: __________

TOC elev.: -



DRILLING SUMMARY

Drilling Company: SJB
Drillers: __________
Drill Rig/Model: __________
Borehole Diameters: __________
Drilling Fluid: __________
Bits/Depths: __________
Total Depth: __________
Depth To Water: __________
Supervisor Geologist: __________

WELL DESIGN

Casing Material:		Diameter:	
Screen Size:		Diameter:	
Slot Size:		Setting:	
Backfill		Setting:	
Filter Material:		Setting:	
Seals Material:		Setting:	
Sand Cap		Setting:	
Grout:		Setting:	
Surface Casing Material:		Setting:	

TIME LOG

	Started	Completed
Drilling:		
Installation:		
Development:		

WELL DEVELOPMENT

Method: __________
Static Depth to Water: __________
Pumping Depth To Water: __________
Pumping Rate: __________
Spec. Capacity: __________
Volume Pumped: __________

Development Log
Former Hornell Waste Materials Site

Monitoring Well Development and Sampling Log								
Monitoring Well Identification Number								
	Units	**Initial Reading**	**1**	**2**	**3**	**4**	**5**	**6**
Development Method								
Static Water Level								
Depth to bottom of monitoring well								
Radius Monitoring Well								
Length of Water Column								
Volume in Monitoring Well								
Turbidity								
Disolved Oxygen								
Specific Conductance								
pH								
Temperature								
Oxidation - Reduction								
Start Time								
End Time								
Flow Rate								
Volume of Water Removed								

APPENDIX D
GROUNDWATER SAMPLING

Procedures for Groundwater Quality Sampling

The purpose of this document is to explain the procedures that will be followed during all groundwater sampling activities at the Site.

The water quality sampling will take place over a period of one to several days. The first day will consist of the pre-sampling activities listed below. All of the water level measurements for the wells to be sampled during each round will be made in a single day. Wells will be evacuated and sampled during the same day.

PRE-SAMPLING ACTIVITIES

Well Maintenance Check

Prior to every sampling event, a routine inspection of the condition of the protective casing and surface seal will be performed. The protective casing will be inspected for the integrity of the locking cap and the surface seal. In addition, each well will be checked for any other signs of damage or inadvertent entry. Observations of any irregularities will be noted in the field log book, as well as the well number, date, and time.

Air Monitoring

In order to provide workers with the proper respiratory protection for sampling, air monitoring in the breathing zone and immediately over the wellhead will be performed immediately after the initial uncapping. Health and safety procedures that are appropriate to the ambient air conditions will be implemented. Readings for both the breathing zone and wellhead will be recorded in the field log book. See the Health and Safety Plan for respiratory protection action levels, and a description of the proper air monitoring equipment.

Water Level Measurements

The depth to groundwater will be measured with an electronic depth-indicating sounder. The probe will be lowered into the well until the meter indicates water is reached. The probe will be raised above the water level and slowly lowered again until water is indicated. The cable will be held against the side of the inner protective casing for water level measurements and a depth reading taken. The value will be recorded to the nearest 0.01 foot in the field log book. The measurement will be repeated three times and the measurement recorded. The probe will be raised to the surface and together with the amount of cable that was wetted in the well, will be decontaminated with a wipe followed by a distilled/deionized water rinse.

The calibrated cable on the depth indicator will be checked against a surveyor's steel tape once per quarter year. A new cable will be installed if the cable has changed by more than 0.01 percent (0.01 feet for a 100-foot cable).

WELL EVACUATION

Overburden Monitoring Wells

- The well will be purged with a low flow peristaltic pump. The pump's acrylic or PVC intake tubing will be lowered into the monitoring well to a point that is approximately in the center of the monitoring well screen or in the center of the water column. The discharge end of the tubing will be placed into a flow-through cell from which groundwater quality parameters will be measured. The discharge from the flow-through cell will be routed into a five-gallon bucket for discharge measurement. For sampling water flow will be approximately 0.25 liters per minute or until a constant stream of water is obtained. The water level in the monitoring well will also be monitored and not allowed to drop below 0.125 feet from the original pre-sampling static water level.
- When the groundwater quality is stable indicating that a representative sample of groundwater can be collected, the discharge end of the tubing will be disconnected from the flow-through cell and routed into a five-gallon bucket to collected spills from the filling of sample containers.
- The appropriate sample vials will be filled slowly and with a constant stream of water (flow) to avoid sample aeration and the field parameter tests conducted as described in "Field Measurements."

FIELD MEASUREMENTS

A portion of the groundwater collected during the sampling procedures will be subjected to the field tests of temperature, dissolved oxygen ("DO"), turbidity, specific electrical conductance, oxidation-reduction potential ("ORP") and pH. Field measurements will be conducted on the well purge water immediately prior to sample collection. Groundwater for these tests will be collected and measured in a plastic flow-through cell. All field test parameters will be measured with a portable water quality instrument such as a Horiba U-22 Water Quality Monitoring System. Temperature will be measured to the nearest tenth of a degree and the value recorded in the field log book. Turbidity will be measured in standardized nephelometeric turbidity units ("N.T.U."). After each measurement the N.T.U. value of the sample will be recorded. The goal of the well purging will be to reduce the turbidity of the groundwater extracted from the monitoring well to less than or equal to 50 N.T.U. The specific electrical conductance will be measured to the nearest 1unit and recorded in the field log book. The pH will be measured to the nearest 0.1 pH unit and the reading recorded in the field log book. The DO will be measured to the nearest 0.1 unit and the reading recorded in the field log book. The ORP will be measured to the nearest 1 millivolt and the reading recorded in the field log book. Calibration will be conducted according to manufacturer's specifications.

EQUIPMENT DECONTAMINATION

All of the sampling equipment (excluding the water quality probes) will be decontaminated between sampling events using the following procedures or disposed of, if dedicated equipment is used (i.e. sample tubing).

- An initial wash with trisodium phosphate dissolved in clean water;
- Clean water rinse;
- Five percent nitric acid rinse;
- Distilled/deionized water rinse;
- Pesticide Grade Methanol rinse;
- Distilled/deionized water rinse; and
- Air dry.

Decontamination wastewater will be collected in containers and disposed of properly.

SAMPLE LABELS

Sample labels will be placed on all samples and will contain the following information:

- Date and time of collection;
- Sample location;
- Sample number;
- Analysis to be performed; and
- Sampler's initials.

FIELD LOG BOOKS

The field log books used during sampling procedures will include the following information:

- Sampler's name (initials);
- Sampling location;
- Static water level (depth to water);
- Depth to bottom of the well;
- Calculated well volume;
- Actual evacuation volume;
- Date and time;
- Analyses to be performed;
- Preservation method;
- Field meter calibration information;
- General remarks (weather conditions, etc.); and

- Sample number.

All entries will be made in black indelible ink with a ball-point pen and will be written legibly. Entry errors will be crossed out with a single line, dated, and initialed by the person making the correction. Field log books will be reviewed by the Quality Assurance Officer on a weekly basis

SAMPLE CHAIN-OF-CUSTODY

A chain-of-custody form will be completed after sample collection event. The chain-of-custody forms will accompany the samples to the laboratory. The field personnel collecting the samples will be responsible for the custody of the samples until transportation to the laboratory. Sample transfer will require the individuals relinquishing and receiving the samples to sign, date, and note the time on the chain-of-custody forms.

Development Log

Former Hornell Waste Materials Site

Monitoring Well Development and Sampling Log								
Monitoring Well Identification Number								
	Units	**Initial Reading**	**1**	**2**	**3**	**4**	**5**	**6**
Development Method								
Static Water Level								
Depth to bottom of monitoring well								
Radius Monitoring Well								
Length of Water Column								
Volume in Monitoring Well								
Turbidity								
Disolved Oxygen								
Specific Conductance								
pH								
Temperature								
Oxidation - Reduction								
Start Time								
End Time								
Flow Rate								
Volume of Water Removed								

APPENDIX E
SOIL VAPOR SAMPLING

Soil Vapor Sampling Procedure

The installation of probes for the collection of soil vapor samples will assist in the determination of whether or not there is a threat to on-site users and offsite receptors to vapor intrusion. The data will also be used to evaluate the subsurface soil and the groundwater quality since these samples are prone to evaluating only small areas and soil vapor data can represent the accumulation of impacts from the soil and groundwater over larger areas.

Sampling Probes

The soil vapor samples will be collected from temporary sampling locations placed into the ground using direct push ("DP") sampling equipment or split spoon sample holes. The soil probes will be extended to a point approximately 5 feet below the ground surface. The water table in the site area is unknown and the depth of the probes may require adjustment to ensure groundwater is not entrained into the sample.

Each sample location will be built using the following procedure:

- A Site utility location survey will be requested from local utilities to identify where utilities enter and cross the property.

- A 2-inch diameter DP hole or split spoon hole will be advanced to the targeted depth using Geoprobe DP rods or drill rods. The DP tools will be pulled and a 0.5-foot slotted PVC screen attached to a 0.25-inch outside diameter PVC or polyethylene food grade tubing will be placed into the hole.

- The hole will be backfilled with clean quartz sand to a point approximately 6 inches above the top of the vapor well intake. On top of the sand and to the ground surface, the open hole will be backfilled with a grout slurry mixture of 2 to 3 percent Bentonite and Portland cement. The 0.25-inch diameter tubing or PVC pipe will extend above the grout approximately 3 feet so it can be accessed for sampling.

- The tubing will then be purged to remove gases trapped in the sand and in the monitoring point during placement. A plug will then be placed into the tubing unless sampling will begin immediately. Purging will be done for a period of 5 minutes or until one to three open space (pore) volumes have been removed at a rate not to exceed 0.2 liters per minute. Ideally, the soil vapor sample point will have a volume of approximately 0.2 liters. After purging the tubing will be plugged.

4.1.2 Sample Collection

Prior to the start of sampling time, weather conditions, air temperature, barometric pressure, wind direction and approximate wind velocity will be noted. In addition, all sample locations will be tested with a tracer gas, consisting of Helium gas or propane, to determine if ambient air is infiltrating the sample. The tracer test will be conducted using the following steps:

- Sample tubing will be connected to the brass fitting on the in-place sample tubing or PVC pipe. The tubing will be of sufficient length to extend beyond a bucket placed over the sample location.

- A ring of hydrated Bentonite clay will be placed around the sample location. The Bentonite ring will act as a seal between the ground and the bucket, which will be used to enclose the sample location and to confine the tracer gas.

- A bucket will be placed over the sample location and a hole placed into the top of the bucket with a diameter equal to the sample tubing. The sample tubing will be placed through the hole and inserted into a sampling pump. The sample pump will be connected to a Helium detector. A second hole will be placed on the side of the bucket near the ground surface. A second tube connected to a Helium/propane gas cylinder will be threaded through the bucket and placed next to the sample location. The tubing will be taped or sealed to the bucket using Silicone or modeling clay. The Helium will be released into the bucket, the sample pump started and the Helium detector monitored.

- The test will be performed for 10 minutes. If Helium/propane is not detected in the sampled gas, the sub-slab sample will be collected. If Helium/propane is detected, the surface seal and tubing connections will be examined and either repaired or replaced and the tracer test completed again until a successful test is performed.

Prior to sample collection, the time, weather conditions, air temperature, barometric pressure, and wind direction and approximate velocity will be noted. Ideally, sample collection will start at 10:00 AM and continue uninterrupted for one hour. During the sample collection period, the sampling technician will inspect the sampling train and gauges several times to ensure the regulator and sampling train are operating properly. Sampling of the soil vapor will follow these procedures:

- The sampling technician will label the Summa canister with a unique sample number and record the sample number in the field notebook. The sampling technician will record the identification number of each canister and assign a canister to each sampling location. The technician will also not have or use permanent markers or use other products containing VOCs during sampling.
- The technician will then connect the Summa canister to the sample tubing. The technician will note the time and open the Summa canister regulator. The laboratory will specify the collection time for the sample flow rate and the desired detection limit needed for the Site. At this time, a 6 liter Summa Canister will be used and the sample will be collected for a period of 1 hour at a flow rate of 0.1 Liters per minute.
- When the sampling is completed the technician will close the regulator noting the time and vacuum, and disconnect the sample canister from the sample tubing. The technician

will label the canister with the sample time on the Summa canister and then complete the chain of custody and the field notebook with the sample information.

- The sampling technician will plug the sample tubing and place the Summa canister into the shipping container.
- The samples will be shipped overnight so the laboratory will receive the samples the next day.

Field Measurement for Former Hornell Waste Materials Site
Hornell, NY

Sample Location						
Sample Canister Number						
Regulator Number						
Time (Start)						
Temperature						
Humidity						
Barametric Pressure						
Wind Speed & Direction						
Gauge Measurement						
Gauge Measurement						
Time						
Gauge Measurement						
Time						
Time (Stop)						
Temperature						
Humidity						
Wind Speed & Direction						
Gauge Measurement						

APPENDIX F
HYDRAULIC CONDUCTIVITY TESTING

Permeability Testing Procedure

Rising Head Hydraulic Conductivity

In order to determine the in-place hydraulic conductivity of the geologic material, single-well, rising head slug tests will be performed. These tests involve lowering the water level in the well and measuring the change in head with respect to time as the well is allowed to recover. In wells, which are slow to recover, the water level will be bailed down as described below. The measurements in these wells will be taken manually. Wells, which recover too quickly for this method, will be tested by removing only one bailer of water and the recovery measured by means of a pressure transducer system.

The rising head slug tests for fast-recovery wells are conducted as follows:

- The static water level in the well to be tested is measured and recorded (to 0.01 foot; refer to Appendix D).
- The pressure transducer is placed in the well to a minimum depth of three feet below the static water level.
- Readings are made using the data logger until three consecutive readings are the same (equilibrium conditions).
- The data logger is then calibrated to read 0.00 feet at static conditions. Following the installation and calibration of the pressure transducer, a pre-cleaned dedicated bailer is lowered into the well and placed just below the water surface.
- Water level measurements will again be made until the water level returns to static conditions following introduction of the bailer. If static conditions are not reached within 15 minutes following introduction of the bailer, the well will be tested using the procedures described below for slow recovery wells.
- Once static conditions are re-established, the bailer will be rapidly removed from the water column, thus creating a virtually instantaneous decline of the water level in the well. Coincident with the withdrawal of the bailer, automatic logging of the water levels will be initiated using the data logger. It is a primary goal in a recovery test to "instantaneously" remove a volume of water that will result in a measurable head decline, the recovery of which (to static conditions) can be monitored over time. Such an instantaneous withdrawal results in recovery due to contributions of flow from the surrounding formation controlled by its hydraulic conductivity and not other factors (e.g. a long-term drawdown that would result in aquifer dewatering and thus inflow which would be affected by a portion going into storage). Thus, storage effects need not be considered in a slug test.

- The water level measurements will continue until water levels recover to within a minimum of 10 percent of the original static level (90 percent recovery), or an elapsed time of one hour. If after one hour the well has not recovered to the above criteria at the discretion of the hydrogeologist, the transducer will be removed and the well will be re-tested at a later date using the procedures described below for slow recovery wells.
- Data stored in the data loggers will be "dumped" either to a hard copy printout using a field printer or to a magnetic disk using a portable computer. If field printouts are used, each will be dated and signed by the hydrogeologist.

A cleaned dedicated bailer for each well will be used in the slug testing. All equipment entering the well, such as the transducer and transducer cable, will be cleaned prior to reuse with a wipe, following by a distilled/deionized water rinse. All well water and rinse water generated by the slug tests will be collected in containers (closeable five-gallon pails) and containerized for possible off site disposal.

For slow recovery wells the following procedure is used:

- The static water level is measured and recorded.
- The well is bailed by hand until the depth-to-water appears to stabilize, based on the depth of travel of the bailer rope (this measurement needs only to be approximated and is not critical to the test), or to the top of the open or screened interval (whichever is higher).
- The bailer is then removed and water level measurements are made by hand (measuring tape or electronic water level indicator) at a frequency which will provide approximately 15 to 20 data points during recovery (to within 10 percent of the total drawdown), if feasible.

The data is then plotted and evaluated as described below:

The following equation is used to calculate the in situ hydraulic conductivity of the formation opposite the interval of the piezometer (Bower and Rice, 1976, 1989).

$$K = \frac{r_c^2 \ln(R_e/r_w)}{2L} \, \frac{1}{t} \, \ln\frac{Y_o}{Y_t}$$

where:

K = hydraulic conductivity
r_c - casing radius
L - length of intake
r_w - radial distance between undisturbed aquifer and well center
R_e - effective radium of well
Y_o - initial drawdown
Y_t - vertical distance between the water level in well at time t and equilibrium level

The above method of calculating hydraulic conductivity developed by Bower and Rice is based on the Theim equation. The equation is accurate to within 10 to 25 percent depending on how much of the well below the water table is perforated or open. The technique is applicable to partially or completely penetrating wells in unconfined aquifers. The wells will be subjected to repeated slug testing for QA/QC purposes in accordance with Section 4.0, “Data Quality Objectives.”

SLUG TEST DATA FORM			**T_i**	**T_0**	**H_0**	**h**	**ΔT (T_i-T_o)**	**(H-b)**	**(H-H_0)**
Project Number								0	0
Location									
Monitoring Well ID									
Date									
Tester									
Method	Slug Injection	Slug Removal							
Slug Volume		Cubic feet							
Radius of Well		Feet							
Radius of Boehole		Feet							
Total Depth of Well		Feet, below ground surface							
Length of Screen (L)		Feet							
Thickness of Acquifer		Feet							
Measuring Point for Water Level Meas.		Feet above or below ground surface							
Pretest Water Level		Feet below measuring point							
H = Initial water level		Initial water level prior to removing slug							
H_0 = Depth at time (T_o)		Feet							
h= Water level at time T>0		Feet							
T_0 = Time T_0 Start of Test		Time Hour, Minutes and Seconds							
Ti = Time at when h is measured		Time Minutes and Seconds							
H_F Depth to water at end of Test		Feet below measuring point							

APPENDIX G
WASTE HANDLING

The procedures identified in this Appendix were prepared with the intent of providing instruction for the safe handling, temporary storage and disposal of investigation derived waste and waste possibly generated from the completion of an interim remedial measure ("IRM"). In general, for any of the wastes generated during this project, will be placed in containers compatible with the waste and appropriate containers the type of waste being handled. Health and safety of the site workers is not covered in this procedure.

Investigation Derived Waste

Investigation derived waste can include: drill cuttings, decontamination water, purge water from monitoring wells, solid waste consisting of personnel protective equipment, card board, plastic, and paper. How the waste is handled will be decided based on the expected volume and the consistency of the waste. Consequently the following acceptable containers have been identified:

Drums - Liquid

Steel or plastic 55-gallon drums with closed lids will be utilized to control decontamination water and purge water from monitoring wells. In general, decontamination water will be kept segregated from other liquid waste because of the potential for this waste stream to be handled as a non-hazardous waste. Decontamination water will be pumped from the decontamination area into the drums after sediment has been removed. This will be done to minimize the amount of sediment accumulating in a drum and the possible need to sample the sediment.

Groundwater pumped from monitoring wells during development and sampling will be containerized in steel or plastic closed lid drums. Since development waters may be heavily laden with sediment an open top drum may be used as an interim step before transferring the waste into closed drums. Sediment separated from development water will be temporarily held in an open top drum. In the event free product is found during the development or monitoring well purging, the free product will be placed in a separate drum and appropriately identified.

When each drum is full, a label will be placed on the drum indicating the type of waste, where it is from (monitoring well number, decontamination pit, etc.), and the date it was generated. The drums will be placed on one of the site's former concrete floor slabs. Caution tape and, or snow fencing will be used to warn passerby's of the materials being stored.

Drums – Solids

Steel or plastic open top 55-gallon drums will be used to containerize solids generated by the investigation activities. During the course of the field investigation waste solids will be generated and consist of unsoiled personnel protective equipment, paper, plastic, and card board ("dry waste"), and soil cuttings or sediment. Dry waste will not be co-mingled with other waste and handed as household trash. Personnel protective equipment that has been contaminated with dirt or free product will be separated from the other non-contaminated dry waste and placed in a separate drum.

Soil cuttings or sediment from the decontamination area or development water will be placed into open top steel drums for temporary storage at work locations. At the completion of work at any particular location the drum will be brought to the temporary storage area.

When each drum is full, a label will be placed on the drum indicating the type of waste, where it is from (monitoring well number or decontamination pit), and the date it was generated. The drums will be placed on one of the site's concrete floor slabs. Caution tape and, or snow fencing will be used to warn passerby's of the materials being stored.

Soil Cuttings and Sediment

Because the cost of the disposal of soil cuttings and sediment is significantly more when the waste is handled in drums, waste of similar quality will be placed on two layers of plastic sheeting. The plastic will be located on a concrete slab used by one of the former buildings. The first layer will have a berm beneath it made from soil, sand bags or wood boards. The second layer will drape over the first and have enough material so it can be folded over the waste and secured in place with tires or water filled pails.

If some of the waste is stained, giving off volatiles as measured by the organic vapor analyzer, or odorous a second pile may be started. If only a small quantity of waste has these characteristics then it may remain in a drum.

The covered soil pile will be inspected for tears or the accumulation of rain or snow. Water will be drained from the plastic and onto the ground if there is no indication of a tear in the plastic. Water found mixed with the waste will be either pumped into a drum or absorbed and the plastic replaced of covered.

Soil piles will be posted or labeled indicating the type of waste, where it is from (monitoring well number or decontamination pit), and the date it was generated. The piles will be surrounded with caution tape and, or snow fencing to warn passerby's of the materials being stored.

IRM Waste

IRM waste will be handled like the investigation derived waste if the quantities expected to be generated remain relatively small: a few hundred gallons of water or less than 5-tons of soil. If the IRM will exceed those volumes and weights then tanks or a roll off box will be used to containerize the waste. However, regardless of the size of the container, the same procedures will be used. Waters will be as sediment free as possible and waste in the roll off box will be covered. If the waste is anticipated to be wet, the roll off box will be lined. The containers will be located to facilitate removal and, or to minimize handling. The containers will be labeled indicating the type of waste, where it is from (monitoring well number, decontamination pit, etc.), and the date it was generated. The tanks will have valves locked to minimize the consequences of vandalism. Roll offs will be surrounded with caution tape and, or snow fencing to warn passerby's of the materials being stored.

Waste Characterization

It is anticipated that the waste characterization requirements will closely follow USEPA's RCRA regulations, but these may be changed based on the requirements of the facilities where the waste may be landfilled and, or treated. Samples of the generated waste will be collected at the completion of field work. The goal of the waste characterization will be to remove the waste from the site within 90-days.

Attachment B
Health and Safety Plan

HEALTH AND SAFETY PLAN

Brownfield Redevelopment
Former Hornell Waste Materials Company, Inc.
Hornell, New York

NYSDEC Site # C851027

Prepared for:

Hornell Site Development LLC
PO Box 356
Hornell, New York 14843

Prepared by:

Leader Professional Services, Inc.
271 Marsh Road, Suite 2
Pittsford, New York 14534

December 2014

856.001

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APPENDICES

1.0 Project Personnel Responsibilities

Project organization is presented below in Section 1.5.

1.1 Principle-In-Charge

The Principle-In-Charge for this project will be Michael Rumrill. Mr. Rumirll will act in a supervisory capacity overall Leader Professional Services, Inc. (Leader) employees and their subcontractors and the planned site activities with respect to the project site. Mr. Rumrill has the authority to direct site operations including the performance of this health and safety plan. The project manager will have the required 29CFR 1910.120 40-Hour Training and have an updated 8-Hour Refresher Training Certificate.

1.2 Project Manager

The Project Manager will be Mr. Peter von Schondorf of Leader. If a substitute is required, the Project Supervisor will be an employee of Leader. The project supervisor oversees all field and related activities specific to the project when the project manager is not on the site. The project manager will have the required 29CFR 1910.120 40-Hour Training and have an updated 8-Hour Refresher Training Certificate.

1.3 Health and Safety Officer

Ms. Robin Miszkiewicz is the site's health and safety officer ("HSO"). Ms. Miszkiewicz has the authority to stop work if any operation threatens the health and safety of workers or the public. The HSO may designate a member of the work party for site health and safety responsibilities when the HSO can not be on site. The HSO will have the required 29CFR 1910.120 40-Hour Training and have an updated 8-Hour Refresher Training Certificate.

1.4 Project Team

Personnel and subcontractors on the project team will be responsible for the completion of the work plan's required tasks. All personnel on the project team will comply with the site safety plan and ensure the site safety and health officer or supervisor is notified of any unsafe conditions. It is anticipated that the project team will consist of one to three individuals. This may vary due to any changes that occur during the actual site work. All personnel on the project team will have the required 29CFR 1910.120 40-Hour Training and participate in daily tailgate health and safety meetings.

1.5 Project Organization

Project Manager – Peter von Schondorf, Leader
Site Supervisor – Luke Spencer, Leader
Health and Safety Officer – Robin Miszkiewicz, Leader

2.0 Site Standard Operating Safety Procedures

Standard operating and safety procedures include safety precautions and operating practices that all personnel will follow. These include:

2.1 Personal Precautions

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated contaminated.

- Hands and face must be thoroughly washed upon leaving the work area.

- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.

- No facial hair, which interferes with a satisfactory fit of the mask-to-face seal, is allowed on personnel required wear respirators. Personnel will use the negative pressure fit test prior to each use of the equipment.

- Contact with contaminated or suspected contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, leachate, discolored surfaces, kneel on ground, lean, sit or place equipment on drums, containers, or the ground.

- Medicine and alcohol can enhance or mask the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by field personnel where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified physician. Alcoholic beverages should be avoided, in the off-duty hours, during the project.

2.2 Operations

- All personnel going on-site must be adequately trained and thoroughly briefed on anticipated hazards, equipment to be worn, safety practices to be followed, emergency procedures, and communications.

- Any required respiratory protection and chemical protective clothing must be worn by all personnel going into areas designated for wearing protective equipment.

- Personnel on-site must use the buddy system when wearing respiratory protection. As a minimum, one person, suitably equipped, is required as safety backup during initial entry.

- Visual contact must be maintained between pairs on-site and safety personnel. Entry team members should remain together to assist each other during emergencies.

- During continual operations, on-site workers act as safety backup to each other. Off-site personnel provide emergency assistance.

  Communications using radios, hand signals, signs, or other means must be maintained between team members at all times.

- Wind indicators visible to all site personnel should be strategically located throughout the site.

- Personnel and equipment in the contaminated area should be minimized to reduce the potential for cross contamination and the generation of decontamination waste.

- Work areas for various operational activities will be established by the project manager, or his designee, and the HSO.

- Procedures for leaving a contaminated area must be planned and implemented prior to going on-site. Work areas and decontamination procedures have been established based on expected site conditions and are described in the project Work Plan.

3.0 Health and Safety Hazards

The potential hazards that may be experienced during the performance of the Work Plan include: chemical exposures from contact with contaminated soil and groundwater; hazards inherent to working with drilling and sampling equipment and working within an active truck terminal; slip, trip and fall hazards; and heat stress from performing heavy work while wearing protective clothing. The extent of contamination is well known, but monitoring for the presence of organic vapors will be conducted. To prevent un-necessary exposures to vapors and to limit the potential for cross-contamination, all work areas will be limited from general access. The formation of distinctive work zones will also assist in reducing the potential hazards that may exist at working at the trucking terminal. To further reduce the potential for accidents to involve moving trucks and forklifts, Leader will coordinate each field activity with the terminal manager(s) so drivers and terminal personnel know where investigative activities are occurring on the Site. To reduce accidents from occurring that involve slip, trip and fall hazards and hypothermia, work will be monitored by the Site HSO and workers will be encouraged to use the "buddy-system" while lifting heavy tools or items to reduce early fatigue while wearing protective clothing.

Table 1 list potential health and safety hazards that may be encountered based on general site tasks. This list has been compiled based on the scheduled activities and potential site conditions.

4.0 Personal Protective Equipment

4.1 Protective Equipment

All personnel will be provided with appropriate personal safety equipment and protective clothing. Each individual will be properly trained in the use of this safety equipment before the start of field activities. Safety equipment and protective clothing shall be used as directed by the Project Manager and/or Site HSO. All such equipment and clothing will be cleaned and maintained in proper condition by the personnel. The Site HSO will monitor the maintenance of personnel protective equipment to ensure proper procedures are followed.

Personal protective equipment will be worn at all times designated by this Health and Safety Plan. Levels of protective clothing and equipment are not expected to exceed Level C. Results from the previous groundwater samplings and on-site readings will be used to set action levels and levels of personal protection.

The personal protective equipment levels designated below are in conformance with EPA criteria for Level A, B, C, and D protection. All respiratory protective equipment used will be approved by National Institute for Occupational Safety and Health ("NIOSH") and Mine Safety and Health Administration ("MSHA"). Although the conditions within the proposed work areas are well known monitoring will be completed at all times, but it is doubtful that levels of respiratory protection will exceed Level D.

4.2 Level C Protection

A. Personal Protective Equipment

- Half-face, air-purifying, canister-equipped respirator (MSHA/NIOSH approved) for acid/gas/organic vapor with particulate filter

- Chemical-resistant clothing (overalls and long sleeved jacket; coveralls or hooded, one piece or two-piece chemical-splash suit; disposable chemical resistant one-piece suits)
- Work Clothes (Long Shelve Shirt and pants)
- Gloves (outer), chemical resistant
- Gloves (inner), chemical resistant
- Boots (inner), leather work shoe with steel toe and shank
- Boots (outer), chemical resistant (disposable*)
- Hard Hat (face shield*)
- Safety Glasses or goggles
- Taping between suit and gloves, and suit and boots

*Optional

B. Criteria for Selection

Meeting all of these criteria permits use of Level C Protection.

- Measured air concentration of identified substances will be reduced by the respirator to, at, or below the substance's Threshold Limit Value (TLV)/Permissible Exposure Limits (PEL) and the concentration is within the service limit of the canister.
- Atmospheric contaminant concentrations do not exceed IDLH levels.
- Atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect the small area of skin left unprotected by chemical resistant clothing.

4.3 Level D Protection

A. Personal Protective Equipment

- Work Clothes (Long shelve shirt and pants)
- Leather, steel-toed boots

- As required:

    - Hard hat
    - Safety glasses/goggles
    - Hearing protection
    - Gloves

B. Criteria for Selection

Meeting all of these criteria permits the use of Level D Protection.

- Measured air concentrations of identified substances are below the substances Permissible Exposure Limit (PEL) or TLV.

- Oxygen content is > 19.5%.

- No unknown substances are present.

5.0 Decontamination

It is expected that the usual level of protection to be Level D. Level C will be used when potential exposures to contaminants justify increased protection. A decontamination zone will be set up at the entrance of each work zone. Based on the level of expected exposure to contaminants, the following decontamination protocol will be used.

5.1 Personnel Decontamination

It is expected that a minimum of Level D decontamination will be continually in effect at the site. On these occasions when higher levels of protection are required, appropriate decontamination procedures will be used. The extent of the decontamination procedures will be at the discretion of the site Health and Safety Officer.

In general, decontamination involves removing potentially contaminated soil from gloves and clothing, followed by scrubbing with a non-phosphate soap/water solution and clean water rinses. As a general rule, protective clothing will be removed in the reverse order as it was put on: gloves and boots off first, followed by protective suits and then breathing apparatus. As the different types of waste are generated, the team members will segregate the waste into different drums. Potentially contaminated soil and sediment will be placed into one drum and decontamination waste fluid into a second drum. All disposable items will be placed into a dry goods drum.

Certain parts of contaminated respirators, harness assemblies and leather or cloth components, are difficult to decontaminate. If grossly contaminated, they may have to be discarded. Rubber components can be soaked in soap and water and scrubbed with a brush. In addition to being decontaminated, all respirators, non-disposable protective clothing, and other personal articles must be sanitized before they can be used again unless they are assigned to individuals. The manufacturer's instruction should be followed in sanitizing the respirator masks. The Site HSO will be responsible for supervising the proper protective equipment.

All decontamination wastewaters will be collected and disposed of according to applicable regulations. This disposal will be done at the direction of the Project Manager.

5.2 Equipment Decontamination

Decontamination will be applicable to all activities on site and be completed in the contamination reduction zone ("CRZ") section of the exclusion zone. All equipment (i.e., tools, monitoring equipment, etc.) will receive initial decontamination. All equipment that has been in contact with contaminants shall be stored in an area within the limits of the existing exclusion zone or shall be thoroughly decontaminated prior to leaving the area. Decontamination will consist of cleaning of the entire piece of equipment to the satisfaction of the Site Supervisor or the HSO. Decontamination will be a multi-process task, first all loose dirt or other foreign materials will be removed from equipment surface. Scrubbing with a synthetic wire brush may be required to remove materials that adhere to the surfaces. After the loose dirt is removed, the equipment will be washed using a detergent and water solution and a wire brush followed by successive rinses with clean water. Washing with hot water from a power washer may be substituted for a synthetic wire brush.

All dirty equipment will be stored on plastic sheeting in such a manner that decontamination waters can be collected and disposed of in accordance with applicable regulations. Clean equipment not in use will be covered with plastic and stored at a designated storage area.

Air monitoring equipment will be protected with an outer coating (i.e. plastic), if there is a potential for the equipment to come into contact with potentially contaminated materials prior to the initial entry into the exclusion zone. Decontamination will then consist of removal of the protective coating in a manner that will not contaminate the air monitoring equipment.

6.0 Site Air Monitoring

Field activities associated with the work tasks at the Site may pose hazardous conditions, such as the release of hazardous substances into the worker's breathing zone. These substances may be in the form of vapors, dusts, or mists that can enter the body through ingestion, inhalation, or direct skin or eye contact. If the HSO, relying on instrument observations and odor, determines that a condition exists in which workers may be exposed to airborne hazardous materials, the HSO will upgrade the team's level of respiratory protection and complete chemical specific monitoring.

The following paragraphs describe the monitoring parameters to be evaluated during the start of the project. As the project continues, other site-specific monitoring will be required based on site conditions and experience at the site. Because this project will be completed in the winter and the proposed work area is covered with asphalt, the concern about contaminated dust being an issue is reduced. Similarly, combustible materials have not been identified as a contaminant in the soil or groundwater, thus the necessity for oxygen and combustible gas monitors is not supported. All instruments to be used during site activities will meet the established requirements set forth by OSHA, MSHA, NIOSH, and state agencies where applicable.

Equipment observations will be made during work progress with direct reading organic vapor meter. Monitoring will take place in the work zone and workers breathing zone, up and down-wind from the work zone and at the Site perimeter. Monitoring within the work zone will be taken at least every 15 to 30-minutes. Monitoring up and down-wind of the work zone will be completed at least every 30 to 60 minutes and monitoring at the Site perimeter will be completed at least every 60 minutes. If elevated readings are obtained (elevated compared to up-wind readings or compared to Site specific action levels), then the frequency of taking measurements will be increased at the monitoring stations.

Based on preliminary monitoring well sampling data, it is anticipated that organic vapors will be below 1 ppm. Organic vapor concentrations will be the primary measure for upgrading or downgrading worker respiratory protective equipment and implementing additional precautions or procedures (See Table 2, Action Levels).

All site monitoring will be conducted by or under the direction of the Site HSO. All readings obtained will be recorded in a dedicated site notebook maintained by the Project Supervisor or designate. The Site HSO will maintain all monitoring instruments throughout the site investigation to ensure their reliability and proper operation.

7.0 Action Levels

Action levels have been established for the upgrade and downgrade in the levels of personal protective equipment. Table 2 lists the action levels, airborne concentrations and their respective personal protection for unknown sources of organic vapor concentrations. Section 8.0 discusses the minimal personal protection required for specific site activities based on current information. Changes to these specified levels are dependent on the result of air monitoring as outlined below.

8.0 Site Activities and Associated Personnel Protective Requirements

The levels of protection have been assigned anticipated Site activities (below) and represent a best estimate of exposure potential and protective equipment needed for that exposure. The site HSO will revise those levels of protection, up or down, based on air monitoring results, and on-site assessments of actual exposures.

- *Level D* - General site work with limited physical contact with contaminated soil by personnel. If workers must pick up contaminated tools or a soil samples, protective chemical resistant gloves will be worn. Respiratory protection is not required because contaminant action levels cited on Table 2 are not exceeded.

- *Modified Level C* - General site work where personnel will be in direct contact with contaminated soil or groundwater, but respiratory protection is not required because contaminant action levels cited on Table 2 are not exceeded.

- *Level C* - General site work where personnel will be in direct contact with contaminated soil or groundwater, and organic vapor measurements or dust measurements are greater than those action levels cited on Table 2.

9.0 Contingency Plan

The Project Manager/Supervisor or HSO is responsible for implementing the Contingency Plan whenever there is either a threat to human health or an environmental hazard. Possible Contingency Plan situations include actual or imminent fires, explosions or spills.

The individual discovering the emergency situation is to notify the Project Supervisor or HSO who will then notify the appropriate organizations as described in Table 3.

9.1 Assessment

The Project Manager/Supervisor is responsible for ascertaining any possible health or environmental hazards and determining the need for evacuation and notification of the proper authorities.

9.2 Control Procedures

The team member or site employee discovering a fire, explosion, spill or other emergency situation is responsible for notifying the Project Supervisor or Site HSO and as much as possible, provide the information listed in Table 3.0. The Project Supervisor or Emergency Response Coordinator will assess the situation to determine if it can be adequately handled by site personnel or if additional assistance is needed.

Before any team member attempts to extinguish a fire, clean-up and contain a spill or take any action, he or she must be aware of the properties of the material involved and its associated hazards. All team members are familiarized with this information during the initial tail grate safety meeting and are instructed on the proper protective clothing to be worn in such a situation.

Table 3 includes a list of the organizations that are available to provide emergency assistance.

9.3 Fire and/or Explosion

The most serious emergency situation that could be faced at the site would be a chemical release or major fire. In the event of a fire or explosion, the Project Supervisor or Site HSO should be notified as described in the preceding section. The Project Supervisor or Emergency Response Coordinator is responsible for determining the requirements for outside assistance as well as the necessity for site evacuation.

The Fire Department should be notified immediately once a fire is detected. Small fires can be extinguished using a fire extinguisher located at the site. Larger fires will require the assistance of the fire department. The fire department will be informed of the nature of the fire and wastes at the site, and if water can be used to extinguishing fire.

9.4 Spill and/or Material Releases

The procedure for notification of the Project Manager/Supervisor and, or Site HSO are described in Section 9.2. Immediately following the discovery of a spill the NYSDEC will be notified. In addition, the Comprehensive Environmental Response, Compensation, and Liability act of 1980 (CERCLA, or Superfund) requires that the National Response Center be notified of any release in excess of the reportable quantity of a listed material.

Spill clean-up poses no danger under normal conditions. The first step is to determine the source of the spill and correct it. This may involve patching a leaking drum, closing a valve or turning off a pump. In the event of a small spill, absorbent granules or sorbent pads will be utilized to soak up the spilled material. The granules would then be swept up and containerized in Department of Transportation approved drums.

In the event a large spill occurs, Hornell Site Development’s preferred remedial contractor will be called to bring in pumps and vacuum trucks, and transfer spilled material from the collection area into storage tanks or drums. All absorbent materials would be placed in DOT approved drums.

Any contaminated structures and equipment must be properly cleaned before being returned to service. This procedure will include use of pressure washers and sorbent materials. All affected floors and equipment, pumps and hoses, will be cleaned with an appropriate detergent and rinsed with clear clean water.

10.0 Work Areas

The Project Manager/Supervisor and HSO, and if needed the Contractor, will clearly layout and identify work areas in the field and will limit equipment, operations, and personnel as defined in the following areas:

a) “Exclusion Zone” - This area will include all areas where environmental monitoring has shown or it is suspected that a contamination may exist and be a potential exposure problem to workers. The level of personnel protective equipment required in these areas will be determined by the Site HSO. The area will be clearly delineated from the decontamination area. As work within the hazardous zone proceeds, the delineating boundary will be relocated as necessary to prevent the accidental contamination of nearby people and equipment. The Exclusion Zone will be delineated by plastic caution tape, barriers, or fencing (e.g., chain link, snow, or orange plastic fencing).

b) Contamination Reduction Zone (CRZ) - This zone will occur at the interface of “Contaminated” and “Clean” areas and will provide for the decontamination of equipment and materials and the transfer of equipment from the Clean Area to the Exclusion Zone. This area will contain all required emergency equipment, etc. This area will be clearly delineated by plastic tape, barriers or fencing (e.g., chain link, snow, or orange plastic fencing).

c) Support Zone (“Clean” Area) - This area is the remainder of the work site and project site. The “Clean” area will be clearly delineated and procedures implemented to prevent active or passive contamination from the work site.

The function of the “Clean” area includes:

1) An entry area for personnel, material, and equipment to the “Contaminated Zone” area of site operations through the neutral zone.

2) An exit for decontaminated personnel, materials, and equipment from the “CRZ” area of site operations; and

3) A clean storage area for safety and work equipment.

11.0 Safety Equipment and Protective Clothing Specifications

All project team members and contractors will have the following safety equipment:

- Air purifying respirator with appropriate cartridges

- All protective clothing including, but not limited to:

    - Tyvek and washable PVC rain suits
    - Gloves
    - Boots

- Safety glasses

- Hearing protection

- Hard hats

12.0 Air Emissions Control

The Project Team and subcontractor shall have on site all equipment and personnel necessary to monitor and control air emissions.

It is not expected that air emissions will pose a significant risk to health and safety or to the environment due to the nature of the contaminants on this project.

The Project Manager(s) and/or the Site HSO will make the determination for requiring monitoring and control of air emissions with the assistance of the following monitoring equipment and the action levels cited on Table 2. It is anticipated that an organic vapor analyzer and chemical specific detection tubes will be used to measure the concentration of most organic contaminants in the air. These two measurement devices will handle the bulk of the real-time contaminant monitoring.

13.0 Additional Health and Safety Comments

1) The Site HSO will ensure that all safety equipment and protective clothing is kept clean and well maintained.

2) All prescription eyeglasses in use on this project will be safety glasses and will be compatible with respirators. No contact lenses shall be allowed on-site.

3) All disposable or reusable gloves worn on the site will be approved by the HSO.

4) During periods of prolonged respirator usage in contaminated areas, respirator filters will be changed upon breakthrough and at a minimum filters will be changed daily.

5) Footwear used on-site will be covered by rubber over-boots when entering or working in the "Exclusion Zone" area or "CRZ." Boots will be washed with water and detergents to remove dirt and contaminated sediment before leaving the "CRZ."

6) All personnel protective equipment used on-site will be decontaminated or disposed of at the end of the workday.

7) All air purifying respirators will be individually assigned and not interchanged between workers without cleaning and sanitizing.

8) Any team member or Contractor unable to pass a fit test as a result of facial hair or facial configuration shall not enter or work in an area that requires respiratory protection.

9) The Contractor will ensure that all project team members shall have vision or corrected vision to at least 20/40 in one eye.

10) Team members found to be disregarding any provision of this plan will, at the request of the HSO, be barred from the project.

11) Used disposable outerwear will be removed upon leaving CRZ and will be placed inside disposable containers labeled for that purpose. These containers will be stored at the site at the designated staging area. Leader will be responsible for proper disposal of these materials at the completion of the project.

12) Tyvek or PVC rain suits that become torn or badly soiled will be replace immediately.

13) Eating, drinking, chewing gum or tobacco, smoking, etc., will be prohibited in the exclusion zones and CRZ zones.

14) All personnel will thoroughly cleanse their hands, face, forearms, and other exposed areas prior to eating, smoking, or drinking.

15) All personnel will wash their hands, face, and forearms before using toilet facilities.

16) No alcohol, firearms, or drugs (without prescription) will be allowed on-site at any time.

14.0 Miscellaneous Health and Safety Items

14.1 Hypothermia

Pervious Clothing: When the ambient air temperature dips below 40^o F. the Site HSO will begin to monitor employees for signs of hypothermia. Monitoring will take the form of measuring oral temperatures. The air temperature will be measured two times a day when the air temperature is expected to be below 40^o F or as determined by the Site HSO.

Impervious Clothing: When the ambient air temperature has dip below 40^o F. the Site HSO will begin to monitor employees for signs of hypothermia. Monitoring will take the form of measuring oral temperatures and checking an individual's verbal and physical responses. As the air temperature dips below 32^o F., oral temperatures will be measured at the direction of the Site HSO and, or every hour during work periods.

In the event that the oral temperature at the beginning of the rest period drops below 96^o F., the employee will be decontaminated and be advised to proceed to a heated room or vehicle and remove wet clothing and to drink warm fluids. At the end of the rest period, the oral temperature will be taken again to ensure that the employee's temperature is above 96^o F. If the oral temperature has remained below 96^o F., the employee will be advised to take a shower to increase his/her temperature. However, if the oral temperature still remains below 96^o F. after the shower, the employee will be immediately sent to consult with a physician.

A fluid/electrolyte replacement will be used as necessary to minimize fluid loss. This liquid supplement will be stored in a cooler or thermos at the edge of the decontamination zone in plastic squeeze bottles. The plastic bottles will be marked with individual's names. Disposable cups with lids and straws may be used in place of the squeeze bottles.

Prior to drinking within the decontamination zone, the project personnel shall follow the following decontamination procedures:

1) Personnel shall wash and rinse their outer gloves and remove them.

2) Personnel shall remove their hard hats and respirators and place on a table.

3) Personnel shall remove their inner gloves and place them on a table.

4) Personnel shall wash and rinse their face and hands.

5) Personnel shall carefully remove their personal bottle or cup from the cooler to ensure that their outer clothes do not touch any bottles, cups, etc.

6) The used bottle or cups will not be returned to the cooler, but will be placed in a receptacle or container to be cleaned or disposed of.

7) Personnel shall replace their respirators, hard hats, gloves, and tape gloves prior to re-entering the hazardous zone.

14.2 Retention On-Site

During the course of the project, it is expected that waste materials will be retained on-site until removed by Hornell Site Development. All waste containers will be labeled according to DOT and other regulations where appropriate. Waste materials, both drummed and bulk, will be stored in designated areas. All waste drums will be sealed before they are moved from the exclusion zone.

14.3 Equipment and Material Decontamination

All equipment and material used in this project shall be thoroughly decontaminated using procedures described in the project Work Plan before it is removed from the project site. Debris and contaminated clothing and tools which cannot be decontaminated, shall be disposed of.

14.4 Communications

Telephone communications will be available at all times on the site. A telephone will be maintained with the Project Manager or Site Supervisor.

Communication procedures are outlined in the Contingency Plan in Section 9.0 of the Health and Safety Plan.

Table 3 contains an emergency call list and will be posted in one of the team member's vehicles and in the Hornell Waste office.

14.5 On-Site Hygiene Facilities

The office lavatories will be available for decontaminated team members and subcontractors. Water will be available in the CRZ for decontamination.

A first aid kit will be kept in the support zone at the Site at all times.

15.0 Tailgate Safety Meetings

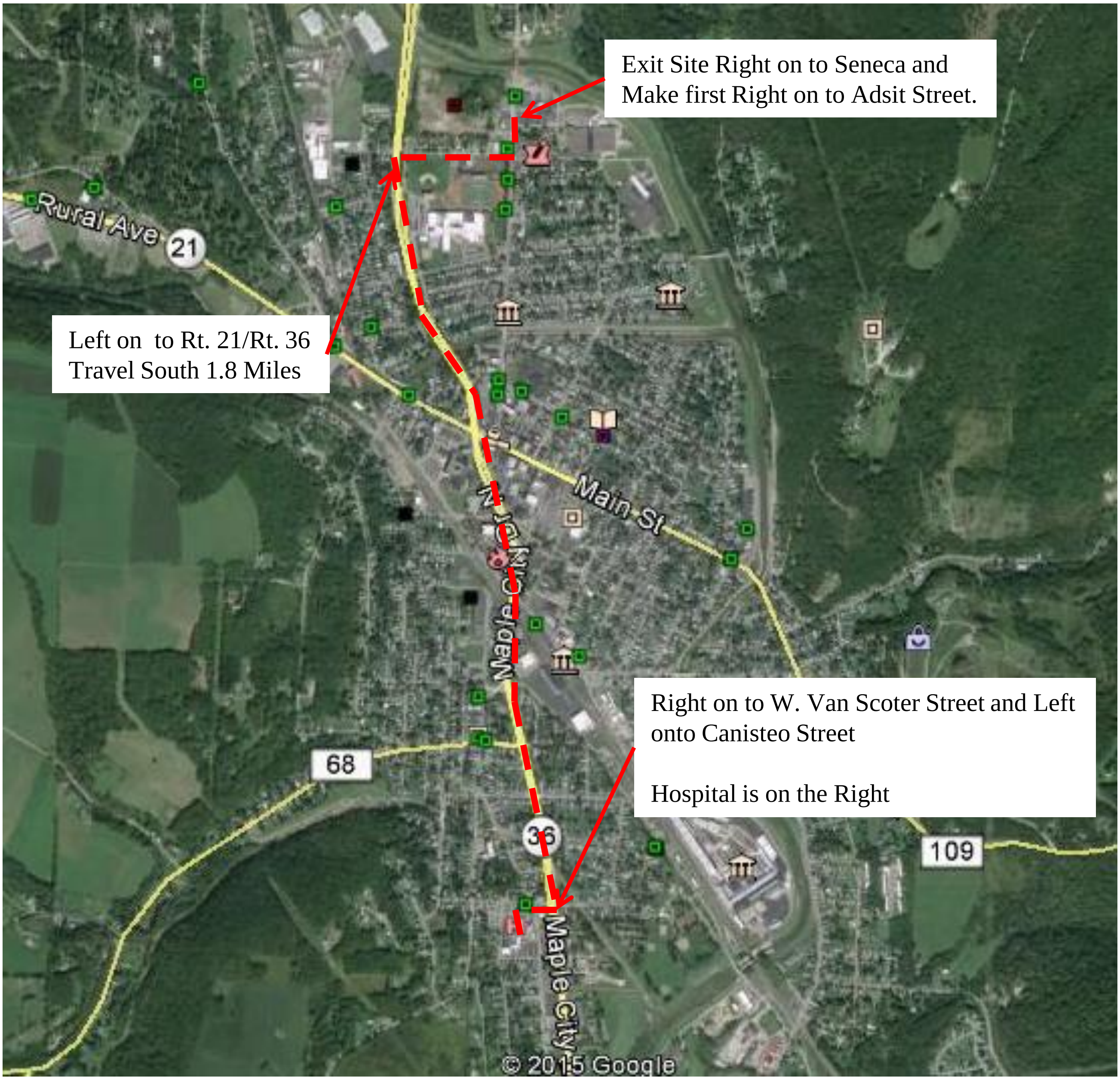
The HSO or the designated representative will conduct daily tailgate safety meetings each workday and will be mandatory for all project personnel. The meetings will provide information on the anticipated site conditions and the work to be completed that day. Appendix A contains a form for documenting Safety Meetings. Completed forms will be retained in Leader's project file.

Additional safety meetings will be held on an as required basis.

16.0 Medical Surveillance

All team members and subcontractors that may potentially have contact with hazardous substances at concentrations above the permissible exposure level (PEL) will be part of a Medical Monitoring Program as outlined in 29CFR 1910.134 and 29CFR 1910.120.

NORTH



Exit Site Right on to Seneca and Make first Right on to Adsit Street.

Left on to Rt. 21/Rt. 36 Travel South 1.8 Miles

Right on to W. Van Scoter Street and Left onto Canisteo Street

Hospital is on the Right

Title:	Route To Hospital St. James Mercy Hospital Hornell, New York
Prepared For:	Hornell Site Development LLC 8668 Cook Road Arkport, New York 14807

LEADER

Leader Professional Services, Inc
271 Marsh Road-Suite 2
Pittsford, New York 14534
(585) 248-2413
Fax (585) 248-2834

Project	490.001A
Date	February 2, 2015
Scale	
Drawn	PVS
Checked	MPR
File Name	Site Location
Figure	1

TABLE 1

KNOWN AND POTENTIAL HEALTH AND SAFETY HAZARDS
HORNELL WASTE MATERIALS SITE
HORNELL, NEW YORK

Known and Potential Site Hazards: *Chemical* (See Appendix B for information sheets and/or MSDSs)

1) Contaminants

   - Acetone
   - PCB
   - Arsenic
   - Barium
   - Cadmium
   - Chromium
   - Lead
   - Mercury

2) Review of Symptoms

   Symptoms of exposure to hazardous wastes and in particular to the contaminants above will be reviewed with all site personnel. Symptoms of both acute and chronic exposures will be covered. In addition, the on-site coordinators will be advised to watch for outward evidence of changes in workers' health. These outward symptoms may include fatigue, tremor, insomnia, skin irritations or discoloration, eye, nose and throat irritation, cough, or abdominal soreness.

   Note the number and nature of potential contaminants mandate that contact of waste materials with the exposed skin must not be allowed to occur under any circumstances.

Known and Potential Site Hazards: *Non-Chemical*

- General Physical Hazards. Since the project will take place at an active truck terminal, the physical hazards include:

  Vehicular traffic
  Underground and aboveground utilities
  Slip, trip, and fall

TABLE 2

ACTION LEVELS
HORNELL SITE DEVELOPMENT
HORNELL, NEW YORK

Unknown Organic Vapor Concentrations (ppm)[1]	Level of Protection
< 1	Level D
≥ 1 < 10	Level C
>10	Level B
Anticipated Chemical Contaminants[2]	**Time Weight Average (ppm)**
Acetone	250
Metals (as Mercury dust)	<0.025 mg/cubic meter
PCBs	0.5 mg/C.M.

Note:

1 Unknown organic vapor action levels are based on the lowest known exposure limits for chlorine (PEL = 1 ppm, IDLH = 30 ppm). The air purifying cartridge limitation for chlorine is 10 ppm.

TABLE 3

EMERGENCY CALL LIST
HORNELL WASTE MATERIALS SITE
HORNELL, NEW YORK

Fires - Spills

Town of Hornell Fire Department	911

Public Services

Town of Hornell Police Emergency	911

Emergency Medical Services

St. James Mercy Health System	(607) 324-8000

SPILL NOTIFICATION

Agencies

National Response Center	(800) 424-8802
Local DEC Office Region 8	(585) 226-2466

Provide the following information to the agencies:

- Name of person making the call
- Company and location
- Nature of fire (fire calls only)
- Name and estimated amount of chemical released to the environment (spills only)
- Time of release
- Remedial action taken to correct the problem

Site Contacts

Matthew Gillette (NYSDEC Project Manager)	(585) 226-2466
Peter von Schondorf (Leader Professional Services-Rochester)	(585) 248-2413
Michael Rumrill (Leader Professional Services – Rochester)	(585) 248-2413

APPENDIX A

SAFETY MEETING SIGN-OFF SHEETS

SAFETY MEETING ATTENDENCE SIGN-OFF SHEET

Person	Date

APPENDIX B

MSDS

SAFETY DATA SHEET

TEDIA
High Purity Solvents

1000 Tedia Way
Fairfield, Ohio 45014
USA
Email: tedia@tedia.com
Web: www.tedia.com

24-Hour Emergency Number (CHEMTREC)
USA: 800-424-9300
International: 703-527-3887

All non-emergency numbers should be directed to Customer Service at 800-PURITY1

ACETONE

SDS No. M0003

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Acetone
Synonyms: Dimethyl Ketone, 2-Propanone
Recommended Use: This product is recommended for laboratory and manufacturing use only. It is not recommended for drug, food or household use.

2. HAZARDS IDENTIFICATION

Classification:
Flammable Liquids: GHS Category 2
Skin Irritation: GHS Category 3
Eye Irritation: GHS Category 2A
Specific Target Organ Toxicity for single exposure: GHS Category 3

Label Elements
Signal Word: DANGER!
Hazard Statements:
- H225 – Highly flammable liquid and vapor.
- H305 – .May be harmful if swallowed and enters airways.
- H320 – Causes eye irritation.
- H332 – Harmful if inhaled.

Precautionary Statements:
- P210 – Keep away from heat/sparks/open flames/hot surfaces. – No smoking.
- P280 – Wear protective gloves/protective clothing/eye protection/face protection.
- P303+P361+P353 – If on skin or hair: Remove/take off immediately all contaminated clothing. Rinse skin with water/shower.
- P403 – Store in a well ventilated place.

Emergency Overview

Highly flammable liquid and vapor! Vapor may cause flash fire. Causes eye irritation. High vapor concentrations may cause drowsiness and irritation of the respiratory tract. Aspiration hazard if swallowed. Prolonged or repeated skin contact may cause drying, cracking, and irritation. Target Organs: Central nervous system, respiratory system, eyes, and skin

HMIS Rating:

Health – 2* Flammability – 3 Physical Hazard – 0 PPE – User supplied

NOTE: HMIS ratings use a numbering scale that ranges from 0 - 4 to indicate the degree of hazard. A value of zero means the chemical presents no hazard while a value of four indicates a high hazard. These ratings are based on the inherent properties of this chemical under expected conditions of normal use and are not intended to be used in emergency situations. PPE is determined by the user based on their needs and conditions.

3. COMPOSITION AND INFORMATION ON INGREDIENTS

Ingredient	CAS No	Percent	Hazardous
Acetone	67-64-1	100%	Yes

4. FIRST-AID MEASURES

Inhalation: If inhaled, remove to fresh air. If breathing is labored or with coughing, give 100% supplemental oxygen. If not breathing, begin artificial respiration. Get medical aid.

Ingestion: Aspiration hazard. Get medical aid. Do not induce vomiting unless directed by medical personnel. If vomiting begins naturally, have victim lean forward. Never give anything by mouth to an unconscious person. If not breathing, begin artificial respiration.

Skin Contact: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover irritated skin with an emollient or anti-bacterial cream. Soap and cold water may be used. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact: Check for and remove contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Notes to Physician: Treat symptomatically and supportively.

5. FIRE FIGHTING MEASURES

Flammability: Highly flammable liquid and vapor (GHS Category 2)

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

Flash Point: -20° C (-4° F)

Flammable Limits: Lower Limit – 2.5 vol %, Upper Limit – 12.8 vol %

Products of Combustion: Will decompose into highly toxic and irritating gases (carbon monoxide and carbon dioxide) under fire conditions.

Specific Fire Hazards: As in any fire, always wear self-contained breathing apparatus in pressure-demand (MSA/NIOSH approved or equivalent), and full protective gear. Use water spray to keep fire exposed containers cool. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Vapors are heavier than air and may travel to a source of ignition and flash back. Vapors can spread along the ground and collect in low or confined areas.

Specific Explosion Hazards: None

Fire Fighting Media: Use dry chemical, carbon dioxide, or appropriate foam. Water may be ineffective because it will not cool acetone below its flash point.

National Fire Protective Association: Health - 1, Flammability - 3, Reactivity - 0

NOTE: NFPA ratings use a numbering scale that ranges from 0 - 4 to indicate the degree of hazard. A value of zero means the chemical presents no hazard while a value of four indicates a high hazard. They are for use by emergency personnel to address the hazards that are presented by short term, acute exposure to this product under fire, spill, or similar emergencies. Ratings involve data and interpretations that may vary from company to company.

6. ACCIDENTAL RELEASE MEASURES

Absorb spilled liquid with sorbent pads, socks, or other inert material such as vermiculite, sand, or earth. Provide ventilation to the affected area and remove all ignition sources. Avoid run-off into storm sewers and ditches that lead to waterways. Approach the spill from upwind and pick up absorbed material and place it in a suitable container. Use only non-sparking tools and equipment. A vapor suppressing foam may be used. Always use proper personal protective equipment as described in section 8.

7. HANDLING AND STORAGE

Precautions: Always use proper personal protective equipment as described in section 8. Wash thoroughly after handling. Ground and bond containers when transferring material. Avoid contact with eyes, skin, and clothing. Remove contaminated clothing and wash before reuse. Empty containers contain product residue (liquid and vapor) and can be dangerous. Keep container tightly closed and away from heat, spark, and flame. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks, or open flames. Use with adequate ventilation. Avoid breathing vapor.
Storage: Keep in a flammables area away from all sources of ignition and oxidizing materials. Keep in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls: Use explosion-proof ventilation equipment. Facilities storing or using the material should be equipped with eyewash station and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.
Personal Protection: Wear protective chemical goggles or appropriate eye protection. Use butyl rubber gloves and protective clothing to prevent skin exposure. A respiratory protection program that meets OSHA 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever possible. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.
Exposure Limits:
ACGIH – 50 ppm TWA; Skin – potential significant contribution to overall exposure by cutaneous route
NIOSH – 50 ppm TWA; 180 mg/m^3 TWA; 1100 ppm IDLH
OSHA Final PELs – 500 ppm TWA; 1800 mg/m^3 TWA

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State and Appearance: Clear, colorless liquid.
Odor: Sweetish odor
Odor Threshold: 130 ppm
Molecular Formula: C_3H_6O
Molecular Weight: 58.08
pH: 7
Auto-ignition Temperature: 465° C (869° F)
Flash Point: -20° C (-4° F)
Flammable Limits: Lower Limit – 2.5 vol %, Upper Limit – 12.8 vol %
Boiling Point: 56.5° C @ 760 mm Hg
Freezing/Melting Point: -94° C
Decomposition Temperature: Not available
Specific Gravity: 0.788 g/cm^3 @ 20°C
Evaporation Rate: 5.6 (n-Butyl acetate = 1)
Vapor Density (Air=1): 2.0
Vapor Pressure: 231 mm Hg @ 25° C
Viscosity: 0.32 cps 20° C
Solubility: Soluble

Conductivity (25°C): Conductive; Conductivity = 6x10^{6} pS/m; Dielectric Constant = 20.7; Relaxation Time Constant = 3x10^{-5} seconds

10. STABILITY AND REACTIVITY

Stability: Stable at room temperatures in closed containers under normal temperatures and pressures.
Conditions to Avoid: Ignition sources, high temperatures, electrical sparks, and confined spaces.
Incompatibility With Various Substances: Strong oxidizing agents, strong reducing agents, strong bases, nitric acid, hexachloromelamine, sulfur dichloride, potassium tert-butoxide.
Hazardous Decomposition Products: Carbon monoxide, carbon, dioxide.
Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Routes of Entry: Inhalation, skin absorption, skin contact
Acute Exposure Hazards:

INHALATION HAZARD: Inhalation of high concentrations can produce central nervous system effects such as nausea, headache, dizziness, unconsciousness, and coma. Causes respiratory tract irritation. May cause motor incoordination and speech abnormalities.

INGESTION HAZARD: May cause irritation of the digestive tract. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma, and possible death due to respiratory failure. Aspiration into lungs may cause chemical pneumonitis, which may be fatal.

SKIN CONTACT HAZARD: Irritation due to defatting action on skin may cause redness, pain, drying and cracking of the skin. May be absorbed though the skin.

EYE CONTACT HAZARD: Vapors are irritating to the eyes and may cause a burning sensation, redness, tearing, inflammation, and possible corneal injury.

Chronic Exposure Hazards: Prolonged or repeated skin contact may produce severe irritation or dermatitis.
Chronic inhalation may cause effects similar to acute inhalation. Matsushita, et al. exposed human volunteers to 500 ppm for 6 hours per day for 6 days and found hematological changes including significantly increase leukocyte and eosinophil counts and decreased neutrophil phagocyte activity.
Animal Toxicity:

Dermal, guinea pig: LD50 = >9400 uL/kg;
Draize test, rabbit, eye: 20 mg Severe
Draize test, rabbit, eye: 20 mg/242 Hr Moderate;
Draize test, rabbit, eye: 10 uL Mild;
Draize test, rabbit, skin: 500 mg/24 Hr Mild;
Inhalation, mouse: LC50 = 44 gm/m^{3}/4H;
Inhalation, rat: LC50 = 50,100 mg/m^{3}/4H;
Oral, mouse: LD50 = 3 g/kg;
Oral, rat: LD50 = 5340 mg/kg;
Oral, rat: LD50 = 5800 mg/kg;

Carcinogenicity: Not listed as a carcinogen by ACGIH, IARC, NTP, or CA Prop 65
Epidemiology: In a series of studies, no statistically different significances in cause of death or clinical laboratory results were observed in 948 employees exposed to up to 1070 ppm acetone over 23 years.
Teratogenicity: Animal studies have only shown harmful effects in the offspring of animals exposed to doses that also produced significant maternal toxicity.
Reproductive Effects: During the Stewart et al. study, four adult female volunteers were exposed 7.5 hours to acetone vapor at a nominal concentration of 1000 ppm. Three of the four women experienced premature menstrual periods which were attributed to the acetone exposure.
Mutagenicity: Sex chromosome loss and nondisjunction (Yeast – Saccharomyces cerevisiae) = 47,600 ppm; Cytogenetic analysis (Rodent – hamster Fibroblast) = 40 gm/L.
Neurotoxicity: No information found .

12. ECOLOGICAL INFORMATION

Ecotoxicity: LC50 Fish: Rainbow trout – 5540 mg/l, 96 hr; LC50 fish: Bluegill/sunfish – 8300 mg/l, 95 hr.
Environmental Fate: Volatilizes, leeches, and biodegrades when released to soil. Terrestrial fate: If released on soil, acetone will not volatilize and leech into the ground. Acetone readily biodegrades and there is evidence suggesting that biodegrades fairly rapidly in soil. Aquatic Fate: If released into water, acetone will probably biodegrade. It is readily biodegradable in screening tests, although data from natural water are lacking. It will also be lost due to volitization (estimated half life 20 hours from a model river). Adsorption to sediment should not be significant. Atmospheric Fate: In the atmosphere, acetone will be lost by photolysis and reaction with photochemically produced hydroxyl radicals. Half life estimates form these combined processes are 79 and 13 days in January and June, respectively, for an overall annual average of 22 days. Therefore, considerable dispersion should occur. Being miscible in water, wash out by rain should be an important removal process. This process has been confirmed around Lake Shinsei-ko in Japan. There, acetone was found in the air and rain, as well as the lake.
Special Remarks: None

13. DISPOSAL CONSIDERATIONS

Material that cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Processing, use or contamination of this product may change the waste management options. Waste generators must decide if discarded material is a hazardous waste. State and local disposal regulations may differ from federal disposal definitions found in 40 CFR 261.3. Dispose of container and unused contents in accordance with federal, state and local requirements. This material is listed as U002 (ignitable waste) under 40 CFR 261.33.

14. TRANSPORT INFORMATION

US DOT, IATA, IMO
Proper Shipping Name: Acetone
Hazard Class: 3
UN Number: UN1090
Packing Group: II

Canada TDG
Additional Information: Flashpoint -20 C

15. REGULATORY INFORMATION

US Federal Regulations:
TSCA: CAS# 67-64-1 is listed on the TSCA Inventory.
Health and Safety Reporting List: CAS# 67-64-1 is not listed.
Chemical Test Rules: CAS# 67-64-1 40 CFR 799.5000
Section 12b: CAS# 67-64-1 is not listed.
TSCA Significant New Use Rule: Does not have an SNUR under TSCA.
CERCLA Hazardous Substances: CAS# 67-64-1 – 5000 lb final RQ; 2270 kg final RQ
SARA Section 302: Does not have a TPQ
SARA Codes: CAS# 67-64-1 – immediate, fire
Section 313: Acetone (CAS# 67-64-1) is not subject to SARA Title III Section 313 and 40 CFR 373 reporting requirements.
Clean Air Act: CAS# 67-64-1 is not listed as a hazardous air pollutant (HAP). It is not a Class 1 Ozone Depleter. It is not a Class 2 Ozone Depleter.
Clean Water Act: CAS# 67-64-1 is not listed as a Hazardous Substance. It is not a Priority Pollutant. It is not a Toxic Pollutant.
OSHA: Not considered highly hazardous by OSHA.
US State Regulations:

CAS# 67-64-1 is on the following state right-to-know lists: California, New Jersey, Pennsylvania, Minnesota, and Massachusetts

California Prop 65: California No Significant Risk Level: Not listed

Canada:

DSL/NDSL: CAS# 67-64-1 is listed on Canada's DSL list.

WHMIS: This product has a WHMIS classification of B2, D2B. This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and this MSDS contains all the information required by those regulations.

Ingredient Disclosure List: CAS# 67-64-1 is listed on Canada's Ingredient Disclosure List.

DSCL (EEC):

Hazard Symbols: Xi; F

Risk Phrases: R11 – Highly Flammable; R36 – Irritating to eyes; R66 – Repeated exposure may case skin dryness and cracking; R67 – Vapors may cause drowsiness and dizziness.

Safety Phrases: S16 – Keep away from sources of ignition-no smoking; S26 – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice; S9 – Keep container in well ventilated place

WGK (Water Danger/protection): CAS# 67-64-1: 0

16. OTHER INFORMATION

Originally Prepared: 10/24/2006
Last Revised: 12/2/2011 – converted to GHS format

The information contained herein is based on current knowledge and experience; no responsibility is accepted that the information is sufficient or correct in all cases. Users should consider these data only as a supplement to other information gathered by them and must make independent determinations of suitability and completeness of information from all sources to assure proper use and disposal of these materials and the safety and health of employees and customers and the protection of the environment.

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aic
American International Chemical, Inc.
135 Newbury St. Framingham, MA 01701
www.aicma.com
800-238-0001

Complying with 1907/2006/EEC Regulation of 18 December 2006 ("REACH Regulation") and REGULATION (EC) No 1272/2008 (CLP)

Section 1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/ UNDERTAKING

Identification of the substance/preparation

Substance Name: BENZENE

Trade names: BENZENE

Synonyms: Benzol; Cyclohexatriene; Phenyl hydride

CAS #: 71-43-2

EC #: 200-753-7

Common/important uses of the substance/preparation: Benzene is used as an intermediate in synthesis and manufacture of organic aromatic substances. Benzene is defined as "transported isolated intermediate" (Article 3 (15) of REACH) and should be used under "Strictly Controlled Conditions" (Article 18 (4) for Intermediates under REACH.

Company/undertaking identification

Supplier/Manufacturer:
GADIV PETROCHEMICAL INDUSTRIES Ltd.
P.O.B 32 HAIFA
Tel: +972-4-8788020
Fax: +972-4-8788018
E-mail: Gadiv@orl.co.il

E-mail address of person responsible for this SDS: gamiram@orl.co.il

Emergency telephone number (including hours of operation): +972-4-8788643

Section 2. HAZARDS IDENTIFICATION

According to EC Directive 2001/59/EC

Most Important Hazards

Physical / Chemical Hazards:
R11: Highly flammable.

Health Hazards:
R45: May cause cancer.
R46: May cause heritable genetic damage.
R36/38: Irritant; Irritating to eyes and skin.
R48/23/24/25: Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with the skin and if swallowed.
R65: Harmful: may cause lung damage if swallowed.

Environmentally Hazards:
Not Classified.

Classification

F – Highly flammable
T-Toxic

GHS-Classification

Physical / Chemical Hazard Statements:
H225: Highly flammable liquid and vapour.

Health Hazard Statements:
H350: May cause cancer.
H340: May cause genetic defects.
H372: Causes damage to organs through prolonged or repeated exposure.
H304: May be fatal if swallowed and enters airways.
H319: Causes serious eye irritation.
H315: Causes skin irritation.

Signal Word

Danger

See section 11 for more detailed information on health effects and symptoms.

Section 3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance/preparation

Formula: C_6H_6

Molecular weigth: 78.11 g/mol

Ingredient name	CAS number	EC number	%	EU Classification	GHS Classification
Benzene	71-43-2	200-753-7	100	F; R11 Carc. Cat. 1; R45 Muta. Cat. 2; R46 T; R48/23/24/25 Xn; R65 Xi; R36/38	Flam. Liq. 2 H225 Carc. 1A H350 Muta. 1B H340 STOT RE 1 H372 Asp. Tox. 1 H304 Eye Irrit. 2 H319 Skin Irrit. 2 H315
See section 16 for the full text of the R-phrases declared above					

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in section 8.

Section 4. FIRST AID MEASURES

Eyes contact:	In case of contact with eyes rinse thoroughly with plenty of water and seek medical advice.
Skin contact:	In case of contact with skin wash off immediately with soap and plenty of water, and seek medical advice.
Inhalation:	Remove from exposure, lie down. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Get medical attention.
Ingestion:	Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Get medical attention immediately.

Expected delayed effects: N/A

See section 11 for more detailed information on health effects and symptoms.

Section 5: FIRE-FIGHTING MEASURES

Extinguishing media

Suitable: For small (incipient) fires, use media such as "alcohol" foam, dry chemical, or carbon dioxide. For large fires, apply water from as far as possible. Use very large quantities (flooding) of water applied as a mist or spray. Cool all affected containers with flooding quantities of water.

Not suitable: Solid streams of water may be ineffective.

Special exposure hazards arising from the substance/preparation including combustion products and gases: Thermal decomposition can lead to release of irritating gases and vapors. Highly flammable material. Flash back possible over considerable distance. Container explosion may occur under fire conditions.

Special protective equipment for fire fighters: Fire fighters should wear full protective clothing and self-contained breathing apparatus in positive pressure mode.

Further information: Move containers from fire area if possible to do so without risk. Use water spray to cool unopened containers.

Section 6: ACCIDENTAL RELEASE MEASURES

Personal precautions: Wear protective clothing. Avoid contact with skin eyes. Avoid breathing vapors, mist or gas. Remove all sources of ignition. Ventilate area of spill. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

Environmental precautions: Prevent entry into waterways, sewers, basements or confined areas.

Methods for cleaning up

Absorb the chemical onto sand, vermiculite, or any other non-combustible absorbent, and scoop into containers for later disposal.

Section 7: HANDLING AND STORAGE

Handling: Avoid contact with eyes, skin and clothing. Avoid inhalation of vapour or mist. Do not permit eating/drinking/smoking near the material. Keep away from heat, sparks and open flame. Take measures to prevent the build up of electrostatic charge.

Storage: Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Keep away from incompatible materials.

Section 8: EXPOSURE CONTROL / PERSONAL PROTECTION

Exposure limit values:

Ingredient name	Occupational exposure limits
Benzene	TLV-ACGIH 0.5 ppm (TWA), 2.5 ppm (STEL) REL-NIOSH 0.1 ppm (TWA), 1 ppm (CEIL)* *15 Minutes

Exposure controls

Occupational exposure controls:

Use process enclosures, local exhaust ventilation, or others engineering controls to keep airborne levels below recommend exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Respiratory protection: Suitable respirator. Be sure to use an approved/certified or equivalent. Wear appropriate respirator when ventilation is inadequate.

Hand protection: Chemically compatible gloves.

Eye protection: Wear protective safety glasses.

Skin protection: Wear appropriate long-sleeved clothing to minimize skin contact.

Hygiene measures: Handle in accordance with good industrial hygiene and safety practice.

Environmental exposure controls: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment may be necessary to reduce emissions to acceptable levels.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

General information

Physical state: Liquid
Colour: Colourless
Odour: Aromatic

Safety data

pH: Not available
Boiling point/boiling range: 80˚C
Flash point: -11˚C
Flammability: Not applicable
Explosive properties: Not applicable
Oxidizing properties: Not applicable
Vapor pressure: 10 hPa at 20˚C and 100hPa at 79.7˚C
Water solubility: 1.88 g/l at 23.5˚C
Relative density (15.6°C): 0.8765 g/cm^3
Solubility: Not available
Log Octanol/Water partition coefficient: 2.13
Viscosity: 0.604 mPa at 25°C
Vapor density: Not available
Evaporation rate (butyl acetate=1): Not available

Other information:

Melting point/melting range: 5.5 °C
Auto-ignition temperature: 498°C

Section 10: STABILITY AND REACTIVITY

Stability: Stable under normal conditions.

Conditions to avoid: Heat, flames and sparks.

Materials to avoid: Acids, Bases, Halogens, Strong oxidizing agents, Metallic salts.

Hazardous Decomposition products: Carbon oxides.

Hazard polymerization: Not available.

Section 11: TOXICOLOGICAL INFORMATION

Potential acute health effects

Acute toxicity:

Product/ingredient name	Test	Species	Dose
Benzene	LD_{50}, Oral LD_{50}, Oral LC_{50}, Inhalation LC_{50}, Dermal	Rat Mouse Rat	1800 mg/kg 4700 mg/kg 10000 ppm/7H >5000 mg/kg

Inhalation: Toxic if inhaled. May cause respiratory tract irritation.

Ingestion: Toxic if swallowed. Aspiration hazard if swallowed - can enter lungs and cause damage.

Skin contact: Toxic if absorbed through skin. Causes skin irritation.

Eyes contact: Causes eye irritation.

Irritation and corrosivity: Irritating.

Skin Sensitization: Not sensitizing.

Toxicokinetics:
At low exposure levels, benzene is rapidly metabolized and excreted predominantly as conjugated urinary metabolites. At higher exposure levels, metabolic pathways appear to become saturated and a large portion of an absorbed dose of benzene is excreted as parent compound in exhaled air.

CMR Effects:

Carcinogenicity:

IARC-GROUP 1 – Carcinogenic to humans.

EPA-GROUP A – Human carcinogen.

NTP1 – Known to be carcinogenic.

Carcinogenic by OSHA.

Carcinogenic by NIOSH.

ACGIH A1: Confirmed Human Carcinogen.

Mutagenicity: Genotoxic.

Reproductive toxicity: No evidence of reproductive or developmental effects.

Repeated dose toxicity:
Inhalation: May cause bone marrow toxicity and depression of red and white blood cells.

Chronic/Other Effects

Carcinogen and an aspiration hazard (kinematic viscosity below 20.5 mm^2/s at 40°C).

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity: Experimental data from reliable studies are available for acute aquatic ecotoxicity endpoints. Data are not available for sediment or soil toxicity.

Substance name	Toxicity to fish	Toxicity to crustaceans	Toxicity to algae / terrestrial plants	Toxicity to other aquatic plants	Other toxicity data (birds, bees, plants etc.)
Benzene	LC_{50}/96H: 5.3 mg/l Long-term: (32 day NOEC) 0.8 mg/l	EC_{50}/48H (Daphnia): 10 mg/l Long term (7 day NOEC): 3 mg/l	Not available	EC_{50}/72H: 100 mg/l	Not available

Activated sludge respiration inhibition testing (24 hour IC_{50} - nitrification): 13 mg/l

Mobility: Not expected to adsorb to soil or sediment due to the low log Kow < 3.

Persistence and Degradability
Biotic - Readily biodegradable.
Abiotic - Will not undergo hydrolysis. Will not undergo photolysis. Expected to rapidly degrade by indirect photolysis in air.

Bioaccumulative potential: Not expected to bioaccumulate due to the low log Kow < 3.

Result of PBT / vPvB assessment (if CSR is required): Does not meet the criteria.

Other adverse effects:

Substances which have an unfavorable influence on the oxygen balance and can be measured using parameters such as BOD, COD, etc.: Not available.

Substances, which contribute to eutrophication: Not available

Remarks: Not available.

Section 13: DISPOSAL CONSIDERATIONS

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

Hazardous waste: Not available.

Section 14: TRANSPORT INFORMATION

International transport regulations

Regulatory Information	UN number	Proper shipping name	Class	Packing group	Label	Additional information	Marine pollutant
ADR/RID Class	1114	BENZENE	3	II			-
IMDG class	1114	BENZENE	3	II		EMS-No: F-E, S-D	No
IATA class	1114	BENZENE	3	II			-

National Fire Protection Association Hazard Ratings- NFPA (R):

Health Hazard - 2
Flammability - 3
Stability - 0

Section 15: REGULATORY INFORMATION

Chemical Safety Assessment has been performed for Benzene.

Classification and labeling according to EU Directives 67/548/EEC and 1999/45/EC (including amendments) and take into account the intended product use:

F – Highly flammable

T-Toxic

Risk phrases:
R11: Highly flammable.
R45: May cause cancer.
R46: May cause heritable genetic damage.
R36/38: Irritating to eyes and skin.
R48/23/24/25: Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with the skin and if swallowed.
R65: Harmful: may cause lung damage if swallowed.

Safety advice:
S45: In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S53: Avoid exposure - obtain special instructions before use.

Classification and labeling according to EU Regulation (EC) 1272/2008 (CLP Regulation) and Globally Harmonized System (GHS):

Signal Word **Danger**

Dangerous as defined by the EU CLP 2008:

Physical/Chemical Properties:

Flammable liquids: Flam. Liquid cat. 2	H225: Highly flammable liquid and vapour.

Health Hazards:

Carcinogenicity: Carc. cat. 1A	H350: May cause cancer.
Germ cell mutagenicity: Muta. cat. 1B	H340: May cause genetic defects.
Specific target organ toxicity - repeated exposure: STOT RE 1	H372: Causes damage to organs through prolonged or repeated exposure.
Aspiration hazard: Asp. Tox. cat. 1	H304: May be fatal if swallowed and enters airways.
Eye irritation: Eye Irrit. cat. 2	H319: Causes serious eye irritation.
Skin corrosion / irritation: Skin Irrit. cat. 2	H315: Causes skin irritation.

Precautionary Statements
P202: Do not handle until all safety precautions have been read and understood.
P210: Keep away from heat, sparks, open flame, hot surfaces - no smoking.
P243: Take precautionary measures against static discharges.
P280: Wear protective gloves/clothing/eye protection/face protection.
P303+P361+P353: if on skin (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P301 + P310: IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.
P331: Do NOT induce vomiting.

National Paint & Coating Hazardous Materials Identification System – HMIS (R):

Health Hazard Rating -2
Flammability Rating - 3
Instability Rating - 0
Personal Protection - H

Section 16: OTHER INFORMATION

Full text of R-phrases referred to in sections 2 and 3:
R11: Highly flammable.
R45: May cause cancer.
R46: May cause heritable genetic damage.
R36/38: Irritating to eyes and skin.
R48/23/24/25: Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with the skin and if swallowed.
R65: Harmful: may cause lung damage if swallowed.

Full text of Hazards Statements referred to in sections 2 and 3:
H225: Highly flammable liquid and vapour.
H350: May cause cancer.
H340: May cause genetic defects.
H372: Causes damage to organs through prolonged or repeated exposure.
H304: May be fatal if swallowed and enters airways.
H319: Causes serious eye irritation.
H315: Causes skin irritation.

Training advice: Before using / handling the product one must read carefully present MSDS.

Recommended restriction on use: *Should be used under Strictly Controlled Conditions (Article 18 (4)) for Intermediates under REACH.*

Key Legend Information:
ACGIH- American Conference of Govermental Industrial Hygienists
OSHA- Occupational Safety and Health Administration
NTP- National Toxicology program
IARC- International Agency for Research on Cancer
ND- Not Determined
N/A- Not available
R-phrases- Risk phrases
S-phrases- Safety phrases

Date of printing: 2.12.2010

Version no. 1

According to Regulation (EC) No. 1907/2006 (REACH), Annex II, Commission Directive 2001/59/EC and REGULATION (EC) No 1272/2008 (CLP).

SAFETY DATA SHEET

TEDIA®
High Purity Solvents

1000 Tedia Way
Fairfield, Ohio 45014
USA
Email: tedia@tedia.com
Web: www.tedia.com

24-Hour Emergency Number (CHEMTREC)
USA: 800-424-9300
International: 703-527-3887

All non-emergency numbers should be directed to Customer Service at 800-PURITY1

CARBON DISULFIDE

SDS No. M0029

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Carbon Disulfide
Synonyms: Carbon Bisulfide; Dithiocarbonic anhydride; Sulphocarbonic anhydride
Recommended Use: This product is recommended for laboratory and manufacturing use only. It is not recommended for drug, food or household use.

2. HAZARDS IDENTIFICATION

Classification:
Flammable Liquids: GHS Category 2
Acute Toxicity, Oral: GHS Category 4
Skin Irritation: GHS Category 2
Eye Irritation: GHS Category 2A
Reproductive Toxicity: GHS Category 2
Specific Organ Toxicity Repeated Exposure, inhalation: GHS Category 1
Acute Aquatic Toxicity: GHS Category 3

Label Elements
Signal Word: DANGER!
Hazard Statements:
- H224 – Extremely flammable liquid and vapor.
- H302 – Harmful if swallowed.
- H312 – Harmful in contact with skin.
- H320 – Causes eye irritation.
- H332 – Harmful if inhaled.
- H336 – May cause drowsiness or dizziness.
- H360 – May damage fertility or the unborn child.

Precautionary Statements:
- P210 – Keep away from heat/sparks/open flames/hot surfaces – No smoking.

P243 – Take precautionary measures against static discharge.
P280 – Wear protective gloves/protective clothing/eye protection, and face protection.
P303+P361+P353 – IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P403+P235 – Store in well ventilated place. Keep cool.

Emergency Overview

Harmful if swallowed, inhaled, or absorbed thought the skin. Causes eye, skin, and respiratory tract irritation. Stench. Aspiration hazard if swallowed. May cause nervous system effects. May increase risk of cardiovascular disease. Known to cause adverse reproductive effects in animals. Extremely flammable liquid and vapor!. May cause flash fire. Static electrical hazard. Target Organs: Cardiovascular system, central nervous system, and reproductive system

HMIS Rating:

Health – 3* Flammability – 4 Physical Hazard – 0 PPE – User supplied

NOTE: HMIS ratings use a numbering scale that ranges from 0 - 4 to indicate the degree of hazard. A value of zero means the chemical presents no hazard while a value of four indicates a high hazard. These ratings are based on the inherent properties of this chemical under expected conditions of normal use and are not intended to be used in emergency situations. PPE is determined by the user based on their needs and conditions.

3. COMPOSITION AND INFORMATION ON INGREDIENTS

Ingredient	CAS No	Percent	Hazardous
Carbon Disulfide	75-15-0	>99%	Yes

4. FIRST-AID MEASURES

Inhalation: If inhaled, remove to fresh air. If breathing is labored, give supplemental oxygen. If not breathing, begin artificial respiration using a suitable mechanical device and oxygen. Get medical aid. Do not use mouth-to-mouth respiration.
Ingestion: Aspiration hazard. Get medical aid immediately. Do not induce vomiting unless directed by medical personnel. If vomiting begins naturally, have victim lean forward. Never give anything by mouth to an unconscious person.
Skin Contact: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Dispose of shoes after making unusable.
Eye Contact: Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately. Do not allow victim to rub eyes or keep eyes closed.
Notes to Physician: Effects may be delayed. Observe patient.

5. FIRE FIGHTING MEASURES

Flammability: Highly flammable liquid and vapor (GHS Category 2)
Auto-ignition Temperature: 90° C (194° F)
Flash Point: -30° C (-22° F)
Flammable Limits: Lower Limit – 1.3 vol %, Upper Limit – 50.0 vol %
Products of Combustion: Will decompose into highly toxic and irritating gases (carbon monoxide, carbon dioxide, and oxides of sulfur) under fire conditions.
Specific Fire Hazards: As in any fire, always wear self-contained breathing apparatus in pressure-demand (MSA/NIOSH approved or equivalent), and full protective gear. Use water spray to keep fire exposed containers cool. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Combustion generates toxic fumes. May be ignited by friction, heat, sparks, or flames. Vapors are heavier than air and may travel to a source of ignition and flash back. May accumulate static electricity. Because of very low autoignition temperature, ignition is easily accomplished by contact with hot surfaces such as light bulbs, steam pipes, or engine exhaust pipes. Vapors can spread along the ground and collect in low or confined areas.
Specific Explosion Hazards: Vapors may form an explosive mixture with air. Containers may explode in the heat of the fire.
Fire Fighting Media: Use water spray, dry chemical, carbon dioxide, or appropriate foam.
Special Remarks: None

National Fire Protective Association: Health - 3, Flammability - 4, Reactivity - 0
NOTE: NFPA ratings use a numbering scale that ranges from 0 - 4 to indicate the degree of hazard. A value of zero means the chemical presents no hazard while a value of four indicates a high hazard. They are for use by emergency personnel to address the hazards that are presented by short term, acute exposure to this product under fire, spill, or similar emergencies. Ratings involve data and interpretations that may vary from company to company.

6. ACCIDENTAL RELEASE MEASURES

Absorb spilled liquid with sorbent pads, socks, or other inert material such as vermiculite, sand, or earth. Provide ventilation to the affected area and remove all ignition sources. Avoid run-off into storm sewers and ditches that lead to waterways. Approach the spill from upwind and pick up absorbed material and place it in a suitable container. Evacuate unnecessary personnel. Use only non-sparking tools and equipment. Use water spray to cool and disperse vapors. Always use proper personal protective equipment as described in section 8.

7. HANDLING AND STORAGE

Precautions: Always use proper personal protective equipment as described in section 8. Wash thoroughly after handling. Ground and bond containers when transferring material. Avoid contact with eyes, skin, and clothing. Remove contaminated clothing and wash before reuse. Empty containers contain product residue (liquid and vapor) and can be dangerous. Keep container tightly closed and away from heat, spark, and flame. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks, or open flames. Use with adequate ventilation. Avoid breathing vapor.
Storage: Keep in a flammables area away from all sources of ignition and oxidizing materials. Keep in a tightly closed container and store under a nitrogen blanket. Store in a cool, dry, well-ventilated area away from incompatible substances.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls: Use explosion-proof ventilation equipment. Facilities storing or using the material should be equipped with eyewash station and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.
Personal Protection: Wear protective chemical goggles or appropriate eye protection. Use butyl rubber gloves and protective clothing to prevent skin exposure. A respiratory protection program that meets OSHA 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever possible. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.
Exposure Limits:
ACGIH – 10 ppm TWA; Skin – potential significant contribution to overall exposure by cutaneous route
NIOSH – 1 ppm TWA; 3 mg/m^3 TWA; 500 ppm IDLH
OSHA Final PELs – 20 ppm TWA; 30 ceiling
OSHA Vacated PELs – 4 ppm TWA; 12 mg/m^3 TWA

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State and Appearance: Clear, colorless to pale yellow liquid.
Odor: Strong, rotten egg-like stench
Odor Threshold: 200+ ppm
Molecular Formula: CS_2
Molecular Weight: 76.13
Auto-ignition Temperature: 90^o C (194^o F)
Flash Point: -30^o C (-22^o F)
Flammable Limits: Lower Limit – 1.3 vol %, Upper Limit – 50.0 vol %
pH: Not available
Boiling Point: 46.^{o} C @ 760 mm Hg
Freezing/Melting Point: -111^o C
Decomposition Temperature: Not available
Specific Gravity (water = 1): 1.262

Evaporation Rate: 22.6 (n-Butyl acetate = 1)
Vapor Density (Air=1): 2.67
Vapor Pressure: 297.5 mm Hg @ 20° C
Viscosity: 0.363 cps 20° C
Solubility: 0.294% @ 20°C
Conductivity: Nonconductive; Conductivity = 7.8x10^{-4} pS/m; Dielectric Constant = 2.6; Relaxation Time Constant = ~100 seconds (dissipation)

10. STABILITY AND REACTIVITY

Stability: Stable under normal temperature and pressure. Exposure to ultraviolet radiation from sunlight may cause carbon disulfide vapor to ignite and explode.
Conditions to Avoid: Ignition sources, friction, heat, extreme temperatures, confined spaces, direct sunlight.
Incompatibility With Various Substances: Strong oxidizing agents, strong reducing agents, alkali metals, amines, halogens, azides, chemically active metals, air rust.
Hazardous Decomposition Products: Carbon monoxide, oxides of sulfur, carbon, dioxide.
Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Routes of Entry: Inhalation, skin absorption, skin contact
Acute Exposure Hazards*:*
INHALATION HAZARD: Intoxication can involve all parts of the central and peripheral nervous systems, including damage to the nerves from paresthesias, muscle weakness, unsteady gait, and tremors. Exposure may accelerate the development or worsen coronary heart disease.
INGESTION HAZARD: May cause disturbances of the digestive tract. May cause effects similar to those of inhalation exposure. Aspiration into lungs may cause chemical pneumonitis, which may be fatal. May cause central nervous system damage. Ingestion may cause convulsions, seizures, and possible coma.
SKIN CONTACT HAZARD: Causes skin irritation. May be absorbed though the skin in harmful amounts. Prolonged or repeated skin contact may produce severe irritation or dermatitis. Dermatitis and vesiculation from skin contact with vapor and liquid. Dermal contact with concentrated solution may cause burning pain, erythema, and exfoliation.
EYE CONTACT HAZARD: May cause severe eye irritation.
Chronic Exposure Hazards: Prolonged or repeated exposure can cause psychic abnormalities, such as anxiety, depression, and excitability. May cause reproductive and fetal effects. Chronic exposure may cause visual disturbances. Repeated exposure may cause central and peripheral nervous damage and digestive tract disturbances. Chronic exposure may cause coronary heart disease. Chronic toxicity of carbon disulfide includes marked psychic disturbances ranging from extreme irritability to mania with hallucinations, tremors, auditory and visual disturbances, weight loss, and blood dyscrasias.
Animal Toxicity:
Inhalation, mouse: LC50 = 10 gm/m^3/2H;
Inhalation, mouse: LC50 = 10,000 gm/m^3;
Inhalation, rat: LC50 = 25 mg/m^3/2H;
Inhalation, rat: LC50 = 25,000 mg/m^3;
Inhalation, rat: LC50 = 1000 mg/m^3;
Oral, mouse: LD50 = 2780 mg/kg;
Oral, rabbit: LD50 = 2550 mg/kg;
Oral, rat: LD50 = 1200 mg/kg;
Carcinogenicity: Not listed as a carcinogen by ACGIH, IARC, NTP, or CA Prop 65
Epidemiology: Based on the results of studies of workers exposed to carbon disulfide and supporting data from animal studies, the nervous system appears to be the critical target for carbon disulfide induced toxicity, manifested most often as reduced conduction velocity in the peripheral nerves and impaired performance in psychomoter testing. Other effects for which there is considerable weight of evidence for humans exposed to carbon disulfide alteration sin serum lipids and blood pressure that are associated with increase risk of cardiovascular disease, systemic opthalmological effects, including those

on color vision and damage to the blood vessels of the retina, and (with higher exposures) increased mortality from heart disease.
Teratogenicity: Animal studies have indicated behavioral effects and reduced weight gain by rat inhalation. Premature fetal death and stunted fetuses were shown by rat inhalation and the oral route. Specific developmental abnormalities included craniofacial abnormalities including the nose and tongue by rat inhalation, effects on the eyes, ears, and homeostatic by rat inhalation, and other unspecified abnormalities by the oral route in rabbits.
Reproductive Effects: Hypospermia, abnormal sperm morphology, menstrual cycle irregularities and pain have been reported in humans. Effects on fertility and paternal effects have been reported in animal studies by oral and inhalation routes. These included effects on the prostate, seminal vesicle, Cowper gland, urethra, and spermatogenesis. Some studies have found no adverse effects.
Mutagenicity: Sister Chromatid Exchange: human lymphocyte 10,200 ug/L.
Neurotoxicity: Neurotoxic effects have occurred in experimental animals. Neurotoxic effects have occurred in humans.

12. ECOLOGICAL INFORMATION

Ecotoxicity: Mosquito fish (fresh water) TLm=35 ppm/48H; Sunfish LC100=100 ug/L/H; Trout LC100=500 ug/L/0.1H
Environmental Fate: When released to soil, substance volatilizes, leaches, and may biodegrade. The product is expected to be harmful to aquatic life. In water, substance volatilizes. In air, substance biodegrades by reaction with atomic oxygen and hydroxyl radicals. Substance does not have potential to bioconcentrate. Soil mobility is predicted to be high.

13. DISPOSAL CONSIDERATIONS

Material that cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Processing, use or contamination of this product may change the waste management options. Waste generators must decide if discarded material is a hazardous waste. State and local disposal regulations may differ from federal disposal definitions found in 40 CFR 261.3. Dispose of container and unused contents in accordance with federal, state and local requirements. This material is listed as P022 under 40 CFR 261.

14. TRANSPORT INFORMATION

US DOT, IATA, IMO
Proper Shipping Name: Carbon Disulfide
Hazard Class: 3 (6.1)
UN Number: UN1131
Packing Group: I

Canada TDG
Additional Information: Flashpoint -30 C

15. REGULATORY INFORMATION

US Federal Regulations:
TSCA: CAS# 75-15-0 is listed on the TSCA Inventory.
Health and Safety Reporting List: CAS# 75-15-0 is not listed.
Chemical Test Rules: CAS# 75-15-0 Testing required by manufactures and processors
Section 12b: CAS# 75-15-0 Section 4.
TSCA Significant New Use Rule: Does not have an SNUR under TSCA.
CERCLA Hazardous Substances: CAS# 75-15-0 – 100 lb final RQ; 45.4 kg final RQ
SARA Section 302: 10,000 lb TPQ
SARA Codes: CAS# 75-15-0– immediate, delayed, fire
Section 313: Carbon Disulfide (CAS# 75-15-0) is subject to SARA Title III Section 313 and 40 CFR 373 reporting requirements.

Clean Air Act: CAS# 75-15-0 is listed as a hazardous air pollutant (HAP). It is not a Class 1 Ozone Depleter. It is not a Class 2 Ozone Depleter.

Clean Water Act: CAS# 75-15-0 is listed as a Hazardous Substance. It is not a Priority Pollutant. It is not a Toxic Pollutant.

OSHA: Not considered highly hazardous by OSHA.

US State Regulations:

CAS# 75-15-0 is on the following state right-to-know lists: California, New Jersey, Pennsylvania, Minnesota, and Massachusetts

California Prop 65: The following statement is made in order to comply with the California State Drinking Water Act: Warning: This product contains Carbon disulfide, a chemical known to the state of California to cause male reproductive toxicity.

California No Significant Risk Level: Not listed

Canada:

DSL/NDSL: CAS# 75-15-0 is listed on Canada's DSL list.

WHMIS: This product has a WHMIS classification of B2, D1B, D2A, D2B. This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and this MSDS contains all the information required by those regulations.

Ingredient Disclosure List: CAS# 75-15-0 is listed on Canada's Ingredient Disclosure List.

DSCL (EEC):

Hazard Symbols: T; F

Risk Phrases: R11 – Highly Flammable; R36/38 – Irritating to eyes and skin; R48/23 – Toxic: danger of serious damage to health by prolonged exposure through inhalation: R62 - Possible risk of impaired fertility; R6s – Possible risk of harm to the unborn child.

Safety Phrases: S16 – Keep away from sources of ignition-no smoking; S33 – Take precautionary measures against static discharge; S36/37 – Wear suitable protective clothing and gloves; S45 – In case of accident, or if you feel unwell, seek medical advice immediately (shoe label where possible).

WGK (Water Danger/protection): CAS# 75-15-0: 2

16. OTHER INFORMATION

Originally Prepared: 10/24/2006
Last Revised: 12/2/2011 – converted to GHS Format

The information contained herein is based on current knowledge and experience; no responsibility is accepted that the information is sufficient or correct in all cases. Users should consider these data only as a supplement to other information gathered by them and must make independent determinations of suitability and completeness of information from all sources to assure proper use and disposal of these materials and the safety and health of employees and customers and the protection of the environment.

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Safety Data Sheets (SDS)

SECTION 1-IDENTIFICATION

Product name: Ethylbenzene

Other names: —

Proper shipping name: Ethylbenzene

Recommended use of the chemical and restrictions on use:
The main use of ethylbenzene is to manufacture styrene, a compound used to make plastics. Ethylbenzene is also found in gasoline, paints, inks, insecticides, carpet glues and tobacco products.

Manufacturer/Supplier Name: Taiwan SM Corp., Kaohsiung plant
Address: NO.7, Industrial 1st Rd, Lin-Yuan Kaohsiung County 83203, Taiwan, R.O.C.
Phone No.: 886-7-6414511

Emergency phone No./Fax No.: 886-7-6414511 Ext. 221 (on duty), 886-7-6414517 (off duty)/886-7-6423828

SECTION 2-HAZARDS IDENTIFICATION

GHS Classification:

Flammable Liquid Category 2
Acute Toxicity (Inhalation) Category 4
Skin Corrosion/Irritation Category 3
Serious Eye Damage/Eye Irritation Category 2
Carcinogenicity Category 2
Reproductive Toxicity Category 2
Specific Target Organ Toxicity Repeated Exposure Category 2
Aspiration Hazard Category 1

GHS Label elements:

Hazard symbols

Signal word

Danger

Hazard statements

Flammable liquid and vapor
Harmful if inhaled
Causes skin irritation
Causes serious eye irritation
Suspected of causing cancer
May damage the unborn child
May be harmful to organs by prolonged and repeated exposure
May be fatal if swallowed and enters airways

Precautionary statements

Use only in well ventilated area.
Control of exposure by mechanical ventilation in an unventilated or confined space
Avoid breathing vapors and contact with skin and eyes.
Wear breathing apparatus/protective gloves/face protection.
Store in well-ventilated place.
Disposal must be in accordance with applicable federal, state, or local regulations.

Other hazards: —

SECTION 3-COMPOSITION/INFORMATION ON INGREDIENTS

CAS No.	Chemical Name	wt% by weight	EINECS No.
00100-41-4	Ethylbenzene	99.0 min.	202-849-4
Synonyms	Phenylethane、EB、Ethylbenzol		

SECTION 4-FIRST AID MEASURES

Description of necessary first aid measures

Eye:

1. Flush eye with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids.
2. Get medical aid immediately.

Skin:

1. Washing affected area thoroughly with soap and water for at least 20 minutes.
2. Call a Physician if irritation develops or persists.
3. Removing contaminated clothing, shoes, and leathery wearings, cleaning procedure is available before reused or waste treatment.

Ingestion:

1. If victim is conscious and alert, give 2～4 cupfuls of milk/water to dilute the substance in stomach.
2. Never give anything by mouth to an unconscious person.
3. Don’t induce vomiting unless directed to do so by medical person.
4. Then seek for medical attention.

Inhalation:

1. Remove from further exposure and flush thoroughly with air.
2. If not breathing, give artificial respiration. If breathing is difficult, give Oxygen.
3. If respiratory irritation, seek immediate medical assistance and call a physician.

Most important symptoms/effects, acute and delayed

Headaches, dizziness, fatigue, eye, nose and throat irritation. Target organs: Eyes, upper respiratory system, skin, CNS, lung, liver, kidney, skin (dermatitis), eye (conjuntivitis and other eye injuries), upper respiratory system disorders, and central nervous system disorders.

Indication of immediate medical attention and special treatment needed, if necessary

For acute or short term repeated exposures to Ethylbenzene:

Inhalation:

1. Severe exposures should have cardiac monitoring to detect arrhythmia.
2. If bronchospasm and wheezing occur, consider treatment with inhaled sympathomimetic agents.
3. If pulmonary edema (noncardiogenic) occurs, then maintain ventilation and oxygenation with close arterial blood gas monitoring. Early use of PEEP and mechanical ventilation may be needed to maintain pO2 greater than 50 mmHG with FIO2 less than 60%.

Ingestion:

1. Induction of emesis is not recommended.
2. Cautious gastric lavage followed by administration of activated charcoal may be of benefit if the patient is seen soon after the exposure.

SECTION 5-FIRE FIGHTING MEASURES

Extinguishing media

Foam、CO_2、Dry chemical powder、Water spray or fog – Large fires only.

Specific hazards arising from the chemical

1. Liquid and vapor are flammable.
2. Moderate fire hazard when exposed to heat or flame.
3. Vapor forms an explosive mixture with air.
4. Moderate explosion hazard when exposed to heat or flame.
5. Vapor may travel a considerable distance to source of ignition.
6. Heating may cause expansion or decomposition leading to violent rupture of containers.
7. On combustion, may emit toxic fumes of carbon monoxide (CO).

Special protective equipment and precautions for fire-fighters

1. Must wear MSHA/NOISH approved positive self-contained breathing apparatus（SCBA）and protective clothing.
2. Withdrawing and isolation the possible dangerous sources, fire fighting at safe distance and suitable protection area. Keep toxic vapors and decompositions away from inhalation, when standing at upper-wind area as well.
3. Stop leakage before fire extinguishing, otherwise it may explode again because of vapors above leakage. However, it’s not well extinguishment at nondangerous circumstance, preferring to burning up.
4. Water spray may not work effectively in terms of lower flash point. Better fire fighting performed by experienced people.
5. In huge fire at larger area, automatic water spray system should be recommended. If extinguishing is not available, evacuating people back as soon as possible.
6. Out off the space immediately, if vessel collapsed or pressure relief valve went pop.

SECTION 6-ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedure

1. Personal protective equipment (specified in Section 8)
   Eyes : Chemical safety goggles are recommended, and a face shield is added when needed.
   Skin : Wear appropriate protective gloves to avoid skin contact.
   Clothing : When direct contact is likely, Use rubberized clothings, apron and boots.
   Respiratory : When limits are exceeded, wear a respirator approved by NIOSH/MSHA for protection against organic dust, mists and vapors.
2. Remove all sources of ignition. No smoking, naked lights or ignition sources. Ventilate area of leak or spill.
3. Keep unnecessary and unprotected personnel from entering. Evacuate personnel from the danger area. Consult with an expert about the emergency procedures.

Environmental precautions

1. Prevent spillage from entering drains, surface, and groundwater.
2. Contain and recover liquid when possible. Use non-sparking tools and equipment.
3. Collect liquid in an appropriate container or absorb with an inert material (e.g. vermiculite, dry sand, earth), and place in a chemical waste container.
4. Report the accidental spill/release to Local/State government.

Methods and materials for containment and cleaning up

Minor spill:

1. Remove all ignition sources.
2. Clean up all spills immediately.
3. Avoid breathing vapors and contact with skin and eyes.
4. Control personal contact by using protective equipment.
5. Contain and absorb small quantities with vermiculite or other absorbent material.
6. Wipe up.
7. Collect residues in a flammable waste container.

Major spill

1. Clear area of personnel and move upwind.
2. Alert emergency responders and tell them location and nature of hazard.
3. May be violently or explosively reactive.
4. Wear breathing apparatus plus protective gloves.
5. Prevent spillage from entering drains or water course.
6. No smoking, naked lights or ignition sources. Increase ventilation.
7. Stop leak if safe to do so.
8. Water spray or fog may be used to disperse/absorb vapor.
9. Contain spill with sand, earth or vermiculite.
10. Use only spark-free shovels and explosion proof equipment.
11. Collect recoverable product into labeled containers for recycling..
12. Absorb remaining product with sand, earth or vermiculite.
13. Collect solid residues and seal in labeled drums for disposal.
14. Wash area and prevent runoff into drains.
15. If contamination of drains or waterways occurs, advise emergency services.

SECTION 7-HANDLING AND STORAGE

Precautions for safe handling

1. Wash thoroughly after handling.
2. Use only in well ventilated area.
3. Ground and bond containers when transferring.
4. Use spark-free tools and explosion proof equipment.
5. Empty containers retain product residue (liquid/vapor), and can be dangerous.
6. Do not pressurize, cut, weld, braze, solder, drill, or expose empty containers to heat, sparks or open flames.

Conditions for safe storage, including any incompatibilities

1. Iron, galvanized iron, and steel are suitable metals for tanks.
2. Storage should be located away from any area subject to fire hazards. Storage tanks located in the open or underground minimize the danger of fire, vapor and health problems.
3. All openings in the system should terminate outdoors and be protected by flash screen.
4. Electrical installation should conform to the National Electrical Code.
5. Storage tanks should be electrically bonded and grounded to prevent dangerous accumulations of static electricity. (see NFPA pamphlet “Static Electricity”)
6. Natural ventilation is all that is needed for outdoor storage installation.
7. For indoor storage : Good natural ventilation may be sufficient. The generally considered maximum allowable concentration is 100 ppm by volume in air for an eight-hour working exposure. If other than natural ventilation is required,

the ventilation equipment should be designed to handle the heavy ethylbenzene vapor. Since ethylbenzene vapor is heavier than air, a down draft mechanical exhaust is indicated in those operation in which general ventilation should be to ensure a substantial air flow away from the work area. All ventilating systems require periodic inspection.

SECTION 8-EXPOSURE CONTROLS, PERSONAL PROTECTION

Control parameters

OSHA- Final PELs : 100 ppm TWA.
ACGIH TLV-TEL : 100 ppm.
ACGIH TLV-STEL : 125 ppm.
Taiwan TWA : 100 ppm (skin).
Taiwan STEL : 125 ppm (skin).
Taiwan Ceiling : -------.
Taiwan BEI : 1 mg/l (before on duty).

Engineering control

1. Process should be located at least 17 meter (50 feet) away from open flames and all high temperature operations likely to cause ignition of the ethylbenzene vapor.
2. In venting ethylbenzene vapors, consideration should be given to possible halogenation of the vapors by low concentrations of free chlorine and bromine with the resultant formation of lacrimations.
3. Process should be designed so that the operator is not exposed to direct contact with ethylbenzene or the vapor. The technical problems of designing equipment, providing adequate ventilation and operating procedures which promise maximum security and economy, can best be handled by competent engineers.
4. It is essential for safety that equipment be used and maintained as recommended by the manufacturer.
5. Tanks used to store or process ethylbenzene should be closed vessels vented to a safe point of discharge in the outside atmosphere away from operating stations, roadways, and at least 17 meter (50 feet) from possible sources of ignitions. All sparks, flames, heated surface, or other sources of ignition should be kept away from all vents. It is advisable, to provide suction on vessels when inspection or observation openings are made, to minimize or eliminate escape of vapors.

Personal protective equipment

Personal respirators (NIOSH Approved):
If the exposure limit is exceeded, a half-face organic vapor respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator.
(Warning: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.)

Skin protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

SECTION 9-PHYSICAL AND CHEMICAL PROPERTIES

Appearance : Transparent liquid	Upper/lower explosive limits : 1.0%～6.7%
Odor: Aromatic odor	Vapor Pressure : 7.1 mmHg @20℃/68℉
Odor threshold : 0.092～0.6 ppm	Vapor Density : 3.66 (air=1)
PH : Not available	Relative density : 0.864 (water=1)
Melting/Freezing Point : －94.9℃	Solubility : 0.015 @25℃ in water
Initial boiling point/boiling range : 132.6℃	Partition coefficient : 3.15 (n-octanol/water)
Flash point : 21℃	Auto-ignition temperature : 432℃
Evaporation Rate : 0.84 (BuAc=1)	Decomposition temperature : Not available
Flammability (solid/gas) : Not available	Viscosity : Not available
Molecular Formula : C_8H_{10}	Molecular Weight : 106.7

SECTION 10-STABILITY AND REACTIVITY

Reactivity

The product is stable. Vapor is explosive when exposed to heat or flame.

Chemical stability

Stable under normal temperatures and pressures.

Possibility of hazardous reaction

Has not been reported.

Condition to avoid
Incompatible materials, ignition sources, excess heat.

Incompatible materials
Oxidizing agents.

Hazardous decomposition products
Carbon dioxide and carbon monoxide may form when heated to decomposition.

SECTION 11-TOXICOLOGICAL INFORMATION

Routes of exposure
Eye, Skin, inhalation, Ingestion.

Symptoms (treatments as indicated in Section 4)
Eye:
May cause irritation, redness, pain, and corneal damage.

Skin:
Causes irritation to skin. Symptoms include redness, itching, and pain. May produce blisters. May be absorbed through the skin.

Ingestion:
May cause irritation to the gastrointestinal tract. Symptoms may include nausea, vomiting and diarrhea. May cause central nervous system depression. Symptoms may include giddiness, headache, dizziness, nausea, anaesthetic effects, slowed reaction time, slurred speech and may progress to unconsciousness. Serious poisonings may result in respiratory depression and may be fatal.

Inhalation:
Inhalation of high concentrations of gas/vapor causes lung irritation with coughing and nausea, central nervous depression with headache and dizziness, slowing of reflexes, fatigue and inco-ordination. Central nervous system (CNS) depression may include general discomfort, symptoms of giddiness, headache, dizziness, nausea, anaesthetic effects, slowed reaction time, slurred speech and may progress to unconsciousness. Serious poisonings may result in respiratory depression and may be fatal. If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Chronic exposure:
There has been some concern that this material can cause cancer or mutations but there is not enough data to make an assessment. Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems. Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Aggravation of pre-existing conditions:
Persons with pre-existing skin disorders, eye problems, liver disease, central nervous system disorders, or impaired respiratory function may be more susceptible to the effects of the substance.

Toxicity
LD50: 3500 mg/kg (rat, oral)
LC50: 4000 ppm/4h (rat, inhalation)

Irritation
Skin (rabbit): 15 mg/24h Mild
Eye (rabbit): 500 mg- SEVERE

Chronic effect
Carcinogenicity:
ACGIH : A3- Proven for animals.
OSHA : Classified None.
IARC : Group 2B carcinogen.

Epidemiology:
Not available.

Teratogenicity:
Not available.
Reproductive Effects:
Not available.

Neurotoxicity:
Not available

Mutagenicity:
Mutation in mammalian somatic cells（Rodent, mouse）Lymphocyte=80mg/L.

SECTION 12-ECOLOGICAL INFORMATION

Ecotoxicity

LC_{50} (96 hr.) Fish: 32.0～97.1 mg/l
EC_{50} (48 hr.) Water flea: Not available
Biocencentration factor (BCF): Not available

Persistence and degradability

1. In the atmosphere, it exists primarily in the vapor phase based on its vapor pressure. It photochemically degrades by reaction with hydroxyl radicals (half-life 0.5 to 2 days) and partially returns to the earth in rain.
2. Degradation occurs faster under smog conditions. Photooxidation products include ethylphenol, benzaldehyde, acetophenone and m- and p- ethylnitrobenzene.
3. In water, ethylbenzene's concentration decreases by evaporation and biodegradation. The rate of decrease is dependent on the season. Half-lives in water range from several days to 2 weeks.
4. Some ethylbenzene is absorbed by sediment, but bioconcentration in fish is not expected to be significant.

Half-life (Air): 8.56～85.6 hr
Half-life (Surface water): 72～240 hr
Half-life (Ground water): 144～5472 hr
Half-life (Soil): 7.2～240 hr

Bioaccumulative potential

This material is not expected to significantly bioaccumulate.

Mobility in soil

Ethylbenzene is adsorbed moderately by soil. It does not significantly hydrolyze in either water or soil.

Other adverse effects: －

SECTION 13-DISPOSAL CONSIDERATIONS

Residues and spilled material are hazardous waste due to ignitability. Disposal must be in accordance with applicable federal, state, or local regulations.

The container for this product can present explosion or fire hazards, even when emptied. To avoid risk of injury, do not cut, puncture, or weld on or near this container. Since the emptied containers retain product residue, follow label warnings even after container is emptied.

SECTION 14-TRANSPORTATION INFORMATION

US DOT	Shipping Name	ETHYLBENZENE	Hazard Labels	
	Hazard Class	3		
	UN Number	1175		
	Packing Group	II		
Sea(IMO/IMDG)	Shipping Name	ETHYLBENZENE	Hazard Labels	
	Hazard Class	3.2		
	UN Number	1175		
	Packing Group	II		
Air(ICAO/IATA)	Shipping Name	ETHYLBENZENE	Hazard Labels	
	Hazard Class	3		
	Subsidiary Class	1175		
	Packing Group	II		

EUROPEAN RID/ADR (ADR/RID)	Shipping Name	ETHYLBENZENE	Hazard Labels	
	Hazard Class	3		
	UN Number	1175		
Canadian TDG	Shipping Name	ETHYLBENZENE	Hazard Labels	
	Hazard Class	3		
	UN Number	1175		
	Packing Group	II		
	Subsidiary Class	9.2		

SECTION 15-REGULATORY INFORMATION

US FEDERAL

TSCA

CAS# 100-41-4 is listed on the TSCA inventory.

Health & Safety Reporting List

CAS# 100-41-4：Effective Date：June 19, 1987；Sunset Date：June 19, 1997

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

SARA

Section 302 (RQ)

CAS# 100-41-4：final RQ＝1000 pounds（454 ㎏）

Section 302（TPQ）

None of the chemicals in this product have a TPQ.

SARA Codes

CAS# 100-41-4：acute, chronic, flammable.

Section 313

This material contains Ethylbenzene（CAS# 100-41-4, 99.0％ ）,which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 372.

Clean Air Act

CAS# 100-41-4 is listed as a hazardous air pollutant（HAP）.

This material does not contain any class 1 Ozone depletors.

This material does not contain any class 2 Ozone depletors.

Clean Water Act

CAS# 100-41-4 is listed as a hazardous Substance under the CWA.

CAS# 100-41-4 is listed as a Priority Pollutant under the Clean Water Act.

CAS# 100-41-4 is listed as a Toxic Pollutant under the Clean Water Act.

OSHA

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

Ethylbenzene can be found on the following state right to know lists : California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

California No Significant Risk Level：None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols : XN F

Risk Phrases : R 11 Highly flammable.
R 20 Harmful by inhalation.

Safety Phrases : S 16 Keep away form sources of ignition-No smoking.
S 24/25 Avoid contact with skin and eyes.
S 29 Do not empty into drains.

CANADA

CAS# 100-41-4 is listed on Canada’s DSL/NDSL list.

This product has a WHMIS classification of B2, D2B.

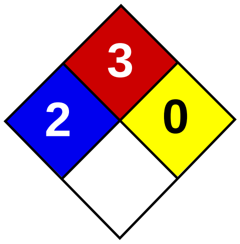
CAS# 105-05-5 is not listed on Canada’s Ingredient Disclosure List.

SECTION 16-OTHER INFORMATION

References and sources

1. CHEMINFO Data Bank, CCINFO CD, 2005-3
2. HSDB Data Bank, TOMES PLUS CD, Vol.65,2005
3. RETECS Data Bank, TOMES PLUS CD, Vol.65, 2000
4. Hazardous Substance Data Bank, Environment Protection, Administration, Executive Yuan, ROC (Taiwan)
5. Chemwatch Data Bank, 2005-1
6. SDS, GHS in Taiwan, Council of Labor Affairs, Executive Yuan, ROC (Taiwan)

Version	**Date**	**Remark**
Version 1	06/01/1998	Original Version.
Version 2	04/20/2001	Updated 10 sections to 16 sections.
Version 3	08/01/2003	Updated “SECTION 9-PHYSICAL AND CHEMICAL PROPERTIES”.
Version 4	01/01/2006	Updated “SECTION 14-TRANSPORTATION INFORMATION”.
Version 5	08/21/2008	Updated each section by GHS SDS.
Version 6	08/01/2011	Checked each section by SHE
Prepared by	Safety & Environment Protection Section, Taiwan SM Corporation Kaohsiung Plant.	



Health	2
Fire	3
Reactivity	0
Personal Protection	J

Material Safety Data Sheet

m-Xylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: m-Xylene

Catalog Codes: SLX1066

CAS#: 108-38-3

RTECS: ZE2275000

TSCA: TSCA 8(b) inventory: m-Xylene

CI#: Not applicable.

Synonym: m-Methyltoluene

Chemical Name: 1,3-Dimethylbenzene

Chemical Formula: C6H4(CH3)2

Contact Information:

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

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

Order Online: ScienceLab.com

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

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

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

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{m-}Xylene	108-38-3	100

Toxicological Data on Ingredients: m-Xylene: ORAL (LD50): Acute: 5000 mg/kg [Rat.]. DERMAL (LD50): Acute: 14100 mg/kg [Rabbit.].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation. CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to blood, kidneys, the nervous system, liver. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

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

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 527°C (980.6°F)

Flash Points: CLOSED CUP: 25°C (77°F). OPEN CUP: 28.9°C (84°F) (Cleveland).

Flammable Limits: LOWER: 1.1% UPPER: 7%

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

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

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

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapor may travel considerable distance to source of ignition and flash back. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

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

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as oxidizing agents.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

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

Personal Protection: Splash goggles. Lab coat. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 150 (ppm) from ACGIH (TLV) TWA: 434 STEL: 651 (mg/m3) from ACGIHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Liquid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless.

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

Boiling Point: 139.3°C (282.7°F)

Melting Point: -47.87°C (-54.2°F)

Critical Temperature: Not available.

Specific Gravity: 0.86 (Water = 1)

Vapor Pressure: 6 mm of Hg (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.62 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

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

Solubility:
Easily soluble in methanol, diethyl ether. Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact.

Toxicity to Animals:
Acute oral toxicity (LD50): 5000 mg/kg [Rat.]. Acute dermal toxicity (LD50): 14100 mg/kg [Rabbit.].

Chronic Effects on Humans: The substance is toxic to blood, kidneys, the nervous system, liver.

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

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
0347 Animal: embryotoxic, foetotoxic, passes through the placental barrier. 0900 Detected in maternal milk in human. Narcotic effect; may cause nervous system disturbances.

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

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

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

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

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Xylene : UN1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: m-Xylene Massachusetts RTK: m-Xylene TSCA 8(b) inventory: m-Xylene SARA 313 toxic chemical notification and release reporting: m-Xylene CERCLA: Hazardous substances.: m-Xylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

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

DSCL (EEC):
R10- Flammable. R38- Irritating to skin. R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: j

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

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec. -SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du rÃ¨glement sur le transport des marchandises dangeureuses au canada. Centre de conformitÃ© internatinal LtÃ©e. 1986.

Other Special Considerations: Not available.

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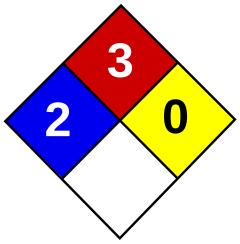

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
o-Xylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: o-Xylene

Catalog Codes: SLX1012

CAS#: 95-47-6

RTECS: ZE2450000

TSCA: TSCA 8(b) inventory: o-Xylene

CI#: Not applicable.

Synonym: 1,2-Dimethylbenzene

Chemical Name: o-Xylene

Chemical Formula: C6H4(CH3)2

Contact Information:

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

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

Order Online: ScienceLab.com

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

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

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

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{o-}Xylene	95-47-6	100

Toxicological Data on Ingredients: o-Xylene 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: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Classified POSSIBLE for human. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/male [POSSIBLE]. The substance may be toxic to kidneys, liver, 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. Get medical attention.

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

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

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

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 463°C (865.4°F)

Flash Points: CLOSED CUP: 17°C (62.6°F).

Flammable Limits: LOWER: 0.9% UPPER: 6.7%

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

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

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

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

Special Remarks on Fire Hazards:
Vapors are heavier than air and may travel considerable distance to source of ignition and flash back. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapors may form explosive mixtures with air. Containers may explode when heated. Runoff to sewer may create fire or explosion hazard

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:

Toxic flammable liquid, insoluble or very slightly soluble in water. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

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

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

Section 8: Exposure Controls/Personal Protection

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

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

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

Exposure Limits:
TWA: 434 STEL: 651 (mg/m3) from ACGIH (TLV) [United States] TWA: 100 STEL: 150 (ppm) from ACGIH (TLV) [United States] STEL: 150 (ppm) from NIOSH STEL: 655 (mg/m3) from NIOSHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Mobile, nonpolar liquid.)

Odor: Aromatic. Sweetish.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless.

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

Boiling Point: 144.4°C (291.9°F)

Melting Point: -25°C (-13°F)

Critical Temperature: 359°C (678.2°F)

Specific Gravity: 0.88 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.05 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.1

Ionicity (in Water): Not available.

Dispersion Properties:
Dispersed in diethyl ether. Is not dispersed in cold water, hot water. See solubility in diethyl ether, acetone.

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

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, flames, incompatible materials.

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

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Photochemically reactive. Incompatible with strong oxidizers(e.g. chlorine, bromine, fluorine), and strong acids (e.g. nitric acid, acetic acid).

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:
Lowest Published Lethal Dose - Inhalation (LCL): 6125 ppm 12 hours [Rat]; 6125 ppm 12 hours [Human] Lowest Published Lethal Dose - Oral: 5000 mg/kg [Rat]

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. TERATOGENIC EFFECTS: Classified POSSIBLE for human. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/male [POSSIBLE]. May cause damage to the following organs: kidneys, liver, 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.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (male) and birth defects based on animal data. 0347 Animal: embryotoxic, foetotoxic, passes through the placental barrier. 0900 Detected in maternal milk in human. Narcotic effect; may cause nervous system disturbances.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Efffects Skin: May cause skin irritation. May be absorbed through skin i harmful amounts. Eyes: Causes severe eye irritation. Inhalation: Causes respiratory tract and mucous membranes irritation. May affect sense organs, behavior (Central Nervous system) which may result in dizziness, general weakness, central nervous system depression, confusion, ataxia, disorientation, lethargy, drowsiness, headaches. May also affect respiration, cardiovascular system, liver, blood, and digestive system (nausea, vomiting) Ingestion: Harmful if swallowed. Causes digestive tract irritation with nausea, vomiting

and diarrhea. May also affect metabolism, liver, and urinary system, and central nervous system (excitement followed by headache, dizziness, drowsiness and nausea). Chronic Potential Health Effects: Skin: Prolonged or repeated contact may cause defatting of skin and dermatitis. Eyes: Prolonged or repeated exposure may cause conjunctivitis or permanent eye damage. Inhalation: Chronic inhalation may cause effects similar to those of acute inhalation.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

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

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

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

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Xylene UNNA: 1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: o-Xylene Illinois chemical safety act: o-Xylene New York release reporting list: o-Xylene Pennsylvania RTK: o-Xylene Florida: o-Xylene Massachusetts RTK: o-Xylene Massachusetts spill list: o-Xylene New Jersey: o-Xylene New Jersey spill list: o-Xylene Louisiana spill reporting: o-Xylene California Director's List of Hazardous Substances: o-Xylene TSCA 8(b) inventory: o-Xylene TSCA 8(d) H and S data reporting: o-Xylene: Effective: 10/4/82; Sunset: 10/4/92 SARA 313 toxic chemical notification and release reporting: o-Xylene CERCLA: Hazardous substances.: o-Xylene: 1000 lbs. (453.6 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):

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

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

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

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

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du rÃ¨glement sur le transport des marchandises dangeureuses au canada. Centre de conformitÃ© internatinal LtÃ©e. 1986.

Other Special Considerations: Not available.

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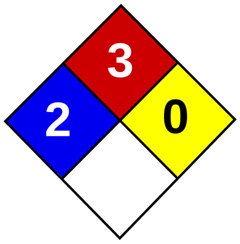

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
o-Xylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: o-Xylene

Catalog Codes: SLX1012

CAS#: 95-47-6

RTECS: ZE2450000

TSCA: TSCA 8(b) inventory: o-Xylene

CI#: Not applicable.

Synonym: 1,2-Dimethylbenzene

Chemical Name: o-Xylene

Chemical Formula: $C_6H_4(CH_3)_2$

Contact Information:

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

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

Order Online: ScienceLab.com

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

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

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

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{o-}Xylene	95-47-6	100

Toxicological Data on Ingredients: o-Xylene 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: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Classified POSSIBLE for human. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/male [POSSIBLE]. The substance may be toxic to kidneys, liver, 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. Get medical attention.

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

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

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

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 463°C (865.4°F)

Flash Points: CLOSED CUP: 17°C (62.6°F).

Flammable Limits: LOWER: 0.9% UPPER: 6.7%

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

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

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

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

Special Remarks on Fire Hazards:
Vapors are heavier than air and may travel considerable distance to source of ignition and flash back. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapors may form explosive mixtures with air. Containers may explode when heated. Runoff to sewer may create fire or explosion hazard

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:

Toxic flammable liquid, insoluble or very slightly soluble in water. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

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

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

Section 8: Exposure Controls/Personal Protection

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

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

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

Exposure Limits:
TWA: 434 STEL: 651 (mg/m3) from ACGIH (TLV) [United States] TWA: 100 STEL: 150 (ppm) from ACGIH (TLV) [United States] STEL: 150 (ppm) from NIOSH STEL: 655 (mg/m3) from NIOSHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Mobile, nonpolar liquid.)

Odor: Aromatic. Sweetish.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless.

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

Boiling Point: 144.4°C (291.9°F)

Melting Point: -25°C (-13°F)

Critical Temperature: 359°C (678.2°F)

Specific Gravity: 0.88 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.05 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.1

Ionicity (in Water): Not available.

Dispersion Properties:
Dispersed in diethyl ether. Is not dispersed in cold water, hot water. See solubility in diethyl ether, acetone.

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

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, flames, incompatible materials.

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

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Photochemically reactive. Incompatible with strong oxidizers(e.g. chlorine, bromine, fluorine), and strong acids (e.g. nitric acid, acetic acid).

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:
Lowest Published Lethal Dose - Inhalation (LCL): 6125 ppm 12 hours [Rat]; 6125 ppm 12 hours [Human] Lowest Published Lethal Dose - Oral: 5000 mg/kg [Rat]

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. TERATOGENIC EFFECTS: Classified POSSIBLE for human. DEVELOPMENTAL TOXICITY: Classified Reproductive system/ toxin/male [POSSIBLE]. May cause damage to the following organs: kidneys, liver, 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.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (male) and birth defects based on animal data. 0347 Animal: embryotoxic, foetotoxic, passes through the placental barrier. 0900 Detected in maternal milk in human. Narcotic effect; may cause nervous system disturbances.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Efffects Skin: May cause skin irritation. May be absorbed through skin i harmful amounts. Eyes: Causes severe eye irritation. Inhalation: Causes respiratory tract and mucous membranes irritation. May affect sense organs, behavior (Central Nervous system) which may result in dizziness, general weakness, central nervous system depression, confusion, ataxia, disorientation, lethargy, drowsiness, headaches. May also affect respiration, cardiovascular system, liver, blood, and digestive system (nausea, vomiting) Ingestion: Harmful if swallowed. Causes digestive tract irritation with nausea, vomiting

and diarrhea. May also affect metabolism, liver, and urinary system, and central nervous system (excitement followed by headache, dizziness, drowsiness and nausea). Chronic Potential Health Effects: Skin: Prolonged or repeated contact may cause defatting of skin and dermatitis. Eyes: Prolonged or repeated exposure may cause conjunctivitis or permanent eye damage. Inhalation: Chronic inhalation may cause effects similar to those of acute inhalation.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

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

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

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

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Xylene UNNA: 1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: o-Xylene Illinois chemical safety act: o-Xylene New York release reporting list: o-Xylene Pennsylvania RTK: o-Xylene Florida: o-Xylene Massachusetts RTK: o-Xylene Massachusetts spill list: o-Xylene New Jersey: o-Xylene New Jersey spill list: o-Xylene Louisiana spill reporting: o-Xylene California Director's List of Hazardous Substances: o-Xylene TSCA 8(b) inventory: o-Xylene TSCA 8(d) H and S data reporting: o-Xylene: Effective: 10/4/82; Sunset: 10/4/92 SARA 313 toxic chemical notification and release reporting: o-Xylene CERCLA: Hazardous substances.: o-Xylene: 1000 lbs. (453.6 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):

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

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

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

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

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du rÃ¨glement sur le transport des marchandises dangeureuses au canada. Centre de conformitÃ© internatinal LtÃ©e. 1986.

Other Special Considerations: Not available.

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Safety Data Sheets (SDS)

SECTION 1-IDENTIFICATION

Product name: Toluene

Other names:-

Proper shipping name: Toluene

Recommended use of the chemical and restrictions on use:

The major use of toluene is as a mixture added to gasoline to improve octane ratings. Used as a solvent for paint, resins, lacquers inks & adhesives. Component of solvent blends and thinners. Used in the manufacture of chemicals, dyes, explosives, benzoic acid. Some grades of toluene may contain traces of xylene and benzene.

The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

WARNING: Intentional misuse by concentrating/inhaling contents may be lethal.

Manufacturer/Supplier Name: Taiwan SM Corp., Kaohsiung plant
Address: NO.7, Industrial 1st Rd, Lin-Yuan Kaohsiung County 83203, Taiwan, R.O.C.
Phone No.: 886-7-6414511

Emergency phone No./Fax No.: 886-7-6414511 Ext. 221 (on duty), 886-7-6414517 (off duty)/886-7-6423828

SECTION 2-HAZARDS IDENTIFICATION

GHS Classification:

Flammable Liquid Category 2
Acute Toxicity (Oral) Category 4
Skin Corrosion/ Irritation Category 2
Serious Eye Damage/ Eye Irritation Category 2
Specific Target Organ Toxicity Repeated Exposure Category 2
Hazardous To The Aquatic Environment (Acute) Category 3
Aspiration Hazard Category 1

GHS Label elements:

Hazard symbols

Signal word

Danger

Hazard statements

Highly flammable liquid and vapor
Harmful if inhaled
Causes skin irritation
Causes serious eye irritation
May cause damage to organs through prolonged or repeated exposure.
May cause long lasting harmful effects to aquatic life.
May be fatal if swallowed and enters airways.

Precautionary statements

Use only in well ventilated area.
Control of exposure by mechanical ventilation in an unventilated or confined space.
Avoid breathing vapors and contact with skin and eyes.
Wear breathing apparatus/protective gloves/face protection.
Store in well-ventilated place.
Disposal must be in accordance with applicable federal, state, or local regulations.

Other hazards: –

SECTION 3-COMPOSITION/INFORMATION ON INGREDIENTS

CAS No.	**Chemical Name**	**wt% by weight**	**EINECS No.**
00108-88-3	Toluene	97.0 min.	203-625-9
Synonyms	**Methylbenzol; Methylbenzene; Toluol; Phenylmethane**		

SECTION 4-FIRST AID MEASURES

Description of necessary first aid measures

Eye:

1. Flush immediately with warm water for at least 20 minutes.
2. Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
3. If pain persists or recurs seek medical attention.
4. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin:

1. Removing contaminated clothing, shoes, and leathery wearings, cleaning procedure is available before reused or waste treatment.
2. Washing affected area thoroughly with soap and water for at least 20 minutes.
3. Call a Physician if irritation develops or persists.

Ingestion:

1. If spontaneous vomiting appears imminent or occurs, hold patient's head down, lower than their hips to help avoid possible aspiration of vomits.
2. If victim is conscious and alert, give 2～4 cupfuls of milk/water to dilute the substance in stomach.
3. Never give anything by mouth to an unconscious person.
4. Don’t induce vomiting unless directed to do so by medical person.
5. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
6. Then seek for medical attention.

Inhalation:

1. Remove from further exposure and flush thoroughly with air.
2. Lay patient down. Keep warm and rested.
3. Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
4. If respiratory irritation, seek immediate medical assistance and call a physician.

Most important symptoms/effects, acute and delayed

Headache, fatigue, drowsiness, insomnia, anorexia and pain in limbs, nervousness, impairment of memory.

Indication of immediate medical attention and special treatment needed, if necessary

For acute or short term repeated exposures to toluene:

Inhalation:

1. Inhalation overexposure can produce toxic effects. Monitor for respiratory distress.
2. If cough or difficulty in breathing develops, evaluate for upper respiratory tract inflammation, bronchitis, and pneumonitis. Administer supplemental oxygen with assisted ventilation, as required.
3. This material (or a component) sensitizes the heart to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material.
4. Administration of sympathomimetic drugs should be avoided.

Ingestion:

1. If ingested, this material presents a significant aspiration and chemical pneumonitis hazard.
2. Induction of emesis is not recommended.
3. Consider activated charcoal and/or gastric lavage.
4. If patient is obtunded, protect the airway by cuffed endotracheal intubation or by placement of the body in a Trendelenburg and left lateral decubitus position.

SECTION 5-FIRE FIGHTING MEASURES

Extinguishing media

Foam、CO_2、Dry chemical、Water fog.

Specific hazards arising from the chemical

1. Liquid and vapor are highly flammable.
2. Severe fire hazard when exposed to heat, flame and/or oxidizers.
3. Vapor may travel a considerable distance to source of ignition.
4. Heating may cause expansion or decomposition leading to violent rupture of containers.
5. On combustion, may emit toxic fumes of carbon monoxide (CO).

Special protective equipment and precautions for fire-fighters

1. Firefighters must use full bunker gear including NIOSH-approved positive pressure self-contained breathing apparatus to protect against potential hazardous combustion or decomposition products and oxygen deficiencies.
2. Evacuate area and fight the fire from a maximum distance or use unmanned hose holders or monitor nozzles.
3. Cover pooling liquid with foam.
4. Containers can build pressure if exposed to radiant heat; cool adjacent containers with flooding quantities of water until well after the fire is out.
5. Withdraw immediately from the area if there is a rising sound from a venting safety device or discoloration of vessels, tanks, or pipelines.
6. Be aware that burning liquid will float on water.
7. Notify appropriate authorities of potential fire and explosion hazard if liquid enter sewers or waterways

SECTION 6-ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedure

1. Personal protective equipment (specified in Section 8)
   Eyes : Chemical safety goggles are recommended, and a face shield is added when needed.
   Skin : Wear appropriate protective gloves to avoid skin contact.
   Clothing: When direct contact is likely, use rubberized clothings, apron and boots.
   Respiratory : When limits are exceeded, wear a respirator approved by NIOSH/MSHA for protection against organic dust, mists and vapors.
2. Remove all sources of ignition. No smoking, naked lights or ignition sources. Ventilate area of leak or spill.
3. Keep unnecessary and unprotected personnel from entering. Evacuate personnel from the danger area. Consult with an expert about the emergency procedures.

Environmental precautions

1. Prevent spillage from entering drains, surface, and groundwater.
2. Contain and recover liquid when possible. Use non-sparking tools and equipment.
3. Collect liquid in an appropriate container or absorb with an inert material (e.g. vermiculite, dry sand, earth), and place in a chemical waste container.
4. Report the accidental spill/release to Local/State government.

Methods and materials for containment and cleaning up

Minor spill:

1. Remove all ignition sources.
2. Clean up all spills immediately.
3. Avoid breathing vapors and contact with skin and eyes.
4. Control personal contact by using protective equipment.
5. Contain and absorb small quantities with vermiculite or other absorbent material.
6. Wipe up.
7. Collect residues in a flammable waste container.

Major spill

1. Clear area of personnel and move upwind.
2. Alert emergency responders and tell them location and nature of hazard.
3. May be violently or explosively reactive.
4. Wear breathing apparatus plus protective gloves.
5. Prevent spillage from entering drains or water course.
6. No smoking, naked lights or ignition sources. Increase ventilation.
7. Stop leak if safe to do so.
8. Water spray or fog may be used to disperse/absorb vapor.
9. Contain spill with sand, earth or vermiculite.
10. Use only spark-free shovels and explosion proof equipment.
11. Collect recoverable product into labeled containers for recycling..
12. Absorb remaining product with sand, earth or vermiculite.
13. Collect solid residues and seal in labeled drums for disposal.
14. Wash area and prevent runoff into drains.
15. If contamination of drains or waterways occurs, advise emergency services.

SECTION 7-HANDLING AND STORAGE

Precautions for safe handling

1. Wash thoroughly after handling.
2. Use only in well ventilated area.
3. Ground and bond containers when transferring.
4. Use spark-free tools and explosion proof equipment.
5. Empty containers retain product residue (liquid/vapor), and can be dangerous.
6. Do not pressurize, cut, weld, braze, solder, drill, or expose empty containers to heat, sparks or open flames.

Conditions for safe storage, including any incompatibilities

1. Store in original containers in approved flame-proof area.
2. No smoking, naked lights, heat or ignition sources.
3. DO NOT store in pits, depressions, basements or areas where vapors may be trapped.
4. Keep containers securely sealed.
5. Store away from incompatible materials in a cool, dry well ventilated area.
6. Protect containers against physical damage and check regularly for leaks.
7. Keep containers tightly closed and store in a cool, dry, well-ventilated place, plainly labeled, and out of closed vehicles.
8. Ground all equipment containing this material.
9. Observe manufacturer's storing and handling recommendations.
10. Containers should be able to withstand pressures expected from warming and cooling in storage. This flammable liquid should be stored in a separate safety cabinet or room. A refrigerated room is preferable for materials with a flash point temperature lower than 70°F (21°C).

SECTION 8-EXPOSURE CONTROLS, PERSONAL PROTECTION

OSHA - Final PELs : 200 ppm TWA.
OSHA Ceiling : 300ppm.
ACGIH : 50 ppm, skin -potential forcutaneous absorption.
NIOSH : 100 ppm TWA; 375 mg/m^3 TWA; 500 ppm IDLH.
Taiwan TWA : 100 ppm (skin).
Taiwan STEL : 125 ppm (skin).
Taiwan Ceiling : -------.
Taiwan BEI : 1 mg/l (before on duty).

Engineering control

1. Process should be located at least 17 meter (50 feet) away from open flames and all high temperature operations likely to cause ignition of the styrene monomer vapor.
2. In venting styrene monomer vapors, consideration should be given to possible halogenation of the vapors by low concentrations of free chlorine and bromine with the resultant formation of lacrimations.
3. Process should be designed so that the operator is not exposed to direct contact with Toluene or the vapor. The technical problems of designing equipment, providing adequate ventilation and operating procedures which promise maximum security and economy, can best be handled by competent engineers.
4. It is essential for safety that equipment be used and maintained as recommended by the manufacturer.
5. Tanks used to store or process Toluene should be closed vessels vented to a safe point of discharge in the outside atmosphere away from operating stations, roadways, and at least 17 meter (50 feet) from possible sources of ignitions. All sparks, flames, heated surface, or other sources of ignition should be kept away from all vents. It is advisable, to provide suction on vessels when inspection or observation openings are made, to minimize or eliminate escape of vapors.

Personal protective equipment

Eye Protection:
Safety glasses equipped with side shields are recommended as minimum protection in industrial settings. Chemical goggles should be worn during transfer operations or when there is a likelihood of misting, splashing, or spraying of this material. A suitable emergency eye wash water and safety shower should be located near the work station.

Skin protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Clothing:
Avoid skin contact. Wear long-sleeved fire-retardant garments (e.g., Nomex®) while working with flammable and combustible liquids. Additional chemical-resistant protective gear may be required if splashing or spraying conditions exist. This may include an apron, boots and additional facial protection. If product comes in contact with clothing, immediately remove soaked clothing and shower. Promptly remove and discard contaminated leather goods.

Respirators:
For known vapor concentrations above the occupational exposure guidelines (see below), use a NIOSH-approved organic vapor respirator if adequate protection is provided. Protection factors vary depending upon the type of respirator used. Respirators should be used in accordance with OSHA requirements (29 CFR 1910.134). For airborne vapor concentrations that exceed the recommended protection factors for organic vapor respirators, use a full-face, positive-pressure, supplied air respirator. Due to fire and explosion hazards, do not enter atmospheres containing concentrations greater than 10% of the lower flammable limit of this product.

SECTION 9-PHYSICAL AND CHEMICAL PROPERTIES

Appearance : Transparent liquid	Upper/lower explosive limits : 1.2%～7.1%
Odour : pleasant aromatic petroleum odour	Vapor Pressure : 22 mmHg @20℃/68℉
Odour threshold : 0.16～37 ppm (detect) 1.9～69 ppm (recognition)	Vapor Density : 3.1 (air=1)
PH : Not available	Relative density : 0.86 (water=1)
Melting/Freezing Point : －95 ℃	Solubility in water : 54～58 mg/100 ml
Initial boiling point/boiling range : 110.6 ℃	Partition coefficient : 2.73 (n-octanol/water)
Flash point : 4.4 ℃ (closed cup)	Auto-ignition temperature : 480℃
Evaporation Rate : 2.24 (BuAc=1)	Decomposition temperature : Not available
Flammability (solid/gas) : Not available	Viscosity : 0.6 mPa.s max @20℃
Molecular Formula : $C_6H_5CH_3$	Molecular Weight : 92.056

SECTION 10-STABILITY AND REACTIVITY

Reactivity
Vapor is explosive when exposed to heat or flame

Chemical stability
Stable at room temperature in closed containers under normal storage and handling conditions.

Possibility of hazardous reaction
Has not been reported.

Condition to avoid
Product is highly flammable – Keep away from sources of ignition. Avoid the higher temperatures. Keep away from open fire, heating elements and heat radiating surface and prevent from forming of the vapours mixtures with air in explosion limits.

Incompatible materials
Heat, flame, strong oxidizers, nitric and sulfuric acids, chlorine, nitrogen tetraoxide; will attack some forms of plastics, rubber, coatings.

Hazardous decomposition products
Carbon monoxide, carbon dioxide, hydrocarbons.

SECTION 11-TOXICOLOGICAL INFORMATION

Routes of exposure
Eye, Skin, inhalation, Ingestion.

Symptoms (treatments as indicated in Section 4)
Eye: The liquid produces a high level of eye discomfort and is capable of causing pain and severe conjunctivitis. Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated. There is evidence that material may produce eye irritation in some persons and produce eye damage 24 hours or more after instillation. Severe inflammation may be expected with pain. There may be damage to the cornea. Unless treatment is prompt and adequate there may be permanent loss of vision. Conjunctivitis can occur following repeated exposure.

Skin: Contact with the material may damage the health of the individual; systemic effects may result following absorption. The material may cause moderate inflammation of the skin either following direct contact or after a delay of some time. Repeated exposure can cause contact dermatitis which is characterized by redness, swelling and blistering. Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

Ingestion: Accidental ingestion of the material may be harmful; animal experiments indicate that ingestion of less than 150 gram may be fatal or may produce serious damage to the health of the individual. Swallowing of the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis; serious consequences may result. (ICSC13733). Considered an unlikely route of entry in commercial/industrial environments. The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Inhalation: Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may be damaging to the health of the individual. There is some evidence to suggest that the material can cause respiratory irritation in some persons. The body's response to such irritation can cause further lung damage. Inhalation of vapours may cause drowsiness and dizziness. This may be accompanied by sleepiness, reduced alertness, loss of reflexes, lack of co-ordination, and vertigo. Inhalation of high concentrations of gas/vapour causes lung irritation with coughing and nausea, central nervous depression with headache and dizziness, slowing of reflexes, fatigue and inco-ordination. If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death. The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

Chronic exposure: There has been some concern that this material can cause cancer or mutations but there is not enough data to make an assessment. Substance accumulation, in the human body, may occur and may cause some concern following repeated or long-term occupational exposure.

Toxicity
LD50: <870 mg/kg (rat, oral)
LC50: 6000 ppm/6h (rat, inhalation)

Chronic effect
Carcinogenicity:
ACGIH : A4-Not classifiable as a Human Carcinogen.
OSHA : Possible select carcinogen.
IARC : Group 3 carcinogen.

Epide miology: Not available.

Teratogenicity: Teratogenic effects have occurred in experimental animals.

Reproductive Effects: Adverse reproductive effects have occurred in experimental animals.

Neurotoxicity: Not available.

Mutagenicity: Not available.

SECTION 12-ECOLOGICAL INFORMATION

Ecotoxicity
LC_{50} (96 hr.) Fish: 7.3～22.8 mg/l
EC_{50} (48 hr.) Water flea: －
Biocencentration factor (BCF): 1.67～380

Persistence and degradability

1. The material are expected to form a slick on the surface of waters after release in calm sea conditions. This is expected to evaporate and enter the atmosphere where it will be degraded through reaction with hydroxyl radicals.
2. Some of the material will become associated with benthic sediments, and it is likely to be spread over a fairly wide area of sea floor. Marine sediments may be either aerobic or anaerobic. The material, in probability, is biodegradable, under aerobic conditions. Evidence also suggests that the hydrocarbons may be degradable under anaerobic conditions although such degradation in benthic sediments may be a relatively slow process.
3. Under aerobic conditions the material will degrade to water and carbon dioxide, while under aerobic processes it will produce water, methane, carbon dioxide and carbon dioxide.
4. Based on test results, as well as theoretical considerations, the potential for bioaccumulation may be high. Toxic effects are often observed in species such as blue mussel, daphnia, freshwater green algae, marine copepods and amphipods.

Half-life (Air): 10～104 hr
Half-life (Surface water): 96～528 hr
Half-life (Ground water): 168～672 hr
Half-life (Soil): 96～528 hr

Bioaccumulative potential
This material is not expected to significantly bioaccumulate.

Mobility in soil: －

Other adverse effects: －

SECTION 13-DISPOSAL CONSIDERATIONS

Residues and spilled material are hazardous waste due to ignitability. Disposal must be in accordance with applicable federal, state, or local regulations.
The container for this product can present explosion or fire hazards, even when emptied. To avoid risk of injury, do not cut, puncture, or weld on or near this container. Since the emptied containers retain product residue, follow label warnings even after container is emptied.

SECTION 14-TRANSPORTATION INFORMATION

US DOT	Shipping Name	Toluene	Hazard Labels	
	Hazard Class	3		
	UN Number	1294		
	Packing Group	II		
Sea(IMO/IMDG)	Shipping Name	Toluene	Hazard Labels	
	Hazard Class	3.2		
	UN Number	1294		
	Packing Group	II		
	IMDG Code Page	3285		
	MARPOL	Not a DOT "Marine Pollutant" per 49 CFR 171.8.		
Air(ICAO/IATA)	Shipping Name	Toluene	Hazard Labels	
	Hazard Class	3.2		
	Subsidiary Class	1294		
	Packing Group	II		
RID/ ADR	No information available.			
Canadian TDG	Shipping Name	Toluene	Hazard Labels	
	Hazard Class	3		
	UN Number	1294		
	Packing Group	II		
	Subsidiary Class	9.2		

SECTION 15-REGULATORY INFORMATION

US FEDERAL

TSCA

CAS# 108-88-3 is listed on the TSCA inventory.

Health & Safety Reporting List

CAS# 108-88-3: Effective Date: 10/4/82; Sunset Date: 10/4/92

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

SARA

Section 302 (RQ)

CAS# 108-88-3 : final RQ = 1000 pounds (454 kg)

Section 302 (TPQ)

None of the chemicals in this material have a TPQ.

SARA Codes

CAS# 108-88-3 : acute, flammable.

Section 313

This material contains Toluene (CAS# 108-88-3, 99% & 100%), which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 372.

Clean Air Act

CAS# 108-88-3 is listed as a hazardous air pollutant (HAP).

This material does not contain any Class 1 Ozone depletors.

This material does not contain any Class 2 Ozone depletors.

Clean Water Act

CAS# 108-88-3 is listed as a Hazardous Substance under the CWA.
CAS# 108-88-3 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 108-88-3 is listed as a Toxic Pollutant under the Clean Water Act.

OSHA

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

Toluene can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

WARNING: This product contains Toluene, a chemical known to the state of California to cause birth defects or other reproductive harm.

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols: XN F
Risk Phrases : R 10 Flammable.
R 20 Harmful by inhalation.
Safety Phrases : S 9 Keep container in a well-ventilated place.
S 16 Keep away from sources of ignition - No smoking.
S 25 Avoid contact with eyes.
S 29 Do not empty into drains.
S 33 Take precautionary measures against static discharges.

WGK (Water Danger/Protection)

CAS# 108-88-3: 2

United Kingdom Occupational Exposure Limits

CAS# 108-88-3: OES-United Kingdom, TWA 50 ppm TWA; 191 mg/m3 TWA.
CAS# 108-88-3: OES-United Kingdom, STEL 150 ppm STEL; 574 mg/m3 STEL.

CANADA

CAS#100-42-5 is listed on Canada’s DSL/NDSL list.
This product has a WHMIS classification of B2, D2A (99%)/B3, D2A (100%).
CAS# 105-05-5 is not listed on Canada’s Ingredient Disclosure List.

Exposure Limits

- CAS# 108-88-3: OEL-AUSTRALIA:TWA 100 ppm (375 mg/m3);STEL 150 ppm (560 mg/m3)
- OEL-BELGIUM:TWA 100 ppm (377 mg/m3);STEL 150 ppm (565 mg/m3)
- OEL-CZECHOSLOVAKIA:TWA 200 mg/m3;STEL 1000 mg/m3
- OEL-DENMARK:TWA 50 ppm (190 mg/m3);Skin
- OEL-FINLAND:TWA 100 ppm (375 mg/m3);STEL 150 ppm; Skin
- OEL-FRANCE:TWA 100 ppm (375 mg/m3);STEL 150 ppm (560 mg/m3)
- OEL-GERMANY:TWA 100 ppm (380 mg/m3)
- OEL-HUNGARY:TWA 100 mg/m3;STEL 300 mg/m3;Skin
- OEL-JAPAN:TWA 100 ppm (380 mg/m3)
- OEL-THE NETHERLANDS:TWA 100 ppm (375 mg/m3);Skin
- OEL-THE PHILIPPINES:TWA 100 ppm (375 mg/m3)
- OEL-POLAND:TWA 100 mg/m3
- OEL-RUSSIA:TWA 100 ppm; STEL 50 mg/m3
- OEL-SWEDEN:TWA 50 ppm (200 mg/m3);STEL 100 ppm (400 mg/m3);Skin
- OEL-SWITZERLAND:TWA 100 ppm (380 mg/m3);STEL 500 ppm
- OEL-THAILAND:TWA 200 ppm; STEL 300 ppm
- OEL-TURKEY:TWA 200 ppm (750 mg/m3)
- OEL-UNITED KINGDOM:TWA 100 ppm (375 mg/m3);STEL 150 ppm; Skin OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

SECTION 16-OTHER INFORMATION

References and sources

1. CHEMINFO Data Bank, CCINFO CD, 2005-3
2. HAZARD TEXT Data Bank, TOMES PLUS CD, Vol.65, 2005
3. RETECS Data Bank, TOMES CPS CD, Vol.65, 2005
4. HSDB Data Bank, TOMES CPS CD, Vol.65, 2005
5. Hazardous Substance Data Bank, Environment Protection, Administration, Executive Yuan, ROC (Taiwan)
6. Chemwatch Data Bank, 2005-1
7. SDS, GHS in Taiwan, Council of Labor Affairs, Executive Yuan, ROC (Taiwan)

Version	Date	Remark
Version 1	06/01/1998	Original Version.
Version 2	04/20/2001	Updated 10 sections to 16 sections.
Version 3	08/01/2003	Updated “SECTION 9-PHYSICAL AND CHEMICAL PROPERTIES”.
Version 4	01/01/2006	Updated “SECTION 14-TRANSPORTATION INFORMATION”.
Version 5	08/05/2008	Updated each section by GHS SDS.
Prepared by	Safety & Environment Protection Section, Taiwan SM Corporation Kaohsiung Plant.	

SIGMA-ALDRICH

sigma-aldrich.com

SAFETY DATA SHEET

Version 4.7
Revision Date 06/28/2014
Print Date 02/02/2015

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Pyrene

Product Number : 185515
Brand : Aldrich

CAS-No. : 129-00-0

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Acute aquatic toxicity (Category 1), H400
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Warning

Hazard statement(s)
H410 Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)
P273 Avoid release to the environment.
P391 Collect spillage.
P501 Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

Rapidly absorbed through skin.

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Synonyms : Benzo[def]phenanthrene

Formula : $C_{16}H_{10}$
Molecular Weight : 202.25 g/mol
CAS-No. : 129-00-0
EC-No. : 204-927-3

Hazardous components

Component	Classification	Concentration
Pyrene		
	Aquatic Acute 1; Aquatic Chronic 1; H410	90 - 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

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

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

no data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Carbon oxides

5.3 Advice for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

5.4 Further information

no data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.
For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up

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

6.4 Reference to other sections

For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.
Provide appropriate exhaust ventilation at places where dust is formed.Normal measures for preventive fire protection.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Pyrene	129-00-0	TWA	0.2 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.2 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
	Remarks	1910.1002 As used in §1910.1000 (Table Z-1), coal tar pitch volatiles include the fused polycyclic hydrocarbons which volatilize from the distillation residues of coal, petroleum (excluding asphalt), wood, and other organic matter. Asphalt (CAS 8052-42-4, and CAS 64742-93-4) is not covered under the 'coal tar pitch volatiles' standard OSHA specifically regulated carcinogen		

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.4 mm
Break through time: 480 min
Material tested:Camatril® (KCL 730 / Aldrich Z677442, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 30 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
impervious clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
For nuisance exposures use type P95 (US) or type P1 (EU EN 143) particle respirator.For higher level protection use type OV/AG/P99 (US) or type ABEK-P2 (EU EN 143) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: crystalline Colour: yellow
b)	Odour	no data available
c)	Odour Threshold	no data available
d)	pH	no data available
e)	Melting point/freezing point	Melting point/range: 145 - 148 °C (293 - 298 °F) - lit.
f)	Initial boiling point and boiling range	390.0 - 395.0 °C (734.0 - 743.0 °F)
g)	Flash point	> 200.0 °C (> 392.0 °F)
h)	Evapouration rate	no data available
i)	Flammability (solid, gas)	no data available
j)	Upper/lower flammability or explosive limits	no data available
k)	Vapour pressure	no data available
l)	Vapour density	no data available
m)	Relative density	1.21 g/cm3
n)	Water solubility	no data available
o)	Partition coefficient: n-octanol/water	log Pow: 4.88
p)	Auto-ignition temperature	no data available
q)	Decomposition temperature	no data available
r)	Viscosity	no data available
s)	Explosive properties	no data available
t)	Oxidizing properties	no data available

9.2 Other safety information

Bulk density	650 kg/m3

10. STABILITY AND REACTIVITY

10.1 Reactivity

no data available

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

no data available

10.4 Conditions to avoid

no data available

10.5 Incompatible materials

Strong oxidizing agents

10.6 Hazardous decomposition products

Other decomposition products - no data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - rat - 2,700 mg/kg
Remarks: Sense Organs and Special Senses (Nose, Eye, Ear, and Taste):Eye:Conjunctive irritation. Behavioral:Excitement. Behavioral:Muscle contraction or spasticity.

LC50 Inhalation - rat - 170.0 mg/m3
Remarks: Sense Organs and Special Senses (Nose, Eye, Ear, and Taste):Eye:Conjunctive irritation. Behavioral:Excitement. Behavioral:Muscle contraction or spasticity.

Dermal: no data available

no data available

Skin corrosion/irritation
Skin - rabbit
Result: Mild skin irritation - 24 h

Serious eye damage/eye irritation
Eyes - rabbit
Result: Mild eye irritation

Respiratory or skin sensitisation
no data available

Germ cell mutagenicity
Laboratory experiments have shown mutagenic effects.

Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC:	3 - Group 3: Not classifiable as to its carcinogenicity to humans (Pyrene)
ACGIH:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
NTP:	Known to be human carcinogen (Pyrene)
OSHA:	OSHA specifically regulated carcinogen (Pyrene)

Reproductive toxicity
no data available

no data available

Specific target organ toxicity - single exposure
no data available

Specific target organ toxicity - repeated exposure
no data available

Aspiration hazard
no data available

Additional Information
RTECS: UR2450000

Inhalation studies in animals have caused:, Liver toxicity, pulmonary pathologies, intragastric pathologies, neutropenia, leukopenia, anemia, Contact with skin can cause:, hyperemia, weight loss, hematopoietic changes, Dermatitis, Chronic effects, leukocytosis

Kidney -

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Oncorhynchus mykiss (rainbow trout) - > 2 mg/l - 96.0 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 0.002 - 0.003 mg/l - 48 h

12.2 Persistence and degradability

12.3 Bioaccumulative potential

Bioaccumulation	other fish - 48 h - 0.056 mg/l Bioconcentration factor (BCF): 4,810

12.4 Mobility in soil

no data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

Very toxic to aquatic life.
An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Avoid release to the environment.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

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

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 3077 Class: 9 Packing group: III
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Pyrene)

Reportable Quantity (RQ): 5000 lbs
Marine pollutant:
Poison Inhalation Hazard: No

IMDG

UN number: 3077	Class: 9	Packing group: III	EMS-No: F-A, S-F

Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Pyrene)
Marine pollutant: No

IATA

UN number: 3077	Class: 9	Packing group: III

Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Pyrene)

Further information

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

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15. REGULATORY INFORMATION

SARA 302 Components

The following components are subject to reporting levels established by SARA Title III, Section 302:

	CAS-No.	Revision Date
Pyrene	129-00-0	2008-11-03

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

Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Pyrene	129-00-0	2008-11-03

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Pyrene	129-00-0	2008-11-03

New Jersey Right To Know Components

	CAS-No.	Revision Date
Pyrene	129-00-0	2008-11-03

California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.	CAS-No.	Revision Date
Pyrene	129-00-0	

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16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

HMIS Rating

Health hazard:	1
Chronic Health Hazard:	*
Flammability:	1
Physical Hazard	0

NFPA Rating

Health hazard:	0
Fire Hazard:	1
Reactivity Hazard:	0

Further information

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.7 Revision Date: 06/28/2014 Print Date: 02/02/2015

SAFETY DATA SHEET

Based upon Regulation (EC) No. 1907/2006, as amended by Regulation (EC) No. 453/2010

BCR-160R: fluoranthene

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier:

Product name	: BCR-160R: fluoranthene
Product type REACH	: Substance/mono-constituent
CAS number	: 206-44-0
EC number	: 205-912-4
RTECS number	: LL4025000
Molecular mass	: 202.26 g/mol
Formula	: C16H10

1.2 Relevant identified uses of the substance or mixture and uses advised against:

Certified reference material for laboratory use only

1.3 Details of the supplier of the safety data sheet:

Supplier of the safety data sheet

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 number:

Poison Centre:
+32 70 245 245

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture:

2.1.1 Classification according to Regulation EC No 1272/2008

Classified as dangerous according to the criteria of Regulation (EC) No 1272/2008

Class	Category	Hazard statements
Acute Tox.	category 4	H302: Harmful if swallowed.
Aquatic Acute	category 1	H400: Very toxic to aquatic life.
Aquatic Chronic	category 1	H410: Very toxic to aquatic life with long lasting effects.

2.1.2 Classification according to Directive 67/548/EEC-1999/45/EC

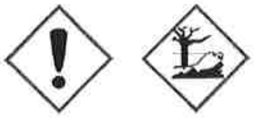
Classified as dangerous in accordance with the criteria of Directives 67/548/EEC and 1999/45/EC

Xn; R22 - Harmful if swallowed.

N; R50-53 - Very toxic to aquatic organisms. May cause long-term adverse effects in the aquatic environment.

2.2 Label elements:

Labelling according to Regulation EC No 1272/2008 (CLP)



Signal word	Warning
H-statements	
H302	Harmful if swallowed.
H410	Very toxic to aquatic life with long lasting effects.
P-statements	
P264	Wash hands thoroughly after handling.
P273	Avoid release to the environment.
P301 + P312	IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell.

P330	Rinse mouth.
P391	Collect spillage.
P501	Dispose of contents/container to manufacturer/competent authority.

2.3 Other hazards:

CLP

Combustible

Its dust is explosive with air

Dust cloud can be ignited by a spark

SECTION 3: Composition/information on ingredients

3.1 Substances:

Name (REACH Registration No)	CAS No EC No	Conc. (C)	Classification according to DSD/DPD	Classification according to CLP	Note	Remark
fluoranthene	206-44-0 205-912-4		Xn; R22 N; R50-53	Acute Tox. 4; H302 Aquatic Acute 1; H400 Aquatic Chronic 1; H410	(1) (9)	Mono-constituent

(1) For R-phrases and H-statements in full: see heading 16- (9) M-factor, see heading 16

3.2 Mixtures:

Not applicable

SECTION 4: First aid measures

4.1 Description of first aid measures:

General:

If you feel unwell, seek medical advice.

After inhalation:

Remove the victim into fresh air. Respiratory problems: consult a doctor/medical service.

After skin contact:

Rinse with water. Do not apply (chemical) neutralizing agents. Consult a doctor/medical service.

After eye contact:

Rinse with water. Do not apply neutralizing agents. Take victim to an ophthalmologist if irritation persists.

After ingestion:

Rinse mouth with water. Consult a doctor/medical service if you feel unwell.

4.2 Most important symptoms and effects, both acute and delayed:

4.2.1 Acute symptoms

After inhalation:

No data available.

After skin contact:

No data available.

After eye contact:

No data available.

After ingestion:

No data available.

4.2.2 Delayed symptoms

If applicable and available it will be listed below.

4.3 Indication of any immediate medical attention and special treatment needed:

If applicable and available it will be listed below.

SECTION 5: Firefighting measures

5.1 Extinguishing media:

5.1.1 Suitable extinguishing media:

Water spray. Alcohol-resistant foam. ABC powder. Carbon dioxide.

5.1.2 Unsuitable extinguishing media:

No unsuitable extinguishing media known.

5.2 Special hazards arising from the substance or mixture:

Upon combustion: CO and CO2 are formed.

5.3 Advice for firefighters:

5.3.1 Instructions:

Take account of environmentally hazardous firefighting water. Use water moderately and if possible collect or contain it.

5.3.2 Special protective equipment for fire-fighters:

Gloves. Protective clothing. Heat/fire exposure: compressed air/oxygen apparatus.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures:

No naked flames.

6.1.1 Protective equipment for non-emergency personnel

See heading 8.2

6.1.2 Protective equipment for emergency responders

Gloves. Protective clothing.

Suitable protective clothing

See heading 8.2

6.2 Environmental precautions:

Contain leaking substance. Dam up the solid spill. Prevent soil and water pollution. Prevent spreading in sewers.

6.3 Methods and material for containment and 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.

6.4 Reference to other sections:

See heading 13.

SECTION 7: Handling and storage

The information in this section is a general description. If applicable and available, exposure scenarios are attached in annex. Always use the relevant exposure scenarios that correspond to your identified use.

7.1 Precautions for safe handling:

Avoid raising dust. Keep away from naked flames/heat. Finely divided: spark- and explosionproof appliances. Finely divided: keep away from ignition sources/sparks. Observe normal hygiene standards. Keep container tightly closed. Do not discharge the waste into the drain.

7.2 Conditions for safe storage, including any incompatibilities:

7.2.1 Safe storage requirements:

Storage temperature: < 4 °C. Store in a cool area. Store in a dry area. Keep locked up. Unauthorized persons are not admitted. Meet the legal requirements.

7.2.2 Keep away from:

Heat sources, ignition sources, oxidizing agents.

7.2.3 Suitable packaging material:

Glass.

7.2.4 Non suitable packaging material:

No data available

7.3 Specific end use(s):

If applicable and available, exposure scenarios are attached in annex. See information supplied by the manufacturer.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters:

8.1.1 Occupational exposure

a) Occupational exposure limit values

If limit values are applicable and available these will be listed below.

b) National biological limit values

If limit values are applicable and available these will be listed below.

8.1.2 Sampling methods

Product name	Test	Number
Fluoranthene (Polynuclear aromatic hydrocarbon)	NIOSH	5515
Fluoranthene (Polynuclear aromatic hydrocarbon)	NIOSH	5506

8.1.3 Applicable limit values when using the substance or mixture as intended

If limit values are applicable and available these will be listed below.

8.1.4 DNEL/PNEC values

If applicable and available it will be listed below.

8.1.5 Control banding

If applicable and available it will be listed below.

8.2 Exposure controls:

The information in this section is a general description. If applicable and available, exposure scenarios are attached in annex. Always use the relevant exposure scenarios that correspond to your identified use.

8.2.1 Appropriate engineering controls

Avoid raising dust. Keep away from naked flames/heat. Finely divided: spark- and explosionproof appliances. Finely divided: keep away from ignition sources/sparks. Carry operations in the open/under local exhaust/ventilation or with respiratory protection.

8.2.2 Individual protection measures, such as personal protective equipment

Observe normal hygiene standards. Keep container tightly closed. Do not eat, drink or smoke during work.

a) Respiratory protection:

Dust production: dust mask with filter type P2.

b) Hand protection:

Gloves.

- materials for protective clothing (good resistance)

Rubber.

c) Eye protection:

Safety glasses. In case of dust production: protective goggles.

d) Skin protection:

Protective clothing.

8.2.3 Environmental exposure controls:

See headings 6.2, 6.3 and 13

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties:

Physical form	Crystalline solid
	Needles
Odour	No data available on odour
Odour threshold	No data available
Colour	Colourless to light yellow
Particle size	No data available
Explosion limits	No data available
Flammability	Combustible
Log Kow	5.33
Dynamic viscosity	No data available
Kinematic viscosity	No data available
Melting point	110 °C
Boiling point	384 °C
Flash point	198 °C
Evaporation rate	No data available
Vapour pressure	No data available
Relative vapour density	Not applicable
Solubility	water ; 0.000026 g/100 ml
	ether ; > 10 g/100 ml
	ethanol ; soluble
	acetic acid ; soluble
	carbon disulfide ; soluble
	chloroform ; soluble
Relative density	1.25 ; 0 °C
Decomposition temperature	No data available
Auto-ignition temperature	No data available
Explosive properties	No chemical group associated with explosive properties
Oxidising properties	No chemical group associated with oxidising properties
pH	No data available

Physical hazards

No physical hazard class

9.2 Other information:

Absolute density	1252 kg/m³

SECTION 10: Stability and reactivity

10.1 Reactivity:

Temperature above flashpoint: higher fire/explosion hazard.

10.2 Chemical stability:

Stable under normal conditions.

10.3 Possibility of hazardous reactions:

No data available.

10.4 Conditions to avoid:

Avoid raising dust. Keep away from naked flames/heat. Finely divided: spark- and explosionproof appliances. Finely divided: keep away from ignition sources/sparks.

10.5 Incompatible materials:

Oxidizing agents.

10.6 Hazardous decomposition products:

Upon combustion: CO and CO2 are formed.

SECTION 11: Toxicological information

11.1 Information on toxicological effects:

11.1.1 Test results

Acute toxicity

BCR-160R: fluoranthene

Route of exposure	Parameter	Method	Value	Exposure time	Species	Gender	Value determination
Oral	LD50		2000 mg/kg		Rat		
Dermal	LD50		3180 mg/kg		Rabbit		

Conclusion

Harmful if swallowed.

Corrosion/irritation

BCR-160R: fluoranthene

No (test)data available

Respiratory or skin sensitisation

BCR-160R: fluoranthene

No (test)data available

Specific target organ toxicity

BCR-160R: fluoranthene

No (test)data available

Mutagenicity (in vitro)

BCR-160R: fluoranthene

No (test)data available

Mutagenicity (in vivo)

BCR-160R: fluoranthene

No (test)data available

Carcinogenicity

BCR-160R: fluoranthene

No (test)data available

Reproductive toxicity

BCR-160R: fluoranthene

No (test)data available

Toxicity other effects

BCR-160R: fluoranthene

No (test)data available

Chronic effects from short and long-term exposure

BCR-160R: fluoranthene

No specific information available. SIMILAR PRODUCTS CAUSE FOLLOWING SYMPTOMS: Tingling/irritation of the skin. Nausea. Accelerated heart action. Disturbances of heart rate. Enlargement/affection of the liver. Risk of lung oedema.

11.1.2 Other information

BCR-160R: fluoranthene

IARC - classification	3

SECTION 12: Ecological information

12.1 Toxicity:

BCR-160R: fluoranthene

	Parameter	Method	Value	Duration	Species	Test design	Fresh/salt water	Value determination
Acute toxicity fishes	LC50		0.0077 mg/l	96 h	Salmo gairdneri (Oncorhynchus mykiss)			
Acute toxicity invertebrates	EC50		<0.1 mg/l	72 h	Daphnia magna			
Toxicity algae and other aquatic plants	EC50		54 mg/l	96 h	Selenastrum capricornutum			

Conclusion

Highly toxic to fishes

Very toxic to invertebrates (Daphnia)

Harmful to algae

12.2 Persistence and degradability:

May cause long-term adverse effects in the aquatic environment

No (test)data available

12.3 Bioaccumulative potential:

BCR-160R: fluoranthene

BCF fishes

Parameter	Method	Value	Duration	Species	Value determination
BCF		3981		Pimephales promelas	
		6110		Lepomis macrochirus	

BCF other aquatic organisms

Parameter	Method	Value	Duration	Species	Value determination
BCF		10000	192 h	Ostreidae	
		695	48 h	Ostreidae	

Log Kow

Method	Remark	Value	Temperature	Value determination
		5.33		

Conclusion

High potential for bioaccumulation (BCF > 5000)

12.4 Mobility in soil:

No (test)data on mobility of the substance available

12.5 Results of PBT and vPvB assessment:

Due to insufficient data no statement can be made whether the substance fulfils the criteria of PBT and vPvB according to Annex XIII of Regulation (EC) No 1907/2006.

12.6 Other adverse effects:

BCR-160R: fluoranthene

Global warming potential (GWP)

Not included in the list of substances which may contribute to the greenhouse effect (Regulation (EC) No 842/2006)

Ozone-depleting potential (ODP)

Not classified as dangerous for the ozone layer (Regulation (EC) No. 1272/2008 and 1005/2009)

SECTION 13: Disposal considerations

The information in this section is a general description. If applicable and available, exposure scenarios are attached in annex. Always use the relevant exposure scenarios that correspond to your identified use.

13.1 Waste treatment methods:

13.1.1 Provisions relating to waste

Waste material code (Directive 2008/98/EC, decision 2000/0532/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.

13.1.2 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. Hazardous waste shall not be mixed together with other waste. Different types of hazardous waste shall not be mixed together if this may entail a risk of pollution or create problems for the further management of the waste. Hazardous waste shall be managed responsibly. All entities that store, transport or handle hazardous waste shall take the necessary measures to prevent risks of pollution or damage to people or animals. Do not discharge into surface water (2000/60/EC, Council decision 2455/2001/EC, O.J. L331 of 15/12/2001).

13.1.3 Packaging/Container

Waste material code packaging (Directive 2008/98/EC).
15 01 10* (packaging containing residues of or contaminated by dangerous substances).

SECTION 14: Transport information

Road (ADR)

14.1 UN number:

UN number	3077

14.2 UN proper shipping name:

Proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Techn./chem. name ADR	fluoranthene

14.3 Transport hazard class(es):

Hazard identification number	90
Class	9
Classification code	M7

14.4 Packing group:

Packing group	III
Labels	9

14.5 Environmental hazards:

Environmentally hazardous substance mark	yes

14.6 Special precautions for user:

Special provisions	274
Special provisions	335
Special provisions	601
Limited quantities	Combination packagings: not more than 5 kg per inner packaging for solids. A package shall not weigh more than 30 kg. (gross mass)

Rail (RID)

14.1 UN number:

UN number	3077

14.2 UN proper shipping name:

Proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Techn./chem. name RID	fluoranthene

14.3 Transport hazard class(es):

Hazard identification number	90
Class	9
Classification code	M7

14.4 Packing group:

Packing group	III
Labels	9

14.5 Environmental hazards:

Environmentally hazardous substance mark	yes

14.6 Special precautions for user:

Special provisions	274
Special provisions	335
Special provisions	601
Limited quantities	Combination packagings: not more than 5 kg per inner packaging for solids. A package shall not weigh more than 30 kg. (gross mass)

Inland waterways (ADN)

14.1 UN number:

UN number	3077

14.2 UN proper shipping name:

Proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Techn./chem. name ADN	fluoranthene

14.3 Transport hazard class(es):

Class	9
Classification code	M7

14.4 Packing group:

Packing group	III
Labels	9

14.5 Environmental hazards:

Environmentally hazardous substance mark	yes

14.6 Special precautions for user:

Special provisions	274
Special provisions	335
Special provisions	601
Limited quantities	Combination packagings: not more than 5 kg per inner packaging for solids. A package shall not weigh more than 30 kg. (gross mass)

Sea (IMDG)

14.1 UN number:

UN number	3077

14.2 UN proper shipping name:

Proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Techn./chem. name IMO	fluoranthene

14.3 Transport hazard class(es):

Class	9

14.4 Packing group:

Packing group	III
Labels	9

14.5 Environmental hazards:

Marine pollutant	P
Environmentally hazardous substance mark	yes

14.6 Special precautions for user:

Special provisions	274
Special provisions	335
Limited quantities	Combination packagings: not more than 5 kg per inner packaging for solids. A package shall not weigh more than 30 kg. (gross mass)

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code:

Annex II of MARPOL 73/78	Not applicable, based on available data

Air (ICAO-TI/IATA-DGR)

14.1 UN number:

UN number	3077

14.2 UN proper shipping name:

Proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Techn./chem. name ICAO	fluoranthene

14.3 Transport hazard class(es):

Class	9

14.4 Packing group:

Packing group	III
Labels	9

14.5 Environmental hazards:

Environmentally hazardous substance mark	yes

14.6 Special precautions for user:

Special provisions	A97
Special provisions	A158
Special provisions	A179
Passenger and cargo transport: limited quantities: maximum net quantity per packaging	30 kg G

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture:

European legislation:

Volatile organic compounds (VOC)

0 %

15.2 Chemical safety assessment:

No chemical safety assessment has been conducted.

SECTION 16: Other information

Labelling according to Directive 67/548/EEC-1999/45/EC (DSD/DPD)

Not listed in Annex I of directive 67/548/EEC et sequens. Labelling established on the basis of the available data.

Labels

Harmful

Dangerous for the environment

R-phrases

22	Harmful if swallowed
50/53	Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment

S-phrases

(02)	(Keep out of the reach of children)
(46)	(If swallowed, seek medical advice immediately and show this container or label)
60	This material and its container must be disposed of as hazardous waste
61	Avoid release to the environment. Refer to special instructions/safety data sheets.

Full text of any R-phrases referred to under headings 2 and 3:

R22 Harmful if swallowed
R50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R50 Very toxic to aquatic organisms
R53 May cause long-term adverse effects in the aquatic environment

Full text of any H-statements referred to under headings 2 and 3:

H302 Harmful if swallowed.
H400 Very toxic to aquatic life.
H410 Very toxic to aquatic life with long lasting effects.

(*) = INTERNAL CLASSIFICATION BY BIG

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)

M-factor

BCR-160R: fluoranthene	100	
fluoranthene	100	

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.

Monsanto
Material Safety Data

POLYCHLORINATED BIPHENYLS (PCBs)

Emergency Phone No.
(Call Collect)
314-694-1000

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: POLYCHLORINATED BIPHENYLS (PCBs)
Aroclor® Series 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, 1268
Therminol® FR Series

MSDS Number: M00018515 Date: 12/95

Chemical Family:	Chlorinated Hydrocarbons
Chemical Name:	Polychlorinated biphenyls
Synonyms:	PCBs, Chlorodiphenyls, Chlorinated biphenyls

Trade Names/Common Names:

PYRANOL® and INERTEEN® are trade names for commonly used dielectric fluids that may have contained varying amounts of PCBs as well as other components including chlorinated benzenes.

ASKAREL is the generic name for a broad class of fire resistant synthetic chlorinated hydrocarbons and mixtures used as dielectric fluids that commonly contained about 30 - 70% PCBs. Some ASKAREL fluids contained 99% or greater PCBs and some contained no PCBs.

PYDRAUL® is the trade name for hydraulic fluids that, prior to 1972, may have contained varying amounts of PCBs and other components including phosphate esters.

The product names/trade names are representative of several commonly used Monsanto products (or products formulated with Monsanto products). Other trademarked PCB products were marketed by Monsanto and other manufacturers. PCBs were also manufactured and sold by several European and Japanese companies. Contact the manufacturer of the trademarked product, if not in this listing, to determine if the formulation contained PCBs.

In 1972, Monsanto restricted sales of PCBs to applications involving only closed electrical systems, (transformers and capacitors). In 1977, all manufacturing and sales were voluntarily terminated. In 1979, EPA restricted the manufacture, processing, use, and distribution of PCBs to specifically exempted and authorized activities.

MONSANTO COMPANY, 800 N. LINDBERGH BLVD., ST. LOUIS, MO 63167

FOR CHEMICAL EMERGENCY, SPILL, LEAK, FIRE, EXPOSURE, OR ACCIDENT
Call CHEMTREC - Day or Night - 1-800-424-9300 Toll free in the continental U.S., Hawaii, Puerto Rico, Canada, Alaska, or Virgin Islands. For calls originating elsewhere: 202-483-7616 (collect calls accepted)

For additional nonemergency information, call: 314-694-3344.

2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemically, commercial PCBs are defined as a series of technical mixtures, consisting of many isomers and compounds that vary from mobile, oily liquids to white crystalline solids and hard noncrystalline resins. Technical products vary in composition, in the degree of chlorination, and possibly according to batch.

The mixtures generally used contain an average of 3 atoms of chlorine per molecule (42% chlorine) to 5 atoms of chlorine per module (54% chlorine). They were used as components of dielectric fluids in transformers and capacitors. Prior to 1972, PCB applications included heat transfer media, hydraulic, and other industrial fluids, plasticizers, carbonless copy paper, paints, inks, and adhesives.

Component	CAS No.
chlorinated biphenyl	1336-36-3
Aroclor 1016	12674-11-2
Aroclor 1221	11104-28-2
Aroclor 1232	11141-16-5
Aroclor 1242	53469-21-9
Aroclor 1248	12672-29-6
Aroclor 1254	11097-69-1
Aroclor 1260	11096-82-5
Aroclor 1262	37324-23-5
Aroclor 1268	11100-14-4

There are also CAS Numbers for individual PCB congeners and for mixtures of Aroclor® products.

PCBs are identified as hazardous chemicals under criteria of the OSHA Hazard Communication Standard (29 CFR Part 1910.1200). PCBs have been listed in the International Agency for Research on Cancer (IARC) Monographs (1987)-Group 2A and in the National Toxicology Program (NTP) Annual Report on Carcinogens (Seventh).

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Appearance and Odor: PCB mixtures range in form and color from clear to amber liquids to white crystalline solids. They have a mild, distinctive odor and are not volatile at room temperature. Refer to Section 9 for details.

WARNING!
CAUSES EYE IRRITATION
MAY CAUSE SKIN IRRITATION

PROCESSING AT ELEVATED TEMPERATURES MAY RELEASE VAPORS OR FUMES WHICH MAY CAUSE RESPIRATORY TRACT IRRITATION

POTENTIAL HEALTH EFFECTS

Likely Routes of Exposure:	Skin contact and inhalation of heated vapors
Eye Contact:	Causes moderate irritation based on worker experience.
Skin Contact:	Prolonged or repeated contact may result in redness, dry skin and defatting based on human experience. A potential exists for developing chloracne. PCBs can be absorbed through intact skin.
Inhalation:	Due to the low volatility of PCBs, exposure to this material in ambient conditions is not expected to produce adverse health effects. However, at elevated processing temperatures, PCBs may produce a vapor that may cause respiratory tract irritation if inhaled based on human experience.
Ingestion:	No more than slightly toxic based on acute animal toxicity studies. Coughing, choking and shortness of breath may occur if liquid material is accidentally drawn into the lungs during swallowing or vomiting.

Other: Numerous epidemiological studies of humans, both occupationally exposed and nonworker environmentally exposed populations, have not demonstrated any causal relationship between PCB exposure and chronic human illnesses such as cancer or neurological or cardiovascular effects. PCBs at high dosage can cause skin symptoms; however, these subside upon removal of the exposure source.

Refer to Section 11 for toxicological information.

4. FIRST AID MEASURES

IF IN EYES, immediately flush with plenty of water for at least 15 minutes. If easy to do, remove any contact lenses. Get medical attention. Remove material from skin and clothing.

IF ON SKIN, immediately flush the area with plenty of water. Wash skin gently with soap as soon as it is available. Get medical attention if irritation persists.

IF INHALED, remove person to fresh air. If breathing is difficult, get medical attention.

IF SWALLOWED, do NOT induce vomiting. Rinse mouth with water. Get medical attention. Contact a Poison Control Center. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

NOTE TO PHYSICIANS: Hot PCBs may cause thermal burn. If electrical equipment arcs between conductors, PCBs or other chlorinated hydrocarbon dielectric fluids may decompose to produce hydrochloric acid (HCl), a respiratory irritant. If large amounts are swallowed, gastric lavage may be considered.

5. FIRE FIGHTING MEASURES

Flash Point: 284 degrees F (140 degrees C) or higher depending on the chlorination level of the Aroclor product

Fire Point: 349 degrees F (176 degrees C) or higher depending on the chlorination level of the Aroclor product

NOTE: Refer to Section 9 for individual flash points and fire points.

Extinguishing Media: Extinguish fire using agent suitable for surrounding fire. Use dry chemical, foam, carbon dioxide or water spray. Water may be ineffective. Use water spray to keep fire-exposed containers or transformer cool.

PCBs are fire-resistant compounds. They may decompose to form CO, CO2, HCl, phenolics, aldehydes, and other toxic combustion products under severe conditions such as exposure to flame or hot surfaces.

Dielectric fluids having PCBs and chlorinated benzenes as components have been reported to produce polychlorinated dibenzo-p-dioxins (PCDDs) and furans (PCDFs) during fire situations involving electrical equipment. At temperatures in the range of 600-650 degrees C in the presence of excess oxygen, PCBs may form polychlorinated dibenzofurans (PCDFs). Laboratory studies under similar conditions have demonstrated that PCBs do not produce polychlorinated dibenzo-p-dioxins (PCDDs).

Federal regulations require all PCB transformers to be registered with fire response personnel.

If a PCB transformer is involved in a fire-related incident, the owner of the transformer may be required to report the incident. Consult and follow appropriate federal, state and local regulations.

Fire Fighting Equipment: Fire fighters and others exposed to products of combustion should wear self-contained breathing apparatus. Equipment should be thoroughly decontaminated after use.

6. ACCIDENTAL RELEASE MEASURES

Cleanup and disposal of liquid PCBs and other PCB items are strictly regulated by the federal government. The regulations are found at 40 CFR Part 761. Consult these regulations as well as applicable state and local regulations prior to any cleanup or disposal of PCBs, PCB items, or PCB contaminated items.

If PCBs leak or are spilled, the following steps should be taken immediately:

All nonessential personnel should leave the leak or spill area.

The area should be adequately ventilated to prevent the accumulation of vapors.

The spill/leak should be contained. Loss to sewer systems, navigable waterways, and streams should be prevented. Spills/leaks should be removed promptly by means of absorptive material, such as sawdust, vermiculite, dry sand, clay, dirt or other similar materials, or trapped and removed by pumping or other suitable means (traps, drip-pans, trays, etc.).

Personnel entering the spill or leak area should be furnished with appropriate personal protective equipment and clothing as needed. Refer to Section 8 for personal protection equipment and clothing.

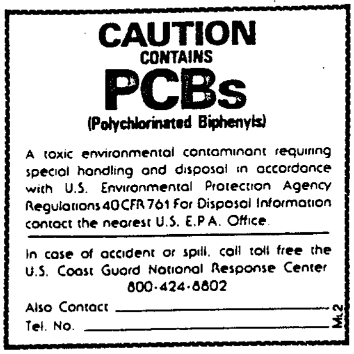
Personnel trained in emergency procedures and protected against attendant hazards should shut off sources of PCBs, clean up spills, control and repair leaks, and fight fires in PCB areas.

Refer to Section 13 for disposal information and Sections 14 and 15 for information regarding reportable quantity, and Section 7 for marking information.

7. HANDLING AND STORAGE

Care should be taken to prevent entry into the environment through spills, leakage, use vaporization, or disposal of liquid or containers. Avoid prolonged breathing of vapors or mists. Avoid contact with eyes or prolonged contact with skin. If skin contact occurs, remove by washing with soap and water. Following eye contact, flush with water. In case of spillage onto clothing, the clothing should be removed as soon as practical, skin washed, and clothing laundered. Comply with all federal, state, and local regulations.

Federal regulations under the Toxic Substances Control Act require PCBs, PCB items, storage areas, transformer vaults, and transport vehicles to be marked (check regulations, 40 CFR 761, for details).



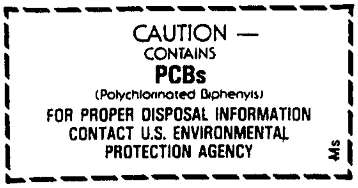
CAUTION
CONTAINS
PCBs
(Polychlorinated Biphenyls)

A toxic environmental contaminant requiring special handling and disposal in accordance with U.S. Environmental Protection Agency Regulations 40 CFR 761 For Disposal Information contact the nearest U.S. E.P.A. Office.

In case of accident or spill, call toll free the U.S. Coast Guard National Response Center
800-424-8802

Also Contact ____________________
Tel. No. ____________________

ML



CAUTION —
CONTAINS
PCBs
(Polychlorinated Biphenyls)
FOR PROPER DISPOSAL INFORMATION
CONTACT U.S. ENVIRONMENTAL
PROTECTION AGENCY

Ms

Storage: The storage of PCB items or equipment (those containing 50 ppm or greater PCBs) and PCB waste is strictly regulated by 40 CFR Part 761. The storage time is limited, the storage area must meet physical requirements, and the area must be labeled.

Avoid contact with eyes.
Wash thoroughly after handling.
Avoid breathing processing fumes or vapors.
Process using adequate ventilation.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Eye Protection: Wear chemical splash goggles and have eye baths available where there is significant potential for eye contact.

Skin Protection: Wear appropriate protective clothing and chemical resistant gloves to prevent skin contact. Consult glove manufacturer to determine the appropriate type glove for a given application. Wear chemical goggles, face shield, and chemical resistant clothing such as a rubber apron when splashing is likely. Wash immediately if skin is contacted. Remove contaminated clothing promptly and launder before reuse. Clean protective equipment before reuse. Provide a safety shower at any location where skin contact can occur. Wash thoroughly after handling.

ATTENTION! Repeated or prolonged skin contact may cause chloracne in some people.

Respiratory Protection: Avoid breathing vapor, mist, or dust. Use NIOSH/MSHA approved equipment when airborne exposure limits are exceeded. Full facepiece equipment is recommended when airborne exposure limits are exceeded and, if used, replaces the need for face shield and/or chemical splash goggles. Consult respirator manufacturer to determine the type of equipment for a given application. The respirator use limitations specified by NIOSH/MSHA or the manufacturer must be observed. High airborne concentrations may require use of self-contained breathing apparatus or supplied air respirator. Respiratory protection programs must be in compliance with 29 CFR Part 1910.134.

ATTENTION! Repeated or prolonged inhalation may cause chloracne in some people.

Ventilation: Provide natural or mechanical ventilation to control exposure levels below airborne exposure limits (see below). If practical, use local mechanical exhaust ventilation at sources of vapor or mist, such as open process equipment.

Airborne Exposure Limits:

Product: Chlorodiphenyl (42% chlorine)

OSHA PEL: 1 mg/m^3 8-hour time-weighted average - Skin*
ACGIH TLV: 1 mg/m^3 8-hour time-weighted average - Skin*

Product: Chlorodiphenyl (54% chlorine)

OSHA PEL: 0.5 mg/m^3 8-hour time-weighted average - Skin*
ACGIH TLV: 0.5 mg/m^3 8-hour time-weighted average - Skin*

*For Skin notation see Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference of Government Industrial Hygienists, 1995-1996.

9. PHYSICAL AND CHEMICAL PROPERTIES

PROPERTIES OF SELECTED AROCLORS®

PROPERTY	**1016**	**1221**	**1232**	**1242**	**1248**	**1254**	**1260**
Color (APHA)	40	100	100	100	100	100	150
Physical state	mobile oil	mobile oil	mobile oil	mobile oil	mobile oil	viscous liquid	sticky resin
Stability	inert	inert	inert	inert	inert	inert	inert
Density (lb/gal 25°C)	11.40	9.85	10.55	11.50	12.04	12.82	13.50
Specific gravity x/15.5°C	1.36-1.37 x-25°	1.18-1.19 x-25°	1.27-1.28 x-25°	1.30-1.39 x-25°	1.40-1.41 x-65°	1.49-1.50 x-65°	1.55-1.56 x-90°
Distillation range (°C)	323-356	275-320	290-325	325-366	340-375	365-390	385-420
Acidity mg KOH/g, maximum	.010	.014	.014	.015	.010	.010	.014
Fire point (°C)	none to boiling point	176	238	none to boiling point	none to boiling point	none to boiling point	none to boiling point
Flash point (°C)	170	141-150	152-154	176-180	193-196	none	none
Vapor pressure (mm Hg @ 100°F)	NA	NA	0.005	0.001	0.00037	0.00006	NA
Viscosity (Saybolt Univ. Sec. @ 100°F) (centistokes)	71-81 13-16	38-41 3.6-4.6	44-51 5.5-7.7	82-92 16-19	185-240 42-52	1800-2500 390-540	— —

NA—*Not Available*

NOTE: These physical data are typical values based on material tested but may vary from sample to sample. Typical values should not be construed as a guaranteed analysis of any specific lot or as specifications for the product.

10. STABILITY AND REACTIVITY

Stability: PCBs are very stable, fire-resistant compounds.
Materials to Avoid: None
Hazardous Decomposition
Products: PCBs may decompose to form CO, CO_2, HCl, phenolics, aldehydes, and other toxic combustion products under severe conditions such as exposure to flame or hot surface.
Hazardous Polymerization: Does not occur.

11. TOXICOLOGICAL INFORMATION

Data from laboratory studies conducted by Monsanto and from the available scientific literature are summarized below.
Single exposure (acute) studies indicate:
Oral - Slightly Toxic (Rat LD50 - 8.65 g/kg for 42% chlorinated; 11.9 g/kg for 54% chlorinated)

The liquid products and their vapors are moderately irritating to eye tissues. Animal experiments of varying duration and at different air concentrations show that for similar exposure conditions, the 54% chlorinated material produces more liver injury than the 42% chlorinated material.

There are literature reports that PCBs can impair reproductive functions in monkeys. The National Cancer Institute (NCI) performed a study in 1977 using Aroclor 1254 with both sexes of rats. NCI stated that the PCB, Aroclor 1254, was not carcinogenic under the conditions of their bioassay. There is sufficient evidence in the scientific literature to conclude that Aroclor 1260 can cause liver cancer when fed to rodents at high doses. Similar experiments with less chlorinated PCB products have produced negative or equivocal results.

The consistent finding in animal studies is that PCBs produce liver injury following prolonged and repeated exposure by any route, if the exposure is of sufficient degree and duration. Liver injury is produced first, and by exposures that are less than those reported to cause cancer in rodents. Therefore, exposure by all routes should be kept sufficiently low to prevent liver injury.

Numerous epidemiological studies of humans, both occupationally exposed and nonworker environmentally exposed population, have not demonstrated any causal relationship between PCB exposure and chronic human illnesses such as cancer or neurological or cardiovascular effects. PCBs at high dosage can cause skin symptoms; however, these subside upon removal of the exposure source.

PCBs have been listed in the International Agency for Research on Cancer (IARC) Monographs (1987)-Group 2A and in the National Toxicology Program (NTP) Seventh Annual Report on Carcinogens.

12. ECOLOGICAL INFORMATION

Care should be taken to prevent entry of PCBs into the environment through spills, leakage, use, vaporization or disposal of liquid or solids. PCBs can accumulate in the environment and can adversely affect some animals and aquatic life. In general, PCBs have low solubility in water, are strongly bound to soils and sediments, and are slowly degraded by natural processes in the environment.

13. DISPOSAL CONSIDERATIONS

The disposal of PCB items or equipment (those containing 50 ppm or greater PCBs) and PCB wastes is strictly regulated by 40 CFR Part 761. For example, all wastes and residues containing PCBs (wiping cloths, absorbent material, used disposable protective gloves and clothing, etc.) should be collected, placed in proper containers, marked and disposed of in the manner prescribed by EPA regulations (40 CFR Part 761) and applicable state and local regulations.

14. TRANSPORT INFORMATION

The data provided in this section are for information only. Please apply the appropriate regulations to properly classify a shipment for transportation.

DOT Classification:	IF WEIGHT OF PCBs TO BE SHIPPED IS OVER ONE POUND, THE FOLLOWING CLASSIFICATION AND LABEL APPLY.	
DOT Label:	LIQUID:	Environmentally Hazardous Substance, liquid, n.o.s. (Contains PCB), 9, UN 3082, III
	SOLID:	Environmentally Hazardous Substance, solid, n.o.s. (Contains PCB), 9, UN 3077, III
DOT Label:	Class: 9	
DOT Reportable Quantity:	One Pound	
IMO Classification:	Polychlorinated Biphenyls, IMO Class 9, UN 2315, II IMO Page 9034, EMS 6.1-02	
IATA/ICAO Classification:	Polychlorinated Biphenyls, 9, UN2315, II	

15. REGULATORY INFORMATION

For regulatory purposes, under the Toxic Substances Control Act, the term "PCBs" refers to a chemical substance limited to the biphenyl molecule that has been chlorinated to varying degrees or any combination of substances which contain such a substance (40 CFR Part 761).

TSCA Inventory: not listed.

Hazard Categories Under Criteria of SARA Title III Rules (40 CFR Part 370): Immediate, Delayed.
SARA Section 313 Toxic Chemical(s): Listed-1993 (De Minimis concentration 0.1%.)

Reportable Quantity (RQ) under DOT (49 CFR) and CERCLA Regulations: 1 lb. (polychlorinated biphenyls) PCBs.

Release of more than 1 (one) pound of PCBs to the environment requires notification to the National Response Center (800-424-8802 or 202-426-2675).

Various state and local regulations may require immediate reporting of PCB spills and may also define spill cleanup levels. Consult your attorney or appropriate regulatory officials for information relating to spill reporting and spill cleanup.

16. OTHER INFORMATION

Reason for revision: Conversion to the 16 section format. Supersedes MSDS dated 10/88.

Therminol®, Aroclor® and Pydraul® are registered trademarks of Monsanto Company
Pyranol® is a registered trademark of General Electric Company
Inerteen® is a registered trademark of Westinghouse Electric Corporation

FOR ADDITIONAL NONEMERGENCY INFORMATION, CONTACT:

Gary W. Mappes
Manager, Product & Environmental Safety

Robert G. Kaley, II
Director, Environmental Affairs

Monsanto Company
800 North Lindbergh Boulevard
St. Louis, MO 63167
(314) 694-3344

Arsenic

SAFETY DATA SHEET

1 PRODUCT AND SUPPLIER IDENTIFICATION

Product Name: Arsenic - lump, powder

Formula: As

Supplier: ESPI Metals
1050 Benson Way
Ashland, OR 97520

Telephone: 800-638-2581

Fax: 541-488-8313

Email: sales@espimetals.com

Emergency: Infotrac 800-535-5053 (US) or 352-323-3500 (24 hour)

Recommended Uses: Scientific Research

2 HAZARDS IDENTIFICATION

GHS Classification (29 CFR 1910.1200): Acute toxicity, Oral, Category 4, Acute toxicity, Inhalation, Category 4.

GHS Label Elements:

Signal Word: Warning

Hazard Statements: H302 Harmful if swallowed, H332 Harmful if inhaled.

Precautionary Statements: P261 Avoid breathing dust/fume/gas/mist/vapors/spray, P264 Wash hands thoroughly after handling, P281 Use personal protective equipment as required, P301+P304+P312 IF SWALLOWED OR INHALED: Call a POISON CENTER or doctor/physician if you feel unwell.

3 COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient:	Arsenic
CAS#:	7440-38-2
%:	100
EC#:	231-148-6

4 FIRST AID MEASURES

INHALATION: Remove to fresh air, keep warm and quiet, give oxygen if breathing is difficult. Seek immediate medical attention.

INGESTION: Rinse mouth with water. Do not induce vomiting. Seek immediate medical attention. Never induce vomiting or give anything by mouth to an unconscious person.

SKIN: Remove contaminated clothing, brush material off skin, wash affected area with soap and water. Seek medical attention.

EYES: Flush eyes with lukewarm water, including under upper and lower eyelids, for at least 15 minutes. Seek medical attention.

Most Important Symptoms/Effects, Acute and Delayed: May cause vomiting, abdominal pain, diarrhea. See section 11 for more information.

Indication of Immediate Medical Attention and Special Treatment: No other information available.

5 FIREFIGHTING MEASURES

Extinguishing Media: Use suitable extinguishing agent for surrounding materials and type of fire. Smother small fires involving arsenic powder or dust with Class D or other metal extinguishing agent.

Unsuitable Extinguishing Media: No information available.

Specific Hazards Arising from the Material: Emits toxic fumes under fire conditions.

Special Protective Equipment and Precautions for Firefighters: Full face, self-contained breathing apparatus and full protective clothing when necessary.

6 ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment, and Emergency Procedures: Wear appropriate respiratory and protective equipment specified in section 8. Avoid raising dusts. Avoid breathing dust or fume.

Methods and Materials for Containment and Cleaning Up: Avoid dusting of powder to the greatest extent possible. Wet sweep or vacuum up spill so as not to create more dust. Place in properly labeled closed containers.

Environmental Precautions: Do not allow to enter drains or to be released to the environment.

7 HANDLING AND STORAGE

Precautions for Safe Handling: Handle under dry protective gas such as argon if possible. Transfer material in closed systems or within a completely hooded containment with local exhaust ventilation. Prevent spillage. Avoid creating dusts. Avoid exposure to high temperature. Avoid breathing dust or fumes. Avoid contact with skin and eyes. Wash thoroughly before eating or smoking. See section 8 for information on personal protection equipment.

Conditions for Safe Storage, Including Any Incompatibilities: Arsenic should be stored in tightly-closed containers under argon. Store in a cool, dry area. Storage containers should be labeled to indicate their contents. Do not store together with oxidizers, acids or halogens. See section 10 for more information on incompatible materials.

8 EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits:	Arsenic
OSHA/PEL:	0.01 mg/m^3
ACGIH/TLV:	0.01 mg/m^3

Appropriate Engineering Controls: Handle in a humidity controlled atmosphere. When working with finely divided powders, handle in a controlled, enclosed environment. Ensure adequate ventilation to maintain exposures below occupational limits. Whenever possible the use of local exhaust ventilation or other engineering controls is the preferred method of controlling exposure to airborne dust and fume to meet established occupational exposure limits. Use good housekeeping and sanitation practices. Do not use tobacco or food in work area. Wash thoroughly before eating or smoking. Do not blow dust off clothing or skin with compressed air. Clothing worn in areas of exposure to arsenic dust or fume should be restricted to the workplace and laundered regularly.

Individual Protection Measures, Such as Personal Protective Equipment:

Respiratory Protection: Where airborne exposures may exceed OSHA/ACGIH permissible air concentrations, the minimum respiratory protection recommended is negative pressure air purifying respirator with cartridges that are NIOSH/MSHA approved against dusts, fumes and mists having a TWA less than 0.05 mg/m^3.

Eye Protection: Safety glasses or goggles.

Skin Protection: Wear impermeable gloves, protective work clothing. Protective overgarments or work clothing must be worn by persons who may become contaminated with particulate during work activities.

9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance:

Form:	Lump or powder
Color:	Gray
Odor:	Odorless
Odor Threshold:	Not determined
pH:	N/A

Melting Point: 817 ^{o}C (28 atm.)

Boiling Point: 613 ^{o}C (sublimes)

Flash Point: N/A

Evaporation Rate: N/A

Flammability: N/A

Upper Flammable Limit: N/A

Lower Flammable Limit: N/A

Vapor Pressure: 1 mm Hg @ 372 ^{o}C (solid)

Vapor Density: N/A

Relative Density (Specific Gravity): 5.727 g/cc @ 14 ^{o}C

Solubility in H_2O: Insoluble

Partition Coefficient (n-octanol/water): Not determined

Autoignition Temperature: No data

Decomposition Temperature: No data

Viscosity: N/A

10 STABILITY AND REACTIVITY

Reactivity: No data

Chemical Stability: Stable under recommended storage conditions.

Possibility of Hazardous Reactions: Hydrogen gas can react with inorganic arsenic to form the highly toxic gas arsine.

Conditions to Avoid: Avoid creating dusts. Avoid high temperatures.

Incompatible Materials: Moist air, strong oxidizing agents, oxidizing acids, halogen and halogen compounds, sulfur, platinum, palladium, zinc, lithium, hydrogen gas.

Hazardous Decomposition Products: Arsenic oxide fume, arsine.

11 TOXICOLOGICAL INFORMATION

Likely Routes of Exposure: Inhalation, skin and eyes

Symptoms of Exposure: May cause irritation and systemic poisoning with symptoms including abdominal pain, nausea, vomiting, diarrhea, and encephalopathy and peripheral neuropathy.

Acute and Chronic Effects: Acute effects of inorganic arsenic compounds include vomiting, abdominal pain and diarrhea, followed by numbness and tingling of the extremities, muscle cramping, and death, in extreme cases. The first signs of long-term exposure to high levels of inorganic arsenic are usually observed in the skin, and include pigmentation changes, skin lesions, and hard patches on the palms and soles of the feet (hyperkeratosis).

Other adverse health effects that may be associated with long-term ingestion of inorganic arsenic include developmental effects, neurotoxicity, diabetes and cardiovascular disease.

Acute Toxicity: LD50 oral - rat - 763mg/kg

Carcinogenicity: **NTP**: Known to be human carcinogen **IARC**: Group 1 - Carcinogenic to humans

To the best of our knowledge the chemical, physical and toxicological characteristics of the substance are not fully known.

12 ECOLOGICAL INFORMATION

Ecotoxicity: No data

Persistence and Degradability: No data

Bioaccumulative Potential: No data

Mobility in Soil: No data

Other Adverse Effects: Danger to drinking water and to aquatic organisms. Do not allow material to be released to the environment. No further relevant information available.

13 DISPOSAL CONSIDERATIONS

Waste Disposal Method:

Product: Dispose of in accordance with Federal, State and Local regulations.

Packaging: Dispose of in accordance with Federal, State and Local regulations.

14 TRANSPORT INFORMATION

DOT/ADR/IATA/IMDG Regulations:

UN Number: 6.1

UN Proper Shipping Name: Arsenic

Transport Hazard Class: UN1558

Packing Group: II

Marine Pollutant: No

Special Precautions: Warning: Toxic substances

15 REGULATORY INFORMATION

TSCA Listed: All components are listed.

Regulation (EC) No 1272/2008 (CLP): Acute toxicity, Oral, Category 4, Acute toxicity, Inhalation, Category 4.

Canada WHMIS Classification (CPR, SOR/88-66): Class D, Division 1, Subdivision A - Very toxic material causing immediate and serious toxic effects, Class D, Division 2, Subdivision A - Very toxic material causing other toxic effects.

HMIS Ratings: **Health**: 2 **Flammability**: 1 **Physical**: 0

NFPA Ratings: **Health**: 2 **Flammability**: 1 **Reactivity**: 0

Chemical Safety Assessment: A chemical safety assessment has not been carried out.

16 OTHER 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. ESPI Metals shall not be held liable for any damages resulting from handling or from contact with the above product.

Prepared by: ESPI Metals

Revised/Reviewed: September 2014

Barium

SAFETY DATA SHEET

1 PRODUCT AND SUPPLIER IDENTIFICATION

Product Name: Barium - rod, pieces, sheet

Formula: Ba

Supplier: ESPI Metals

1050 Benson Way

Ashland, OR 97520

Telephone: 800-638-2581

Fax: 541-488-8313

Email: sales@espimetals.com

Emergency: Infotrac 800-535-5053 (US) or 352-323-3500 (24 hour)

Recommended Uses: Scientific Research

2 HAZARDS IDENTIFICATION

GHS Classification (29 CFR 1910.1200): Water reactive, Category 2, Skin irritation, Category 2, Eye irritation, Category 2A

GHS Label Elements:

Signal Word: Danger

Hazard Statements: H261 In contact with water releases flammable gas, H315 Causes skin irritation, H319 Causes serious eye irritation, H335 May cause respiratory irritation.

Precautionary Statements: P231+P232 Handle under inert gas. Protect from moisture, P261 Avoid breathing dust/fume/gas/mist/vapors/spray, P305+P351+P338 IF IN EYES: rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing, P422 Store contents under inert gas.

3 COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient: Barium

CAS#: 7440-39-3

%: 100

EC#: 231-149-1

4 FIRST AID MEASURES

INHALATION: Remove to fresh air, keep warm and quiet, give oxygen if breathing is difficult. Seek immediate medical attention.

INGESTION: Quickly wipe material from mouth and rinse with water. Do not induce vomiting. Seek medical attention immediately.

SKIN: Remove contaminated clothing if necessary. Brush off any visible solids. Wash the affected area with water for at least 15 minutes. Seek medical attention.

EYES: Immediately flush eyes with copious amounts of water, including under eyelids for at least 10-15 minutes. A victim may need assistance in keeping their eyelids open. Seek immediate medical attention.

Most Important Symptoms/Effects, Acute and Delayed: May cause severe irritation in contact with mucous membranes and moist skin. See section 11 for more information.

Indication of Immediate Medical Attention and Special Treatment: No other relevant information available.

5 FIREFIGHTING MEASURES

Extinguishing Media: Use Class D dry powder extinguishing agent.

Unsuitable Extinguishing Media: Do not use water, carbon dioxide or halogenated extinguishers.

Specific Hazards Arising from the Material: Material readily reacts with water generating flammable hydrogen gas. May emit fumes of barium oxide under fire conditions.

Special Protective Equipment and Precautions for Firefighters: Full face, self-contained breathing apparatus and full protective clothing to prevent contact with skin and eyes. Barium metal can reignite after fire is initially extinguished. Never leave extinguished fire unattended.

6 ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment, and Emergency Procedures: Wear appropriate respiratory and protective equipment specified in section 8. Avoid contact with skin and eyes. Avoid breathing dust or fume. Eliminate all sources of ignition. Isolate spill area.

Methods and Materials for Containment and Cleaning Up: Sweep or scoop spilled product and place in a closed container for further handling and disposal. Do not use water for spill clean-up. Cover very small quantities in the open with powdered limestone and let decompose. Use only non-sparking tools and natural bristle brushes.

Environmental Precautions: Do not flush to sewer, stream, or other bodies of water. Do not allow to enter drains or to be released to the environment.

7 HANDLING AND STORAGE

Precautions for Safe Handling: Handle under dry protective gas such as argon. Use non-sparking tools. Protect from sources of ignition. Do not allow contact with water. Avoid contact with skin and eyes. Wash thoroughly before eating or smoking. See section 8 for information on personal protection equipment.

Conditions for Safe Storage, Including Any Incompatibilities: Barium metal should be stored in tightly-closed containers under argon or mineral oil. Keep away from sparks, heat and flame. Storage area should be free of combustibles and ignition sources. Do not store together with acids, oxidizers, halogens. Protect from water/moisture. See section 10 for more information on incompatible materials.

8 EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits: Barium

OSHA/PEL: 0.5 mg/m^3

ACGIH/TLV: 0.5 mg/m^3

Appropriate Engineering Controls: Handle in a humidity controlled atmosphere. Handle in an enclosed, controlled process under dry argon. Whenever possible the use of local exhaust ventilation or other engineering controls is the preferred method of controlling exposure to airborne dust and fume to meet established occupational exposure limits. Do not use tobacco or food in work area. Wash thoroughly before eating or smoking. Do not blow dust off clothing or skin with compressed air. Prepare for the possibility of a fire. Keep extinguishing agents, tools for handling and protective clothing readily available.

Individual Protection Measures, Such as Personal Protective Equipment:

Respiratory Protection: Wear a NIOSH/MSHA approved respirator when high concentrations are present.

Eye Protection: Always wear approved chemical splash proof goggles.

Skin Protection: Rubber gloves, flame retardant protective work clothing.

9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance:

Form: Solid in various forms

Color: Silver-gray metallic

Odor: Not determined

Odor Threshold: Not determined

pH: N/A

Melting Point: 725 ^{O}C

Boiling Point: 1640 ^{O}C

Flash Point: N/A

Evaporation Rate: N/A

Flammability: Flammable solid

Upper Flammable Limit: No data

Lower Flammable Limit: No data

Vapor Pressure: 10 mm at 1049 ^{O}C

Vapor Density: N/A

Relative Density (Specific Gravity): 3.51 g/cc at 20 ^{O}C

Solubility in H_2O: Decomposes

Partition Coefficient (n-octanol/water): Not determined

Autoignition Temperature: No data

Decomposition Temperature: No data

Viscosity: N/A

10 STABILITY AND REACTIVITY

Reactivity: No data

Chemical Stability: Stable under recommended storage conditions.

Possibility of Hazardous Reactions: Barium reacts readily with water releasing flammable hydrogen gas.

Conditions to Avoid: Heat, sparks, flame. Exposure to water or moist air.

Incompatible Materials: Water or moisture, oxidizing agents, oxygen, acids, alcohols, halocarbons, carbon dioxide, ammonia.

Hazardous Decomposition Products: Barium oxides, hydrogen gas.

11 TOXICOLOGICAL INFORMATION

Likely Routes of Exposure: Inhalation, skin, eyes. Product as shipped does not present an inhalation hazard; however subsequent operations may create dusts or fumes which could be inhaled.

Symptoms of Exposure: May cause severe irritation to the nose, throat, and upper respiratory tract, mouth, throat, and esophagus. Contact with skin can cause mild to moderate irritation. May cause chemical burns in eyes or on skin as it reacts with moisture on living tissue.

Acute and Chronic Effects: Barium compounds may cause severe gastroenteritis, including abdominal pain, vomiting and diarrhea, tremors, faintness, paralysis of the arms and legs, and slow or irregular heartbeat. Severe cases may produce collapse and death due to respiratory failure. Soluble barium compounds are more likely to cause these effects than insoluble compounds. Inhalation of fumes may cause sore throat, coughing, labored breathing, and irritation of the respiratory tract as well as the above symptoms. Chronic exposure to barium may cause sensitization, chronic barium poisoning, dermatitis, corneal opacity and blindness.

Acute Toxicity: No data

Carcinogenicity: **NTP**: Not identified as carcinogenic **IARC**: Not identified as carcinogenic

To the best of our knowledge the chemical, physical and toxicological characteristics of the substance are not fully known.

12 ECOLOGICAL INFORMATION

Ecotoxicity: No data

Persistence and Degradability: No data

Bioaccumulative Potential: No data

Mobility in Soil: No data

Other Adverse Effects: Do not allow material to be released to the environment. No further relevant information available.

13 DISPOSAL CONSIDERATIONS

Waste Disposal Method:

Product: Dispose of in accordance with Federal, State and Local regulations.

Packaging: Dispose of in accordance with Federal, State and Local regulations.

14 TRANSPORT INFORMATION

DOT/ADR/IATA/IMDG Regulations:

UN Number: 4.3

UN Proper Shipping Name: Barium

Transport Hazard Class: UN1400

Packing Group: II

Marine Pollutant: No

Special Precautions: Warning, substances which, in contact with water, emit flammable gases.

15 REGULATORY INFORMATION

TSCA Listed: All components are listed.

Regulation (EC) No 1272/2008 (CLP): Water reactive, Category 2, Skin irritation, Category 2, Eye irritation, Category 2A.

Canada WHMIS Classification (CPR, SOR/88-66): Class B, Division 6 - Reactive flammable material.

HMIS Ratings: **Health**: 2 **Flammability**: 3 **Reactivity**: 1

NFPA Ratings: **Health**: 2 **Flammability**: 3 **Reactivity**: 1 **Special Hazard**: W

Chemical Safety Assessment: A chemical safety assessment has not been carried out.

16 OTHER 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. ESPI Metals shall not be held liable for any damages resulting from handling or from contact with the above product.

Prepared by: ESPI Metals

Revised/Reviewed: May 2014

Cadmium

SAFETY DATA SHEET

1 PRODUCT AND SUPPLIER IDENTIFICATION

Product Name: Cadmium - pieces, shot, sheet, foil, rod, wire, target

Formula: Cd

Supplier: ESPI Metals
1050 Benson Way
Ashland, OR 97520

Telephone: 800-638-2581

Fax: 541-488-8313

Email: sales@espimetals.com

Emergency: Infotrac 800-535-5053 (US) or 352-323-3500 (24 hour)

Recommended Uses: Scientific Research

2 HAZARDS IDENTIFICATION

GHS Classification (29 CFR 1910.1200): Acute toxicity, category 3, Carcinogenicity, category 2, Specific target organ toxicity, repeated or prolonged exposure, category 2.

GHS Label Elements:

Signal Word: Danger

Hazard Statements: H301 Toxic if swallowed, H331 Toxic if inhaled, H350 May cause cancer, H373 May cause damage to kidneys through prolonged or repeated exposure - oral.

Precautionary Statements: P260 Do not breath dust/fume/gas/mist/vapors/spray, P281 Use personal protective equipment as required.

NOTE: In the solid form in which it is provided, this material does not pose a health hazard. Subsequent operations performed by the end user, such as exposure to high temperatures, melting or grinding, may produce highly toxic cadmium oxide dust or fume. ESPI Metals does not warranty this material for any specific application and all precautions must be taken by the end user to prevent and protect against exposure to inhalable particulate. See section 8 for information on exposure controls and personal protection.

3 COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient:	Cadmium
CAS#:	7440-43-9
%:	100
EC#:	231-152-8

4 FIRST AID MEASURES

General Measures: Under normal handling and use, exposure to solid forms of this material present few health hazards. Subsequent operations such as grinding, melting or welding may produce hazardous dust or fumes which can be inhaled or come in contact with the skin or eyes. Emergency responders should take care to avoid secondary exposure to cadmium particulate. Wear appropriate protective equipment.

INHALATION: Remove to fresh air, keep warm and quiet, give oxygen if breathing is difficult. Seek immediate medical attention. Treat pulmonary edema as a priority, even if no symptoms (i.e. wheezing, coughing, shortness of breath, etc.) are apparent. Symptoms of pulmonary edema can be delayed up to 48 hours after exposure. Quickly transport victim to an emergency care facility.

INGESTION: Rinse mouth with water. Do not induce vomiting. Seek immediate medical attention. Never induce vomiting or give anything by mouth to an unconscious person. Ingested cadmium may lead to spontaneous vomiting. If vomiting occurs naturally, have victim rinse mouth with water again.

SKIN: Remove contaminated clothing, wash affected area with soap and water. Seek medical attention. Wash contaminated clothing before reusing.

EYES: Flush eyes with lukewarm water, including under upper and lower eyelids, for at least 15 minutes. Seek medical attention.

Most Important Symptoms/Effects, Acute and Delayed: May cause irritation. See section 11 for more information.

Indication of Immediate Medical Attention and Special Treatment: No other information available.

5 FIREFIGHTING MEASURES

Extinguishing Media: Use Class D dry powder extinguishing agent.

Unsuitable Extinguishing Media: Do not use water or foam.

Specific Hazards Arising from the Material: This product does not present fire or explosion hazards as shipped. Fine dust from processing may ignite if allowed to accumulate and subjected to an ignition source. When heated, cadmium emits highly toxic fumes of cadmium oxide.

Special Protective Equipment and Precautions for Firefighters: Full face, self-contained breathing apparatus and full protective clothing when necessary.

6 ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment, and Emergency Procedures: Wear appropriate respiratory and protective equipment specified in section 8. Avoid creating dusts. Avoid breathing dust or fume. Isolate spill area and provide ventilation.

Methods and Materials for Containment and Cleaning Up: For larger pieces - pick up mechanically. For chips or dust - vacuum spill using a system equipped with a HEPA filtration system and place in properly labeled closed containers. Special precautions must be taken when changing filters on HEPA vacuum cleaners used to clean up hazardous materials. Caution should be taken to minimize airborne generation of particulate and avoid contamination of air and water.

Environmental Precautions: Do not allow to enter drains or to be released to the environment.

7 HANDLING AND STORAGE

Precautions for Safe Handling: Handle in a well-ventilated area. Avoid creating dust. Avoid exposure to high temperature. Avoid breathing dust or fumes. Avoid contact with skin and eyes. Wash thoroughly before eating or smoking. See section 8 for information on personal protection equipment.

Conditions for Safe Storage, Including Any Incompatibilities: Store in a sealed container. Store in a cool, dry area. . Do not store together with oxidizers, acids or halogens. See section 10 for more information on incompatible materials.

8 EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits:	Cadmium
OSHA/PEL:	0.005 mg/m^3
ACGIH/TLV:	0.01 mg/m^3

Appropriate Engineering Controls: Whenever possible the use of local exhaust ventilation or other engineering controls is the preferred method of controlling exposure to airborne dust and fume to meet established occupational exposure limits. Use good housekeeping and sanitation practices. Do not use tobacco or food in work area. Wash thoroughly before eating or smoking. Do not blow dust off clothing or skin with compressed air. Clothing worn in areas of exposure to cadmium dust or fume should be restricted to the workplace and laundered regularly.

Individual Protection Measures, Such as Personal Protective Equipment:

Respiratory Protection: When potential exposures are above the occupational limits, approved respirators must be used.

Eye Protection: Safety glasses

Skin Protection: Wear impermeable gloves, protective work clothing as necessary.

9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance:

Form: Solid in various forms

Color: Silvery metallic

Odor: Odorless

Odor Threshold: Not determined

pH: N/A

Melting Point: 320.9 ^{O}C

Boiling Point: 765 ^{O}C

Flash Point: N/A

Evaporation Rate: N/A

Flammability: No data

Upper Flammable Limit: No data

Lower Flammable Limit: No data

Vapor Pressure: 1 mm Hg @ 394 ^{O}C

Vapor Density: N/A

Relative Density (Specific Gravity): 8.642 g/cc

Solubility in H_2O: Insoluble

Partition Coefficient (n-octanol/water): Not determined

Autoignition Temperature: No data

Decomposition Temperature: No data

Viscosity: N/A

10 STABILITY AND REACTIVITY

Reactivity: No data

Chemical Stability: Stable under recommended storage conditions.

Possibility of Hazardous Reactions: High temperatures will generate toxic cadmium oxide fumes.

Conditions to Avoid: Avoid creating or accumulating fines or dusts. Avoid high temperatures.

Incompatible Materials: Peroxides, chlorates, nitrates, halogens, interhalogens, strong acids, strong bases, sulphur, potassium, zinc, selenium and tellurium.

Hazardous Decomposition Products: Cadmium oxide fume.

11 TOXICOLOGICAL INFORMATION

Likely Routes of Exposure: Inhalation, skin, eyes. Product as shipped does not present an inhalation hazard; however subsequent operations may create dusts or fumes which could be inhaled.

Symptoms of Exposure: Inhalation of fumes may cause upper respiratory tract irritation and systemic poisoning with early symptoms including headache, coughing, and a metallic taste.

Acute and Chronic Effects: After a delay of several hours (up to 10) after inhalation of dust or fumes, a person may develop constriction of the chest, persistent cough, and progressive shortness of breath. There may be headache, chills, diarrhea, muscle aches, nausea, vomiting, irritability, and restlessness. Prolonged exposure to cadmium dust and/or fume may cause loss of sense of smell, occasional ulcerations of the nasal passages, rhinolaryngitis, cough, shortness of breath, mild anemia, sleeplessness, irritability, loss of appetite, and cadmium-yellow fringe on teeth. The primary target organ for chronic cadmium effects is the kidney with increased excretion of a specific low molecular weight protein (beta-2-microglobulin). Exposures to high levels of cadmium dust or fume may be immediately dangerous to life or health and can cause delayed pneumonitis with fever and chest pain, and pulmonary edema resulting in death.

Acute Toxicity: LD50 oral - rat - 225mg/kg, LC50 inhalation - rat - 25mg/kg/30 min

Carcinogenicity: **NTP**: K - Known to be carcinogenic **IARC**: 1 - Carcinogenic to humans

To the best of our knowledge the chemical, physical and toxicological characteristics of the substance are not fully known.

12 ECOLOGICAL INFORMATION

Ecotoxicity: No data

Persistence and Degradability: No data

Bioaccumulative Potential: No data

Mobility in Soil: No data

Other Adverse Effects: May be toxic to aquatic organisms. Do not allow material to be released to the environment. No further relevant information available.

13 DISPOSAL CONSIDERATIONS

Waste Disposal Method:

Product: Dispose of in accordance with Federal, State and Local regulations.

Packaging: Dispose of in accordance with Federal, State and Local regulations.

14 TRANSPORT INFORMATION

DOT/ADR/IATA/IMDG Regulations: Not regulated

UN Number: N/A

UN Proper Shipping Name: N/A

Transport Hazard Class: N/A

Packing Group: N/A

Marine Pollutant: No

Special Precautions: N/A

15 REGULATORY INFORMATION

TSCA Listed: All components are listed.

Regulation (EC) No 1272/2008 (CLP): Acute toxicity, category 3, Carcinogenicity, category 2, Specific target organ toxicity, repeated or prolonged exposure, category 2, Aquatic toxicity, acute and chronic, category 1.

Canada WHMIS Classification (CPR, SOR/88-66): Class D, Division 1, Subdivision B - Toxic material causing immediate and serious toxic effects, Class D, Division 2, Subdivision A - Very toxic material causing other toxic effects.

HMIS Ratings: **Health**: 0 **Flammability**: 0 **Physical**: 0

NFPA Ratings: **Health**: 1 **Flammability**: 0 **Reactivity**: 0

Chemical Safety Assessment: A chemical safety assessment has not been carried out.

16 OTHER INFORMATION

Most of the available information on the health effects of cadmium has been gained from industrial exposure to, and research performed with, cadmium compounds. Comparatively little research has been conducted to determine the difference in health effects of cadmium metal as opposed to cadmium compounds. In animal studies, it appears that in acute exposures, the relatively more soluble cadmium chloride, cadmium oxide fume, and cadmium carbonate compounds are more toxic than the relatively less soluble cadmium sulfide compounds. Toxicity does not strictly correlate with solubility however, and the solubility of cadmium oxide in biological fluids may be greater than it's solubility in water. Cadmium metal dust is believed to be toxic and all precautions should be taken to avoid exposure. Inhalation and ingestion are the most hazardous routes of exposure. Heating cadmium to high temperature will produce cadmium oxide fume, which is known to be extremely toxic.

The above information is believed to be correct, but does not purport to be all inclusive and shall be used only as a guide. ESPI Metals shall not be held liable for any damages resulting from handling or from contact with the above product.

Prepared by: ESPI Metals

Revised/Reviewed: July 2014

Chromium

SAFETY DATA SHEET

1 PRODUCT AND SUPPLIER IDENTIFICATION

Product Name: Chromium - flake, granules, pellets, pieces, rod, target

Formula: Cr

Supplier: ESPI Metals
1050 Benson Way
Ashland, OR 97520

Telephone: 800-638-2581

Fax: 541-488-8313

Email: sales@espimetals.com

Emergency: Infotrac 800-535-5053 (US) or 352-323-3500 (24 hour)

Recommended Uses: Scientific Research

2 HAZARDS IDENTIFICATION

GHS Classification (29 CFR 1910.1200): Not classified as hazardous

GHS Label Elements:

Signal Word: N/A

Hazard Statements: N/A

Precautionary Statements: N/A

3 COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient: Chromium

CAS#: 7440-47-3

%: 100

EC#: 231-157-5

4 FIRST AID MEASURES

General Measures: Under normal handling and use, exposure to solid forms of this material present few health hazards. Subsequent operations such as grinding, melting or welding may produce potentially hazardous dust or fumes which can be inhaled or come in contact with the skin or eyes.

INHALATION: Remove to fresh air, keep warm and quiet, give oxygen if breathing is difficult. Seek medical attention.

INGESTION: Rinse mouth with water. Do not induce vomiting. Seek medical attention. Never induce vomiting or give anything by mouth to an unconscious person.

SKIN: Remove contaminated clothing, brush material off skin, wash affected area with soap and water. Seek medical attention if symptoms develop or persist.

EYES: Flush eyes with lukewarm water, including under upper and lower eyelids, for at least 15 minutes. Seek medical attention if symptoms develop or persist.

Most Important Symptoms/Effects, Acute and Delayed: May cause irritation. See section 11 for more information.

Indication of Immediate Medical Attention and Special Treatment: No other relevant information available.

5 FIREFIGHTING MEASURES

Extinguishing Media: Use extinguishing agent suitable for surrounding material and type of fire.

Unsuitable Extinguishing Media: No information available.

Specific Hazards Arising from the Material: This product does not present fire or explosion hazards as shipped. Fine dust from processing is a weak to moderate fire hazard if allowed to accumulate and subjected to an ignition source. May emit toxic metal oxide fumes under fire conditions.

Special Protective Equipment and Precautions for Firefighters: Full face, self-contained breathing apparatus and full protective clothing when necessary.

6 ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment, and Emergency Procedures: Wear appropriate respiratory and protective equipment specified in section 8. Avoid dust formation. Keep finely divided chromium away from any source of ignition and cleaned up immediately.

Methods and Materials for Containment and Cleaning Up: Sweep or scoop up. Place in appropriate waste disposal container.

Environmental Precautions: Do not allow to be released to the environment.

7 HANDLING AND STORAGE

Precautions for Safe Handling: Avoid creating dust. Do not breathe dust or fumes. See section 8 for information on personal protection equipment.

Conditions for Safe Storage: Store in a cool, dry area. See section 10 for more information on incompatible materials.

8 EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits: Chromium

OSHA/PEL: 1 mg/m^3

ACGIH/TLV: 0.5 mg/m^3

Engineering Controls: Ensure adequate ventilation to maintain exposures below occupational limits. Whenever possible the use of local exhaust ventilation or other engineering controls is the preferred method of controlling exposure to airborne dust and fume to meet established occupational exposure limits. Use good housekeeping and sanitation practices. Do not allow dusts to accumulate as they may present a fire hazard. Do not use tobacco or food in work area. Wash thoroughly before eating or smoking. Do not blow dust off clothing or skin with compressed air.

Respiratory Protection: If permissible levels are exceeded, use NIOSH approved dust respirator.

Eye Protection: Safety glasses

Skin Protection: Wear impermeable gloves, protective work clothing as necessary.

9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance:

Form: Solid in various forms

Color: Silver gray metallic

Odor: Odorless

Odor Threshold: Not determined

pH: N/A

Melting Point: 1857±20 ^{o}C

Boiling Point: 2672 ^{o}C

Flash Point: N/A

Evaporation Rate: N/A

Flammability: No data

Upper Flammable Limit: No data

Lower Flammable Limit: No data

Vapor Pressure: 1 mm Hg @ 1616 $^{\circ}$C

Vapor Density: N/A

Relative Density (Specific Gravity): 7.20 g/cc @ 28 $^{\circ}$C

Solubility in H_2O: Insoluble

Partition Coefficient (n-octanol/water): Not determined

Autoignition Temperature: No data

Decomposition Temperature: No data

Viscosity: N/A

10 STABILITY AND REACTIVITY

Reactivity: No data

Chemical Stability: Stable under recommended storage conditions.

Possibility of Hazardous Reactions: No data

Conditions to Avoid: Avoid creating or accumulating fines or dusts.

Incompatible Materials: Acids, strong oxidizing agents, ammonium nitrite, bromine pentafluoride and carbon dioxide.

Hazardous Decomposition Products: Chromium oxide fume.

11 TOXICOLOGICAL INFORMATION

Likely Routes of Exposure: Inhalation, skin, eyes. Product as shipped does not present an inhalation hazard. However subsequent operations may create dusts or fumes which could be inhaled.

Symptoms of Exposure: May cause irritation if dusts or fumes are inhaled or swallowed. Fines/dusts may irritate skin and eyes.

Acute and Chronic Effects: Although much is known about the health effects of chromium compounds, the health effects of chromium metal, Cr(0), is not well studied. Due to insolubility most elements in their metallic state are not considered to be serious health hazards.

Acute Toxicity: No data

Carcinogenicity: **NTP**: Not identified as carcinogenic **IARC**: 3 - Not classifiable as to carcinogenicity in humans

To the best of our knowledge the chemical, physical and toxicological characteristics of the substance are not fully known.

12 ECOLOGICAL INFORMATION

Ecotoxicity: No data

Persistence and Degradability: No data

Bioaccumulative Potential: No data

Mobility in Soil: No data

Other Adverse Effects: Do not allow material to be released to the environment without proper governmental permits. No further relevant information available.

13 DISPOSAL CONSIDERATIONS

Waste Disposal Method:

Product: Dispose of in accordance with Federal, State and Local regulations.

Packaging: Dispose of in accordance with Federal, State and Local regulations.

14 TRANSPORT INFORMATION

DOT/ADR/IATA/IMDG Regulations: Not regulated

UN Number:	N/A
UN Proper Shipping Name:	N/A
Transport Hazard Class:	N/A
Packing Group:	N/A

Marine Pollutant: No

Special Precautions: N/A

15 REGULATORY INFORMATION

TSCA Listed: All components are listed.

Regulation (EC) No 1272/2008 (CLP): N/A

Canada WHMIS Classification (CPR, SOR/88-66): N/A

HMIS Ratings: **Health**: 0 **Flammability**: 0 **Physical**: 0

NFPA Ratings: **Health**: 0 **Flammability**: 0 **Reactivity**: 0

Chemical Safety Assessment: A chemical safety assessment has not been carried out.

16 OTHER 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. ESPI Metals shall not be held liable for any damages resulting from handling or from contact with the above product.

Prepared by: ESPI Metals

Revised/Reviewed: June 2014

Lead

SAFETY DATA SHEET

1 PRODUCT AND SUPPLIER IDENTIFICATION

Product Name: Lead - pellets, shot, sheet, foil, rod, wire, target

Formula: Pb

Supplier: ESPI Metals
1050 Benson Way
Ashland, OR 97520

Telephone: 800-638-2581

Fax: 541-488-8313

Email: sales@espimetals.com

Emergency: Infotrac 800-535-5053 (US) or 352-323-3500 (24 hour)

Recommended Uses: Scientific Research

2 HAZARDS IDENTIFICATION

GHS Classification (29 CFR 1910.1200): Acute toxicity, category 4, Carcinogenicity, category 2, Reproductive toxicity, category 2.

GHS Label Elements:

Signal Word: Warning

Hazard Statements: H302 Harmful if swallowed, H332 Harmful if inhaled, H351 Suspected of causing cancer, H361 Suspected of damaging fertility or the unborn child.

Precautionary Statements: P260 Do not breath dust/fume/gas/mist/vapors/spray, P264 Wash hands thoroughly after handling, P281 Use personal protective equipment as required, P301+P304+P312 IF SWALLOWED OR INHALED: Call a POISON CENTER or doctor/physician if you feel unwell.

3 COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient:	Lead
CAS#:	7439-92-1
%:	100
EC#:	231-100-4

4 FIRST AID MEASURES

General Measures: Under normal handling and use, exposure to solid forms of this material present few health hazards. Subsequent operations such as grinding, melting or welding may produce hazardous dust or fumes which can be inhaled or come in contact with the skin or eyes. Emergency responders should take care to avoid secondary exposure to lead particulate. Wear appropriate protective equipment.

INHALATION: Remove to fresh air, keep warm and quiet, give oxygen if breathing is difficult. Seek immediate medical attention.

INGESTION: Rinse mouth with water. Do not induce vomiting. Seek immediate medical attention. Never induce vomiting or give anything by mouth to an unconscious person.

SKIN: Remove contaminated clothing, wash affected area with soap and water. Seek medical attention. Wash contaminated clothing before reusing.

EYES: Flush eyes with lukewarm water, including under upper and lower eyelids, for at least 15 minutes. Seek medical attention.

Most Important Symptoms/Effects, Acute and Delayed: May cause irritation. See section 11 for more information.

Indication of Immediate Medical Attention and Special Treatment: No other information available.

5 FIREFIGHTING MEASURES

Extinguishing Media: Use suitable extinguishing agent for surrounding materials and type of fire.

Unsuitable Extinguishing Media: No information available.

Specific Hazards Arising from the Material: This product does not present fire or explosion hazards as shipped. Fine dust from processing is a weak to moderate fire hazard if allowed to accumulate and subjected to an ignition source. Under fire conditions toxic fumes of lead oxide may be released.

Special Protective Equipment and Precautions for Firefighters: Full face, self-contained breathing apparatus and full protective clothing when necessary.

6 ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment, and Emergency Procedures: Wear appropriate respiratory and protective equipment specified in section 8. Avoid creating dusts. Avoid breathing dust or fume. Isolate spill area and provide ventilation.

Methods and Materials for Containment and Cleaning Up: For larger pieces - pick up mechanically. For chips or dust - vacuum using a HEPA filter. Place in properly labeled closed containers. Avoid creating dusts. Do not use compressed air.

Environmental Precautions: Do not allow to enter drains or to be released to the environment.

7 HANDLING AND STORAGE

Precautions for Safe Handling: Handle in a well-ventilated area. Avoid creating dust. Avoid exposure to high temperature. Avoid breathing dust or fumes. Avoid contact with skin and eyes. Wash thoroughly before eating or smoking. See section 8 for information on personal protection equipment.

Conditions for Safe Storage, Including Any Incompatibilities: Store in a sealed container. Store in a cool, dry area. Protect from moisture. Do not store together with strong oxidizers or acids. See section 10 for more information on incompatible materials.

8 EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits:	Lead
OSHA/PEL:	50 μg/m^3
ACGIH/TLV:	0.05 mg/m^3

Appropriate Engineering Controls: Whenever possible the use of local exhaust ventilation or other engineering controls is the preferred method of controlling exposure to airborne dust and fume to meet established occupational exposure limits. Use good housekeeping and sanitation practices. Do not use tobacco or food in work area. Wash thoroughly before eating or smoking. Do not blow dust off clothing or skin with compressed air. Clothing worn in areas of exposure to lead dust or fume should be restricted to the workplace and laundered regularly.

Individual Protection Measures, Such as Personal Protective Equipment:

Respiratory Protection: When potential exposures are above the occupational limits, approved respirators must be used.

Eye Protection: Safety glasses

Skin Protection: Wear impermeable gloves, protective work clothing as necessary.

9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance:

Form:	Solid in various forms
Color:	Silvery metallic
Odor:	Odorless

Odor Threshold: Not determined

pH: N/A

Melting Point: 327.5 ^{o}C

Boiling Point: 1740 ^{o}C

Flash Point: N/A

Evaporation Rate: N/A

Flammability: No data

Upper Flammable Limit: No data

Lower Flammable Limit: No data

Vapor Pressure: 1 mm Hg @ 973 ^{o}C

Vapor Density: N/A

Relative Density (Specific Gravity): 11.34 g/cc

Solubility in H_2O: Insoluble

Partition Coefficient (n-octanol/water): Not determined

Autoignition Temperature: No data

Decomposition Temperature: No data

Viscosity: N/A

10 STABILITY AND REACTIVITY

Reactivity: No data

Chemical Stability: Stable under recommended storage conditions.

Possibility of Hazardous Reactions: High temperatures will generate toxic lead oxide fumes.

Conditions to Avoid: Avoid creating or accumulating fines or dusts. Avoid high temperatures.

Incompatible Materials: Strong acids, strong oxidizers, halogens and interhalogen compounds.

Hazardous Decomposition Products: Lead oxide fume.

Other: Freshly cut or cast lead surfaces tarnish rapidly due to the formation of an insoluble protective layer of basic lead carbonate.

11 TOXICOLOGICAL INFORMATION

Likely Routes of Exposure: Inhalation, skin, eyes. Product as shipped does not present an inhalation hazard; however subsequent operations may create dusts or fumes which could be inhaled.

Symptoms of Exposure: Skin or eye contact with dust or fume may cause local irritation. Inhalation of dust or fumes may cause headache, nausea, vomiting, abdominal spasms, fatigue, sleep disturbances, weight loss, anemia, and pain in legs, arms, and joints. An acute short-term dose of lead could cause acute encephalopathy with seizures, coma, and death. However, short-term exposure of this magnitude is rare. Kidney damage, as well as anemia, can occur from acute exposure. Symptoms due to ingestion of lead dust or fume would be similar to those from inhalation. Other health effects such as metallic taste in the mouth and constipation or bloody diarrhea might also be expected to occur.

Acute and Chronic Effects: Lead accumulates in bone and body organs once it enters the body. Elimination from the body is slow. Initial and periodic medical examinations are advised for persons repeatedly exposed to levels above the exposure limits of lead dust or fumes. Once lead enters the body, it can affect a variety of organ systems, including the nervous system, kidneys, reproductive system, blood formation, and gastrointestinal system.

Acute Toxicity: No data

Carcinogenicity: **NTP**: R - Reasonably anticipated to be a carcinogen **IARC**: 2B - Possibly carcinogenic to humans

To the best of our knowledge the chemical, physical and toxicological characteristics of the substance are not fully known.

12 ECOLOGICAL INFORMATION

Ecotoxicity: No data

Persistence and Degradability: No data

Bioaccumulative Potential: No data

Mobility in Soil: No data

Other Adverse Effects: Do not allow material to be released to the environment. No further relevant information available.

13 DISPOSAL CONSIDERATIONS

Waste Disposal Method:

Product: Dispose of in accordance with Federal, State and Local regulations.

Packaging: Dispose of in accordance with Federal, State and Local regulations.

14 TRANSPORT INFORMATION

DOT/ADR/IATA/IMDG Regulations: Not regulated

UN Number: N/A

UN Proper Shipping Name: N/A

Transport Hazard Class: N/A

Packing Group: N/A

Marine Pollutant: No

Special Precautions: N/A

15 REGULATORY INFORMATION

TSCA Listed: All components are listed.

Regulation (EC) No 1272/2008 (CLP): Acute toxicity, category 4, Carcinogenicity, category 2, Reproductive toxicity, category 2.

Canada WHMIS Classification (CPR, SOR/88-66): Class D, Division 2, Subdivision A - Very toxic material causing other toxic effects.

HMIS Ratings: **Health**: 1 **Flammability**: 0 **Physical**: 0

NFPA Ratings: **Health**: 1 **Flammability**: 0 **Reactivity**: 0

Chemical Safety Assessment: A chemical safety assessment has not been carried out.

16 OTHER 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. ESPI Metals shall not be held liable for any damages resulting from handling or from contact with the above product.

Prepared by: ESPI Metals

Revised/Reviewed: September 2014

Mercury

SAFETY DATA SHEET

1 PRODUCT AND SUPPLIER IDENTIFICATION

Product Name: Mercury

Formula: Hg

Supplier: ESPI Metals
1050 Benson Way
Ashland, OR 97520

Telephone: 800-638-2581

Fax: 541-488-8313

Email: sales@espimetals.com

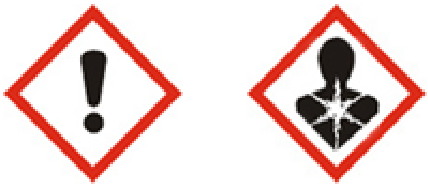
Emergency: Infotrac 800-535-5053 (US) or 352-323-3500 (24 hour)

Recommended Uses: Scientific Research

2 HAZARDS IDENTIFICATION

GHS Classification (29 CFR 1910.1200): Acute toxicity - inhalation, category 4, Specific target organ toxicity, repeated or prolonged exposure, category 1.

GHS Label Elements:



Signal Word: Danger

Hazard Statements: H332 Harmful if inhaled, H372 Causes damage to the central nervous system through prolonged or repeated exposure - inhalation.

Precautionary Statements: P260 Do not breath dust/fume/gas/mist/vapors/spray, P281 Use personal protective equipment as required.

3 COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient:	Mercury
CAS#:	7439-97-6
%:	100
EC#:	231-106-7

4 FIRST AID MEASURES

General Measures: Emergency responders should take precautions to ensure their own safety before attempting rescue. Wear appropriate protective equipment. Remove victims from the source of exposure as quickly as possible. If ingested and transport is necessary, prepare the transport vehicle in case the patient/victim vomits. The vomit may contain elemental mercury that can contaminate the transport vehicle. Have a suction apparatus ready and prepare several towels and double-sealable plastic bags to quickly clean and isolate vomitus. Only a professional mercury clean-up kit with a self-contained vacuum system should be used to decontaminate the transport vehicle. Ordinary vacuum cleaners can vaporize elemental mercury and increase the concentration of airborne mercury.

INHALATION: Remove to fresh air, keep warm and quiet, give oxygen if breathing is difficult. Seek immediate medical attention. If mouth-to-mouth is necessary always use a barrier or bag-valve-mask device.

INGESTION: Rinse mouth with water. Do not induce vomiting. Seek immediate medical attention. Never induce vomiting or give anything by mouth to an unconscious person.

SKIN: Remove contaminated clothing, quickly and gently blot or brush away excess material, wash affected area with soap and water. Seek medical attention. Thoroughly clean or safely dispose of contaminated clothing before reusing.

EYES: Quickly and gently blot or brush material off the face. Flush eyes with lukewarm water, including under upper and lower eyelids, for at least 15 minutes. Seek medical attention.

Most Important Symptoms/Effects, Acute and Delayed: May cause irritation to skin and eyes, difficulty breathing or shortness of breath, chest pain and dry cough. See section 11 for more information.

Indication of Immediate Medical Attention and Special Treatment: No other information available.

5 FIREFIGHTING MEASURES

Extinguishing Media: Use extinguishing media suitable for surrounding materials and type of fire.

Unsuitable Extinguishing Media: Do not use a heavy water stream.

Specific Hazards Arising from the Material: Under fire conditions, highly toxic mercury vapor and mercuric oxide fumes will be released.

Special Protective Equipment and Precautions for Firefighters: Full face, self-contained breathing apparatus and full protective clothing when necessary.

6 ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment, and Emergency Procedures: Wear appropriate respiratory and protective equipment specified in section 8. Isolate spill area and provide ventilation. Keep unnecessary and unprotected personnel out of spill area.

Methods and Materials for Containment and Cleaning Up: Do not touch spilled material. Dike spilled product to prevent runoff. Stop or reduce leak if safe to do so. For small spills, take up with sand or other absorbent material and place in properly labeled closed containers for later disposal. Mercury spill kit may also be used for small spills in the workplace. Uncontrolled releases should be responded to by trained personnel using pre-planned procedures.

After the spill has been contained and removed, decontaminate the area. All equipment used in response should be decontaminated thoroughly. If such equipment cannot be adequately decontaminated, it must be discarded with other spill residue. Place all spill residue in appropriate container, seal immediately, and label appropriately. The area should be properly inspected to ensure that all traces of mercury have been removed prior to re-occupation by non-emergency personnel.

Environmental Precautions: Do not allow to enter drains or to be released to the environment.

7 HANDLING AND STORAGE

Precautions for Safe Handling: Wear appropriate respiratory and protective equipment specified in section 8. Only trained personnel should work with this product. Handle in a well-ventilated area. Open containers slowly on a stable surface. When handling mercury use a glass, plastic or steel tray to contain any spills that might occur. **Caution**: mercury amalgamates with many common metals such as aluminum, so the container should be chosen carefully. Avoid exposure to high temperature. Avoid breathing fumes. Avoid contact with skin and eyes. Wash thoroughly before eating or smoking.

Conditions for Safe Storage, Including Any Incompatibilities: Store in closed unbreakable containers (polyethylene). Store in the original labeled shipping container when possible. Store in an area that is cool, dry and temperature-controlled, away from direct sunlight, heat and ignition sources. Do not store together with ammonia, halogens or oxidizers. See section 10 for more information on incompatible materials.

8 EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits: Mercury

OSHA/PEL: 0.1 mg/m^3 (ceiling)

ACGIH/TLV: 0.025 mg/m^3 (8 hour TWA)

Appropriate Engineering Controls: Whenever possible the use of local exhaust ventilation, process enclosure or other engineering controls is the preferred method of controlling exposure to meet established occupational exposure limits. Use good housekeeping and sanitation practices. Do not use tobacco or food in work area. Wash thoroughly before eating or smoking. Clothing worn in areas of exposure to mercury vapor should be restricted to the workplace and stored in special lockers.

Individual Protection Measures, Such as Personal Protective Equipment:

Respiratory Protection: When potential exposures are above the occupational limits, approved respirators must be used. Self-contained breathing apparatus can be used up to 5 mg/m^3 with a full face piece above 1mg/m^3.

Positive pressure type air supplied breathing equipment has been recommended above 5 mg/m^3.

Eye Protection: Splash goggles or safety glasses. A face shield should be worn when possibility of splash exists.

Skin Protection: Wear impermeable gloves, protective work clothing as necessary.

9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance:

Form: Liquid

Color: Silvery metallic

Odor: Odorless

Odor Threshold: Not determined

pH: N/A

Melting Point: -38.87 ^{o}C

Boiling Point: 356.58 ^{o}C

Flash Point: N/A

Evaporation Rate: N/A

Flammability: N/A

Upper Flammable Limit: N/A

Lower Flammable Limit: N/A

Vapor Pressure: 1 mm Hg @ 126.2 ^{o}C

Vapor Density: N/A

Relative Density (Specific Gravity): 13.546 g/cc @ 20 ^{o}C

Solubility in H_2O: Insoluble

Partition Coefficient (n-octanol/water): Not determined

Autoignition Temperature: No data

Decomposition Temperature: No data

Viscosity: N/A

10 STABILITY AND REACTIVITY

Reactivity: No data

Chemical Stability: Stable under recommended storage conditions.

Possibility of Hazardous Reactions: High temperatures will generate toxic mercury vapor and mercuric oxide fumes.

Conditions to Avoid: Avoid high temperatures, contact with incompatibles.

Incompatible Materials: Acetylenic compounds, ammonia, boron, diiodophosphide, ethylene oxide, metals (aluminum, potassium, lithium, sodium, rubidium) methyl azide, methyl silane, oxygen, oxidants (bromine, peroxyformic acid, chlorine dioxide, nitric acid, tetracarbonylnickel, nitromethane, silver perchlorate).

Hazardous Decomposition Products: Mercury vapor and mercuric oxide fume.

11 TOXICOLOGICAL INFORMATION

Likely Routes of Exposure: Inhalation, skin and eyes.

Symptoms of Exposure: Inhalation of fumes may cause irritation to lungs, gastrointestinal irritation and a metallic taste in the mouth.

Acute and Chronic Effects: Short-term exposure to high levels of metallic mercury vapors may cause effects including lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation. Chronic exposure to small amounts of mercury vapor may cause weakness, fatigue, anorexia, weight loss and gastrointestinal distress. Chronic exposure to larger amounts may cause mercurial fine tremor punctuated by coarse shaking, erethism, gingivitis, excessive salivation and immune dysfunction.

Acute Toxicity: LC_{Lo} - inhalation - rabbit - 29mg/m^3 (30 hours)

Carcinogenicity: **NTP**: Not identified as carcinogenic **IARC**: 3 - Not classifiable as to its carcinogenicity to humans

To the best of our knowledge the chemical, physical and toxicological characteristics of the substance are not fully known.

12 ECOLOGICAL INFORMATION

Ecotoxicity: LC50 Catfish 0.35 mg/L/96

Persistence and Degradability: No data

Bioaccumulative Potential: No data

Mobility in Soil: No data

Other Adverse Effects: Do not allow material to be released to the environment. No further relevant information available.

13 DISPOSAL CONSIDERATIONS

Waste Disposal Method:

Product: Dispose of in accordance with Federal, State and Local regulations.

Packaging: Dispose of in accordance with Federal, State and Local regulations.

14 TRANSPORT INFORMATION

DOT/ADR/IATA/IMDG Regulations:

UN Number: UN2809

UN Proper Shipping Name: Mercury

Transport Hazard Class: 8 (6.1)

Packing Group: III

Marine Pollutant: No

Special Precautions: N/A

15 REGULATORY INFORMATION

TSCA Listed: All components are listed.

Regulation (EC) No 1272/2008 (CLP): Acute toxicity, category 4, Specific target organ toxicity, repeated or prolonged exposure - central nervous system, category 1, Aquatic toxicity, acute and chronic, category 1.

Canada WHMIS Classification (CPR, SOR/88-66): Class D, Division 1, Subdivision B - Toxic material causing immediate and serious toxic effects, Class D, Division 2, Subdivision A - Very toxic material causing other toxic effects, Class E - Corrosive.

HMIS Ratings: **Health**: 3 **Flammability**: 0 **Physical**: 0

NFPA Ratings: **Health**: 3 **Flammability**: 0 **Reactivity**: 1

Chemical Safety Assessment: A chemical safety assessment has not been carried out.

16 OTHER 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. ESPI Metals shall not be held liable for any damages resulting from handling or from contact with the above product.

Prepared by: ESPI Metals

Revised/Reviewed: July 2014

Attachment C
Community Air Monitoring Plan

Attachment C
Generic Community Air Monitoring Plan
Former Hornell Waste Materials
Company Site
Hornell Site Development LLC.
Arkport, New York

1.0 Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain site investigation or remediation activities are in progress. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The site specific CAMP presented below will be sufficient to cover many, if not most, site activities. Specific requirements should be reviewed for each situation in consultation with Site Safety Officer, NYSDEC and NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical-specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures. These requirements will be determined in consultation with Site Safety Officer, NYSDEC, and NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

2.0 Community Air Monitoring Plan

The limited site information suggests VOCs, semivolatile organic compounds (“SVOCs”), PCBs, and metals are present in the soil and possibly only VOCs being present in the groundwater. Based on the known and potential contaminants at the site, real-time air monitoring for VOCs and particulate levels at the perimeter of the exclusion zone and work area will be necessary.

2.1 Continuous Monitoring

Continuous air monitoring will be required for all ground intrusive activities conducted during the site investigation, interim remedial measures or remediation. The activities which will require continuous monitoring would include: drilling of boreholes, sampling and development of monitoring wells (VOCs only), test pitting, and soil/waste excavation and handling.

2.2 Periodic Monitoring

Periodic monitoring for VOCs will be required during non-intrusive site activities such as the collection of surface soil or the collection of groundwater samples from monitoring wells. Periodic monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. At this time the closest sampling location to an occupied building is approximately 75-feet and at this time would not warrant continuous monitoring. As sampling data is obtained the CAMP will be re-evaluated.

2.2.1 VOC Monitoring, Response Levels, and Actions

VOCs will be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as wind speed and as the concentration of VOCs at the point of measurement dictate. Upwind concentrations will be measured at the start of each workday and periodically (every 15 to 30-minutes) thereafter to establish background conditions, particularly if wind direction changes. The monitoring work will be performed using at least an organic vapor analyzer with a photoionization or flame ionization detector. The equipment will be field checked for calibration at least daily using a gas standard. As the field calibration drifts beyond an acceptable limit a complete calibration will be done or the equipment will be replaced. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or the exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

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

    a. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

    b. All 15-minute readings must be recorded and be available for NYSDEC and NYSDOH personnel to review. Instantaneous readings, if any, used for decision purposes will also be recorded.

2.2.2 Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations during actions where larger areas of the ground surface are disturbed or when waste is being handled. For example when test pitting is being conducted or there is a soil/waste handling taking place. Disturbing the soil during the drilling of soil borings will necessitate particulate monitoring when full augers (soil is caked onto the auger flights) are being extracted and the soil is removed. These short duration events monitoring will be done with hand held equipment up and down wind of the drilling equipment. During the collection of surface soil samples particulate sampling will not be required.

The particulate monitoring equipment will be able to measure real time date to particulate sizes of less than 10 micrometers (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment will also provide an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (“mcg/m^3”) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for NYSDEC, NYSDOH and County Health personnel to review.