GEI Consultants

Geotechnical
Environmental
Water Resources
Ecological

Site Characterization Work Plan

Hornell Former MGP Site

Hornell, New York
ACO #A8-0634-02-10
Site # 8-51-032

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Table of Contents

Table of Contents (cont.)

Tables

Figures

Appendices

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Abbreviations and Acronyms

ACGIH	American Conference of Government Industrial Hygienists
ACO	Administrative Order on Consent
AOC	Area of Contamination
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CAMP	Community Air Monitoring Plan
CERCLA	EPA Comprehensive Environmental Response, Compensation, and Liability Act
CHSS	Corporate Health and Safety Specialist
COC	Chain-of-Custody
DER	Division of Environmental Remediation
DNAPL	Dense Non-Aqueous Phase Liquid
DUSR	Data Usability Summary Report
ECL	New York State Environmental Conservation Law
EDR	Environmental Data Resources
ELAP	New York State Environmental Laboratory Approval Program
FOIL	Freedom of Information Law
FSP	Field Sampling Plan
FWRIA	Fish and Wildlife Resources Impacts Analysis
GEI	GEI Consultants, Inc.
HASP	Health and Safety Plan
HSA	Hollow-Stem Auger
IDW	Investigation-Derived Waste
IRM	Interim Remedial Measure
LNAPL	Light Non-Aqueous Phase Liquid
MGP	Manufactured Gas Plant
MNA	Monitored Natural Attenuation
MS/MSD	Matrix Spike/ Matrix Spike Duplicate
NAPL	Non-Aqueous Phase Liquids
NAVD88	North American Vertical Datum of 1988
NTU	Nephelometric Turbidity Units
NYSASP	New York State Analytical Services Protocols
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
ORP	Oxidation reduction potential
OSHA	Occupational Health & Safety Administration
PAH	Polycyclic Aromatic Hydrocarbon
PID	Photo-Ionization Detector
PM-10	Particulate matter less then 10 micrometers in diameter (Respirable Particulates)
PPE	Personal Protective Equipment
PRP	Potential Responsible Party
PSC	New York State Public Service Commission

PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RSCO	Recommended Soil Cleanup Objectives
SC	Site Characterization
SCGs	Standards, Criteria Or Guidance
SCOs	Soil Cleanup Objectives
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TIC	Tentatively Identified Compound
U.S. DOT	United States Department of Transportaion
U.S. EPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound

MEASUREMENTS

cf	Cubic foot
I.D.	Inner diameter
msl	Mean sea level
NTUs	Nephelometric turbidity units
OD	Outer diameter
ppm	Parts per million
ug/m^3	Micrograms per cubic meter

1. Introduction

On behalf of our client, National Fuel Gas Distribution Corporation (National Fuel Gas), GEI Consultants, Inc. (GEI) has prepared this Site Characterization (SC) Work Plan for the Hornell Former Manufactured Gas Plant (MGP) site located in the City of Hornell, Steuben County, New York. Figure 1 shows the location of the Hornell Former MGP site. National Fuel Gas and the New York State Department of Environmental Conservation (NYSDEC) have entered into an Administrative Order on Consent (ACO) and administrative settlement #A8-0634-02-10 to evaluate environmental conditions at the Hornell Former MGP. This Work Plan has been prepared and will be submitted to the NYSDEC and the New York State Department of Health (NYSDOH) for review and approval as a requirement of the ACO. Implementation of the scope of work described in this plan is intended to generate sufficient data to complete the SC. The Work Plan has been prepared in accordance with the document entitled, *"NYSDEC Technical Guidance for Site Investigation and Remediation (DER-10),"* issued May 3, 2010 [NYSDEC, 2010].

The purpose of this Work Plan is to describe the methods and procedures to be implemented in performing a site characterization of the former MGP site. This Work Plan includes the following components:

- A brief site history of the Hornell Former MGP; and
- The scope of work for a site characterization of the Hornell Former MGP site.

Appendices to the Work Plan include the following:

- A Community Air Monitoring Plan (CAMP) is included as Appendix A;
- A site-specific Health and Safety Plan (HASP) is included as Appendix B;
- Standard Operating Procedures (SOPs) are included as Appendix C;
- A Quality Assurance Project Plan (QAPP) is included as Appendix D; and
- A Non-Aqueous Phase Liquid (NAPL) Contingency Plan is included as Appendix E.

1.1 Work Plan Status

Based on their review of the site history, previous investigations, and current site conditions, the NYSDEC has requested that an expedited SC be performed at the Site. If necessary and to the degree that the scope of work for the SC can be expanded safely and within the work area defined by access agreements, additional tasks for accomplishing a Remedial Investigation (RI) will be performed during this mobilization as is reasonable and practical.

2. Site Background

2.1 Site Location and Description

The Hornell Former MGP site is located at the corner of Canisteo and Franklin Streets at the southwest side of the downtown area of Hornell (Figure 1). The Site is on the border between the modern and historic commercial/industrial area and a residential area. It is located on a property that is bounded by Franklin Street, Canisteo Street, and by residential properties fronting on Albion Street to the south and fronting on Hill Street to the west of the site (Figure 2).

The Site is made up of two parcels. The western portion of the site is a parcel owned by the City of Hornell with dimensions of approximately 30 by 120 feet, with the narrow portion fronting Franklin Street. The balance of the site is comprised of a portion of a property owned by Maple City Lodging Partnership. The portion of this property which was previously used for gas production or storage extends from the City property at the west to Canisteo Street to the east, with approximate dimensions of 375 by 125 feet.

The eastern third of the Site is currently developed as part of the Comfort Inn Hotel, with a portion of the building and parking areas present on the property. The central and western portion of the Site is a grassy vacant lot. A line of trees is found along the southern property line which borders residential backyards. The site is generally flat-lying and does not appear to have any surface water features present.

To the north and east across Franklin and Canisteo Streets, respectively, the Site is bordered by commercial properties. Single-family residential properties are found to the northwest, and directly bordering the Site to the west and south sides. Approximately 120 feet to the northeast of the Site is the active Norfolk Southern railroad line.

2.2 Site History

The history of the Hornell Former MGP site and surrounding area was developed through the review of available historic Sanborn Fire Insurance (Sanborn) maps and the Browns Directory of American Gas Companies (Browns Directory), as well as historical photographs and documents obtained from sources on the Internet, and documents provided by the City of Hornell to National Fuel Gas pertaining to the redevelopment of a portion of the site in 1989 to 1990. A summary of the known events in the history of the site is presented in Table 1.

2.2.1 MGP History

From the available sources, it is unknown when the Hornell MGP was constructed and began operations. The earliest record of the site which has been obtained shows the MGP present on a map of Hornellsville (the original name of the community) in 1873 [Beers, 1873] as the McDougal & Avery Gas Works. The MGP is listed in the first Browns Directory [1887], and shown on the first Sanborn map of the site (1888). Both carbureted water gas (Lowe method) and coal gas production methods were used during the known history of the site. A cited method identified as the “English” method is believed to be a form of carbureted water gas. The end of gas production is uncertain. The last Browns Directory citation for gas production was in 1899.

In 1900 Browns Directory states that the gas company was now distributing natural gas. One reference states that gas was piped to Hornell beginning in 1898, and that from 1918 to 1932, part of this gas came from oil wells to the southwest [Baldwin, 2004]. Information provided by the NYSDEC from a review of Public Service Commission (PSC) records indicates that oil gas was produced by the Hornell Gas Light Company from 1926 to 1932. This could not be confirmed, as the 1926 Sanborn map does not indicate the presence of gas-producing equipment at the site, and the Browns Directory listings for these years do not reference any form of gas production for Hornell. Natural gas storage and distribution at the site occurred until around the late 1940s or early 1950s. At that time, the last gas holder (Holder C) was removed from the site.

A period of “urban renewal” took place in Hornell in the 1960s. During this time the “subway” underpass beneath the Norfolk Southern railroad lines was filled, and replaced by a new arterial road over the rail lines. The remaining MGP structures were demolished in 1976, according to the building permit for wrecking issued at that time.

2.2.2 Post MGP History

There is presently little information available regarding use of the site after it was no longer used for gas storage. The site remained generally vacant and was used as a park. In 1989 the City of Hornell began investigation of the eastern portion of the property for construction of a new Comfort Inn hotel. At that time, it appeared that the City owned the former gas company property along Franklin Street, and the property along Canisteo Street between Franklin and Spruce Streets. The City acquired the site in 1980 and the Quit Claim Deed was issued in 1989. The property was subsequently sold to the Hornell Industrial Development Agency in 1993 for development.

2.3 Previous Investigations

Documents from the City of Hornell which were provided by National Fuel Gas describe work which was performed prior to the construction of the Comfort Inn in 1989 and 1990. At that time the former gas company property, along with other commercial properties to the south along Canisteo Street, were owned by the City. In 1989 seven geotechnical soil borings were advanced on the proposed Comfort Inn property (Figure 2). These borings found that the soil conditions in the upper 25 feet are generally as follows:

- A zone of fill soils 4 to 6 feet thick below a topsoil layer. The fill contains occasional brick, ash, and cinders.
- A mixed silt unit with some amounts of clay and sand, approximately 5 to 6 feet thick.
- A sand and gravel unit, beginning at 7 to 12 feet below ground surface (bgs) and extending to the base of all site borings (27 feet). The sand and gravel unit is expected to extend to bedrock; the result of glacial outwash filling the valley.
- Based on the topography and geology of the site, bedrock beneath the site is expected to be approximately 100 feet.

In 1990, a Phase II environmental site assessment was performed to evaluate impacts to groundwater on the property. Four water table monitoring wells were installed as part of this investigation. Water table maps based on measurements from these wells showed that the groundwater flow direction is to the southeast, in keeping with the local hydrogeologic conditions (note the surface water flow directions for the streams shown in Figure 1).
One boring and one groundwater monitoring well were installed on the Site during the 1989 and 1990 investigations. Boring B-6 was installed on the downgradient side of Holder B. This boring found fill soils (including ash) in the upper five feet, and a slight odor and soil staining at the water table at approximately 15 feet below the ground surface (bgs). A maximum soil photoionization detector measurement of 4 parts per million (ppm) was measured at 15 feet bgs. Monitoring well GW-1 was installed at a location downgradient of Holder A. Groundwater from this well was found to contain benzene, toluene, ethylbenzene, and xylenes (BTEX) with total BTEX concentrations of 406 and 219 parts per billion (ppb) for the two sampling events conducted. Total petroleum hydrocarbon (TPH) analysis was measured at 687 and 464 ppb for the two events.

All of the other borings and wells previously installed at the site are located downgradient of the former MGP. Borings B-3, B-4, and B-5 did not show indications of impact. Boring B-7, located downgradient of monitoring well GW-1 and Holder A, did not show any impacts in shallow soils (0 to 14 feet bgs). Notes in the boring log however indicated “apparent free product present” at samples from 19 to 20 feet and from 25 to 26 feet bgs. PID readings on these soil samples were low, therefore it is unknown at this time if the observations are of a weathered NAPL or of some other material.

Soil borings and wells which were advanced south of Albion Street encountered significant petroleum impacts associated with three former underground storage tanks (USTs). These impacts are well south of the former MGP and are not considered to be associated with former gas plant operations.

3. Summary of Records Search

GEI completed a search of environmental records for the Hornell Former MGP site on behalf of National Fuel Gas as part of the preparation of the SC Work Plan. The environmental records search review was prepared in general accordance with requirements established within the ACO.

3.1 Records Search Scope of Work

The record search report for the Hornell Former MGP site included the review or evaluation of the following:

- Environmental data and information currently available;
- History and description of site including nature of operations; and
- Identity of other potential responsible parties (PRPs) for releases of hazardous waste.

The site history and current site conditions are discussed above within Section 2.2.

To evaluate the environmental data, potential hazardous waste storage, and PRPs, GEI relied upon information from Environmental Data Resources (EDR) [EDR, 2010], a commercially available environmental database search dated June 2010, available Sanborn maps from 1888 until 1961, and the Browns Directory of American Gas companies.

3.2 Records of Materials Handling, Storage Processes, and Waste Generation

A search of the NYSDEC spill incidents and environmental site remediation databases was conducted, Sanborn maps were reviewed, and an EDR Radius Map with GeoCheck® report was reviewed. Records of materials handling, storage processes, and waste generation were not identified for the site.

According to information supplied to National Fuel Gas from the City of Hornell, two underground storage tanks were removed from the vicinity of Holder C in the 1970s. The location and conditions of these tanks were not specified.

3.3 Possible Subsurface Structures

It is unknown if any Hornell Former MGP foundations are present at the site. Subsurface investigations and/or remote sensing methods would be required to evaluate whether any subsurface structures are still present. The location of the former buildings and holders are shown on Figure 2.

No other records of possible subsurface structures or product lines were identified through the NYSDEC database search, Sanborn maps or the EDR Radius report.

3.4 Environmental Records Search

The EDR Radius Map with GeoCheck® report ordered by GEI was reviewed to search the NYSDEC spill incidents and environmental site remediation databases. No environmental records information or known discharges on the site were identified based on the records search, aside from the presence of the former MGP. No current or former storage of petroleum or hazardous waste on the site was identified by the records search. However, it was reported in the Phase II Site Assessment performed by North State Consultants that two underground tanks were removed from the site in the 1970s, but no records regarding the nature of the tanks are available [North State Consultants, 1990].

The property to the immediate south (and hydraulically downgradient) of the former gas company property (between Albion and Spruce Streets) was reported to have three petroleum USTs, which were removed sometime in the 1970s by the City of Hornell. Petroleum impacts were found in soils associated with these tanks, in the area shown on Figure 2 [North State Consultants, 1990]. These soils were remediated prior to the construction of the Comfort Inn.

3.5 Identity of Other PRPs

Sanborn maps were used to identify other PRPs. These businesses that are on site or abutting the site have a potential to have impacted the subsurface soil or groundwater on site.

Circa 1947, the site was used for used truck sales as shown on the 1947 Sanborn map. No company name was shown for the used truck sales and the owner could not be identified.

No additional PRPs were identified.

4. Scope of Work

The scope of work addresses field investigation tasks that will provide a better understanding of potential soil and groundwater impacts related to the operation of the Hornell Former MGP site. The type, number, and depth of samples were developed based on a review of historic information. Accordingly, the proposed sampling program includes sampling of groundwater, subsurface soil, and soil vapor.

The scope of work includes the following tasks.

- Preliminary site visit and records search;
- Field investigation preparation and mobilization activities;
- Site utility survey;
- Field investigation sampling and analysis;
- Qualitative Human Health Exposure Assessment;
- Survey of sample point locations;
- Quality assurance/quality control (QA/QC) and data validation; and
- SC Report preparation.

A Fish and Wildlife Resources Impact Analyses (FWRIA) will not be performed as part of the SC due to the site's urban setting. The location, depth, magnitude, and possible extent of the impacts relative to overlying or nearby buildings will be used to determine if soil vapor is of concern. If soil vapor is determined to be of potential concern, then GEI would take a step-wise approach to assessing the potential for soil vapor intrusion.

Descriptions of each proposed work activity are provided separately below. Note that each activity may be expanded to work towards the goal of an RI as necessary and appropriate, as described below in each section. Simply put – RI work which can be reasonably accomplished during this field mobilization will be performed, within the safety and site-access limitations present.

4.1 Preliminary Site Visit

GEI will continue our search of records on the site. The general specifications for the records search are listed in Appendix 3A of DER-10. The scope of work for the records search includes, but is not limited to:

- A site reconnaissance to:

- Observe the site conditions, and to confirm the proposed locations of test pits, soil borings and wells;
- Search for the locations of previously installed groundwater monitoring wells and (if found) make a preliminary evaluation of their condition. The first task planned for the SC will be to perform a well survey to locate the previously installed monitoring wells, and to assess whether the well depths are consistent with the information included in the previous investigation borelogs. Several wells have been previously installed at the site; however, the current status of the wells is unknown. A depth-to-water measurement will be taken at each well found, and the total depth information compared to the borelogs provided in the previous investigation reports. The condition of each well will be noted, and recommendations for well repairs made if needed.
- Observe surface soil conditions, and assess whether surface soil sample collection will be necessary; and
- Meet with the City and hotel owners and discuss the proposed on-site scope of work (work locations, work hours, select waste storage location, etc.).

A fact sheet will be prepared and sent to all adjacent property owners at the commencement of site characterization investigation and another upon completion of that work.

GEI will also obtain available records from the City of Hornell Building Department on the demolition of former MGP structures (if available), and the construction of the Comfort Inn.

GEI will attempt to field locate any potential ground surface features associated with the former gas plant to the extent practicable. Test pits and soil borings (see subsection 4.3.3) will be used to assess the subsurface possible presence of holder-related impacts within the foundations/footings of the former gas holder (if present).

4.2 Field Investigation Preparation and Mobilization Activities

Upon approval of the Work Plan by the NYSDEC, authorization from National Fuel Gas, and execution of property access agreements, GEI will mobilize to the site to implement the sampling program. The initial field mobilization will include the following items to be completed prior to the commencement of the field SC activities:

- Conduct Dig Safely New York mark-out;
- Establish with the property owners the location for a temporary decontamination area; and
- Establish a temporary waste storage area and make arrangements with National Fuel Gas for the removal of investigation-derived wastes (IDW). Note that direct-push sampling methods will be used to the extent possible to minimize the volume of waste soil generated by the sampling program.

4.2.1 Site Access

National Fuel Gas and its contractors will need site access granted by the owners where investigation will occur, namely the City of Hornell and the Comfort Inn. National Fuel Gas has obtained an access agreement with the City of Hornell for work on its portion of the site. National Fuel Gas will also negotiate and obtain an access agreement with the owner of the Comfort Inn property.

4.2.2 Utility Location

The approximate locations of the proposed sampling locations shall also be identified and marked in the field prior to commencement of field activities. Each test pit, soil boring, or monitoring well location will be marked by GEI with white paint, stakes, or flagging prior to intrusive activities. The earthwork and drilling subcontractor will provide the investigation sample locations to the utility clearance organization (Dig Safely New York) to identify potential utility conflicts at the site. At this time, we believe that a natural gas line is present along the southern property line for the site. GEI will also request that the current property owners and holder of any rights-of-way provide the utility plans for on-site utilities.

4.3 Field Investigation Sampling and Analysis

This section discusses the proposed test pit, surface soil, soil boring, and groundwater monitoring well sampling and analysis activities. Table 3 presents the general rationale and proposed sampling and analysis for each investigation point. The proposed sample locations are shown on Figure 3. In addition, air monitoring, well installation, and groundwater sampling procedures to be implemented are discussed. Sampling procedures and methods are detailed within the Standard Operating Procedures in Appendix C.

The proposed analyses, analytical methods, and QA/QC samples are discussed under each of the following subsections for test pits, surface soil, soil borings, monitoring well, and soil vapor sampling procedures and are also provided within the QAPP (Appendix D). Subsection 4.8 discusses laboratory data deliverables and data validation procedures.

4.3.1 Test Pit Excavation

Test pits (test trenches) will be excavated in the footprint of several former MGP features to assess the presence of foundations, and to determine the presence of MGP-related residuals inside of, and outside of any foundations identified. The locations of the proposed test pits are shown on Figure 3. Additional information regarding the test pit excavations is included in Table 3, including: the test pit designations, the sampling rationale and location, the anticipated test pit excavation depth, and the number and type of the laboratory samples to be collected. A minimum of one soil sample will be collected from each test pit. Additional samples may be obtained if varying conditions are found, especially in longer test trenches. The test pits will be excavated with a backhoe or excavator. The excavated areas will be graded and seeded following test pit excavation.

Note that the test pits will be excavated into the fill soils and the silty sub-soil at the Site. The silty soil has a lower permeability than the sand and gravel soil unit which underlies it. For this reason, if NAPL is encountered in an excavation into the upper soil units, the excavation will be stopped in order to prevent penetration of the silt unit and the possible migration of NAPL into the sand and gravel soil.

If former MGP structures are encountered by the test pits, additional excavation may be performed in order to define the lateral limits of the structures, their depths, and their contents. Expansion of the test pit work beyond the locations identified on Figure 3 will be determined by the limits of the utility clearance, the degree to which any impacted soil can be managed, and the degree to which VOCs and odors can be controlled.

4.3.2 Surface Soil Sampling

A reconnaissance was performed to confirm the topsoil cover, and also to assess whether visually impacted surface soil areas are present at the site. A visible tar seep at the surface was observed by NYSDEC personnel, at the location shown on Figure 3. This seep is limited in nature and thus will be shoveled up and disposed of with any site-related IDW (see Section 4.7). Following removal, the area where the seep was removed will be covered with topsoil and grass seed.

Five representative surface soil samples, obtained from 0-2 inches below the vegetative layer, will be obtained during the SC. The locations for these samples will be selected following the completion of the subsurface investigation, so that the field observations can be used to determine the most appropriate locations. The soil samples will be analyzed for the following:

- Semi-volatile organic compounds (SVOCs) by U.S. EPA Method 8270C mod + 20 Tentatively Identified Compounds (TICs);
- Target Analyte List (TAL) metals by U.S. EPA Method 6000/ 7000 series;
- Total cyanide by U.S. EPA Method 9012B; and
- Free cyanide by U.S. EPA Method 9013 extraction and micro-diffusion analysis ASTM Method D-4282-02.

Headspace VOC screening with a PID will be performed on the surface soil at each location. Any soil location which shows the presence of VOCs will also be sampled for:

- Volatile organic compounds (VOCs) by U.S. EPA Method 8260B + 10 TICs.

4.3.3 Soil Borings

A total of 10 soil borings are proposed at the site. A minimum of four of the soil borings will be completed as monitoring wells. The proposed soil boring and well locations are shown on Figure 3. Table 3 presents summary information regarding the boring and wells, including the sample identification, sample location or rationale, and the types of analyses to be performed. Additional borings may be performed if needed to delineate the lateral extent and depth of any areas of impact which may be found at the site.

If utilities cannot be confirmed at a particular location, then that soil boring location will be cleared using a hand auger to a depth of 5 feet, or 1 foot below the estimated depth of any nearby known utility. The subsurface borings will be advanced by either a direct-push (Geoprobe™) drilling rig equipped with discrete-interval Macro-Core™ samplers, or by a conventional hollow-stem auger (HSA) drill rig equipped with 2-inch diameter split-spoon samplers. Either method will allow for continuous soil samples to be taken from the ground surface to the bottom of the borehole for both field characterization (photo-ionization detector [PID] screening and observations) and for the collection of samples for the chemical analyses.

Initially, a direct-push boring will be attempted at each location shown on Figure 3. The 4-foot long sampling barrel will be equipped with a mechanism to obtain discrete samples of soil (e.g., a closed-piston Macro-Core™) to ensure maximum recovery and maintain the integrity of the soil interval. If this sampling method does not successfully obtain the required soil samples at a given location, or if the direct-push tools encounter refusal above the target sampling depths, HSA drilling and split-spoon sampling will be used as an alternative. Drilling equipment (rods and macro-core sampler) will be decontaminated between each sample location. Soil cuttings and decontamination fluids will be collected in 55-gallon United States Department of Transportation (U.S. DOT)-approved steel drums for temporary on-site storage, testing, and ultimate disposal by National Fuel Gas.

The soil samples obtained by either method will be logged by a geologist who will record the following:

- The presence of fill material or subsurface structures;
- The nature of each geologic unit encountered;
- Observations regarding moisture content;
- The results of PID readings; and
- Visual and olfactory observations regarding the presence of MGP-related residuals or other impacts.

It is anticipated that one sample for laboratory analyses will be collected from each boring. Samples will be collected from the most apparently impacted intervals based on PID screening and field observations. If free-phase NAPL is encountered, a sample of the associated soil will

NOT be collected for laboratory analysis. The limits of the NAPL will be noted in the boring log, and a laboratory sample will be obtained from the first soil interval below the impacted zone which does not exhibit apparent contamination. If impacts are not encountered, a sample will be collected from the 1-foot interval immediately below the water table, and possibly a second sample from the bottom of the boring to confirm “non-impacted” conditions. Samples will be collected into laboratory-preserved bottles, chilled with ice, and submitted to the laboratory under chain-of-custody (COC) as described in the SOPs and QAPP (Appendix C and D, respectively). Each soil sample will be sampled for:

- VOCs by U.S. EPA Method 8260B + 10 TICs;
- SVOCs by U.S. EPA Method 8270C mod + 20 TICs;
- TAL metals by U.S. EPA Method 6000/ 7000 series;
- Total cyanide by U.S. EPA Method 9012B; and
- Free cyanide by U.S. EPA Method 9013 extraction and micro-diffusion analysis ASTM Method D-4282-02.

Soil borings will terminate at approximately 30 feet below grade. If impacts are observed close to 30 feet below grade, the boring will be advanced approximately 5 feet beyond observed visual impacts for the purpose of vertical delineation. If the base of the impacted zone is still not reached, drilling will continue until apparent clean conditions are observed. If dense non-aqueous phase liquid (DNAPL) is encountered, potential remobilization and downward migration will be limited by following the NAPL Contingency Plan (Appendix E).

Following the collection of subsurface soil samples, each subsurface soil boring will be abandoned by tremie grouting the boring from the bottom of the boring to the ground surface. The area around the soil borings will be restored as necessary.

Each sampling implement will be decontaminated in accordance with decontamination procedures described in the SOPs (Appendix C). QA/QC procedures are detailed within the QAPP located in Appendix D. QA/QC samples will include blind duplicate soil samples, matrix spike/matrix spike duplicate (MS/MSD) samples, and equipment rinsate blank samples. The QC samples will be completed at a frequency of one set of samples for each 20 field samples. An approved New York State Environmental Laboratory Approval Program (ELAP) laboratory will perform the analyses. One trip blank will be included per shipment of samples to the laboratory.

4.3.4 Monitoring Well Installation

Four permanent monitoring wells (MW1 though MW4) will be installed as part of the SC activities. Additional wells, including an upgradient well, may be installed during the SC if necessary to help define the extent of any NAPL or groundwater impact. The monitoring well locations are shown in Figure 3. Installation of permanent monitoring wells will allow determination of groundwater flow directions and will allow subsequent rounds of groundwater sampling to be performed if necessary. Each monitoring well will be installed in general accordance with procedures described below and within the SOPs (Appendix C).

The boring for each monitoring well will be drilled using 4 ¼-inch I.D. HSAs. Each well will be constructed as a water table monitoring well using a 2-inch inner diameter Schedule 40 PVC flush-joint threaded riser with 10-foot long, 0.020-inch slotted screened section and a 2-foot long DNAPL sump. Note, however, that actual well depth and construction will depend on site conditions encountered, such as thickness of the saturated zone, observed stratigraphy, and the presence, location, and thickness of NAPL, if any. Chemically inert silica sand will be backfilled to 1 to 2 feet above the top of the screen. A bentonite seal will be placed above the screen and sand pack. Where possible, the bentonite seal will be a minimum of 24-inches thick, except in those instances where the top of the well screen is in close proximity to the ground surface. The remainder of the annular space will be filled with a bentonite cement grout up to the ground surface. The grout will be tremied from the bottom up to the top. The grout will be allowed to set for a minimum of 48 hours prior to developing the monitoring wells. The top of the casing will be finished using flush-mount casings with keyed-alike locks. A concrete surface pad will be sloped to channel water away from the well casing. Final well locations and construction details will be discussed with the NYSDEC as the fieldwork progresses.

The monitoring wells will be surveyed for location and elevation of the reference point on the well casing.

4.3.5 Air Monitoring

A Community Air Monitoring Program (CAMP) will be implemented at the site during intrusive field activities. VOCs and respirable particulates (PM-10) will be monitored upwind and downwind of each soil boring or monitoring well location on a continuous basis. When working within 20 feet of an occupied structure (such as the Comfort Inn), additional monitoring measures will be performed as specified by NYSDOH guidance (which has been incorporated into the site-specific CAMP for this project). Work zone air monitoring will be performed by GEI for VOCs, as required by the HASP. Work will be stopped if the threshold for any analyte is exceeded due to site-related activities. The site health and safety officer will assess the site conditions and monitoring results and will take any corrective actions needed to bring the air quality into compliance with the CAMP or HASP. If corrective measures cannot achieve the air quality targets, the work will be stopped and the Project Manager and National Fuel Gas will be notified. The equipment will be calibrated at least daily or in accordance with manufacturers' recommendations. The proposed CAMP is presented in Appendix A, and additional monitoring details are included in the HASP in Appendix B.

Odor monitoring will be performed during the excavation of the test pits and the subsurface soil boring tasks. If odors are observed, BioSolve™ or equivalent will be used to suppress the odors. Other controls such as covering excavated soil with plastic may be used as necessary.

4.3.6 Waste Disposal Sampling

Two representative samples of the IDW will be collected from the waste containers during the investigation and analyzed for full Resource Conservation and Recovery Act (RCRA) Hazardous Characteristics testing for waste profiling purposes. One sample will be obtained from the liquid wastes, and one from the solid wastes. Samples will be collected into laboratory-preserved bottles, chilled with ice, and submitted to the laboratory under COC as described in the SOPs and QAPP (Appendix C and D, respectively). Each disposal sample media will be sampled for parameters to meet the requirements of the approved disposal facilities. The anticipated analyses to be performed include the following; however, the final list of analyses may be modified depending on the waste facility requirements:

- TCLP ZHE Extraction – U.S. EPA Method 1311;
- TCLP VOC – U.S. EPA Method 8260B;
- TCLP SVOC – U.S. EPA Method 8270C;
- TCLP ICP Metals – U.S. EPA Method 6010B (Mercury 7470A);
- Corrosivity – U.S. EPA SW-846 Chapter 7;
- Ignitability – U.S. EPA SW-846 Method 1010;
- Reactive Cyanide – U.S. EPA SW-846 Chapter 7; and
- Reactive Sulfide – U.S. EPA SW-846 Chapter 7.

4.3.7 Well Development

Each of the new monitoring wells will be developed not sooner than 48 hours after their installation to evacuate fine-grained sediments that may have accumulated within the well during installation.

Development of the newly installed monitoring wells will be performed by alternately surging and pumping for a maximum of 1 hour, or until the turbidity of the development water is less than 50 nephelometric turbidity units (NTUs), or until a maximum of 10 well volumes have been removed in accordance with the SOPs (Appendix C). A field turbidity meter will be used to monitor NTU levels. Groundwater sampling will not be completed for at least two weeks following the development of the permanent monitoring wells in order to allow groundwater conditions in the surrounding formation to stabilize.

4.3.8 Groundwater Sampling

The monitoring wells will be sampled at a minimum of two weeks following completion of development. Prior to sampling, a synoptic round of groundwater level measurements will be recorded for each of the monitoring wells. If the monitoring wells from the 1990 Phase II investigation are found to be present and usable, they will also be included in the groundwater gauging event.

Each newly installed monitoring well, and any previous Phase II monitoring wells located, will be purged and sampled utilizing low flow groundwater sampling procedures. Samples will be collected when measured field parameters have stabilized according to the requirements in the SOPs (Appendix C). Samples will be collected into laboratory-preserved bottles, chilled with ice, and submitted to the laboratory under COC as described in the SOPs and QAPP (Appendix C and D, respectively).

Each well will be sampled for:

- VOCs by U.S. EPA Method 8260B;
- SVOCs by U.S. EPA Method 8270C mod;
- TAL metals by U.S. EPA Method 6000/ 7000 series;
- Total cyanide by U.S. EPA Method 9012B; and
- Free cyanide by ASTM Method D-4282-02.

If NAPL accumulation is present in a well, then no groundwater sample will be collected for laboratory analysis. If NAPL is found to accumulate in a well, then the NAPL will be bailed or pumped from the well, the volume of tar will be recorded, and the recovery rate of the NAPL will be assessed through periodic measurements with an oil/water interface probe. If present, a sample of the accumulated light non-aqueous phase liquid (LNAPL) or DNAPL may be analyzed for hydrocarbon fingerprinting and/or disposal characteristics if requested by National Fuel Gas. All NAPL removed from a well will be containerized for disposal. DNAPL measurements will be collected immediately following the removal of the DNAPL from a well, within 1 hour, and at the end of the sampling event before demobilization from the site.

QA/QC procedures are detailed within the QAPP located in Appendix D. QA/QC samples will include one blind duplicate groundwater sample, a MS/MSD sample, and an equipment rinsate blank sample. An approved New York State ELAP laboratory will perform the analyses. One trip blank for VOC analysis will be included per shipment of samples to the laboratory.

4.3.9 Soil Vapor Intrusion Evaluation

The SC will include a preliminary evaluation of soil vapor intrusion potential at the Comfort Inn. This evaluation will include collection and analysis of one sub-slab soil vapor sample, one indoor air sample, and one ambient air sample. The collection and analysis of these samples will be performed according to current NYSDOH and NYSDEC guidelines. These procedures are described in GEI SOPs SG-001 (General Guidance), -002 (Soil Vapor Sample Collection), -003 (Sub-slab Soil Vapor Collection), and -004 (Ambient Air Sample Collection), provided in Appendix C. The samples will be analyzed for U.S. EPA TO-15 compound list plus six additional compounds which can be used as MGP indicators. This work will be performed during the site visit for groundwater sampling rather than during the primary mobilization, so that the building heating system will be operating during the time of the sampling.

4.3.10 Site Restoration

The subsurface investigation activities will, to the extent possible, work within unpaved areas at the site. It is presumed that these areas will require a limited amount of landscaping and seeding following completion of the SC fieldwork. Asphalt will be patched in those areas that will be investigated in paved areas. Site restoration will be conducted during the mobilization to the site for groundwater sampling and surveying.

4.4 Qualitative Human Health Exposure Assessment

In accordance with direction provided by the NYSDEC, a qualitative human health exposure assessment will be prepared. This assessment will generally follow the guidelines provided in the "*New York State Department of Health Qualitative Human Health Exposure Assessment (Appendix 3B to NYSDEC's May 2010 DER-10 Technical Guidance for Site Investigation and Remediation*)." In general, the assessment will identify the exposure setting, identify exposure pathways, and will evaluate the fate and transport of the contaminants. The assessment will include text discussions, tables, and graphics depicting the potential exposure pathways. The qualitative assessment will identify potential exposures for specific potential receptors based on complete pathways of exposure to contaminant levels exceeding default "screening criteria," such as the NYSDEC-recommended soil cleanup objectives (RSCOs) and drinking water standards. The assessment will be used to render an opinion as to whether potential complete exposure pathway(s) and/or risk exist for potential receptors.

4.5 Survey and Sample Point Location

Each of the completed SC sample locations including the test pits, surface soil samples, soil boring locations and the monitoring wells, will be surveyed by a qualified New York State Licensed Land Surveyor. The elevation of each monitoring well will be determined to ±0.01 foot. All horizontal locations will be referenced to the appropriate New York State Plane NAD83 coordinate system and all vertical data to the North American Vertical Datum (NAVD 88), per NYSDEC requirements. The results of the survey will be used by GEI to create a base map for the site.

4.6 Decontamination

Drilling equipment (i.e., drilling rods, auger, casing, samplers) will be decontaminated between each sample location. The decontamination will be performed on a decontamination pad which will be constructed at the beginning of the field activities. All decontamination wash-water will be containerized in a bulk storage tank or 55-gallon U.S. DOT-approved drums.

Sampling equipment used for sample collection (e.g., stainless steel split spoons, sample spoons, and hand trowels) will be decontaminated prior to use and reuse, or disposable sampling equipment will be used. All decontamination liquids will be collected and contained in 55-

gallon U.S. DOT-approved steel drums for temporary on-site storage and ultimate disposal by National Fuel Gas.

4.7 IDW Management

Soil cuttings and fluids generated during the installation of soil borings and monitoring wells will be collected in a bulk water tank, or in 55-gallon U.S. DOT-approved drums and transported to a temporary waste storage area on the site in preparation for disposal by National Fuel Gas (see SOPs in Appendix C).

National Fuel Gas will arrange for disposal of the IDW. GEI will support this process by properly labeling and storing all waste containers, by collecting and analyzing two waste profile samples, and assisting National Fuel Gas in the profiling of the waste materials for disposal. GEI may provide other support services if requested by National Fuel Gas.

4.8 QA/QC and Data Validation

An approved New York State ELAP laboratory will provide New York State Category B data deliverables. The data will be validated in accordance with New York State Analytical Service Protocols (NYSASP) protocols, dated July 2005. The data validator will prepare a Data Usability Summary Report (DUSR) summarizing the adequacy of the analytical data obtained from the laboratory and discussing any pertinent data excursions or limitations on the use of the data. The DUSR will be submitted along with SC data. The QAPP is located in Appendix D.

Through the use of standardized sample collection and decontamination procedures, the quality of the samples during field collection can be assured. The data validation process will ensure that the data collected and reported by the laboratory are of sufficient quality that management decisions regarding the degree and extent of potential impacts can be reliably made. The data validation will evaluate whether the required quantitation limit has been achieved for each sample analyzed, and will evaluate the precision, accuracy, and completeness of the data. The data validator will use the duplicate samples, the MS/MSD samples, the trip blanks, and the equipment rinsate blank samples, as well as laboratory calibration blanks, spikes, and other standards to assess the quality of the data obtained. Any deviations from the required level of sample quality will be called out in the DUSRs prepared by the data validator and these deviations will be taken into consideration when using the data to explain site conditions.

4.9 Other Potential SC Activities

Additional tasks may be recommended if the SC finds that extensive impacts are present at the site. These additional tasks may include forensic analysis or an additional search and review of historical information.

Forensic Analysis

Forensic chemical evaluation or analysis may be called for in the event that the SC finds impacts migrating onto the site from upgradient or other locations. Likewise, if impacts are found on site which are not consistent with known types of MGP-related residuals, forensic analysis may be conducted.

5. SC Report Preparation

In response to NYSDEC’s request to conduct an expedited SC at the Hornell site, a full report will not be prepared at the conclusion of the SC field and analysis program, if it is determined that an RI needs to be completed. Rather, a data report will be prepared for submittal to NYSDEC which will include the following:

- A table summarizing the location, depth, and nature of NAPL impacts, if any, observed in the soil boring and test pits;
- A tabulation of site soil and groundwater analytical data, with comparisons to applicable NYSDEC standards (Unrestricted, Restricted Residential);
- A tabulation of soil vapor, indoor air, and ambient air results, with a comparison to NYSDEC and NYSDOH guidelines;
- Test pit and soil boring logs and monitoring well construction details;
- Figures showing the present and historic site features, soil conditions, and groundwater conditions;
- Geologic cross-sections;
- Site photographs; and
- Recommendations for additional investigation, if warranted.

6. Schedule

National Fuel Gas anticipates that the sampling program can be completed in approximately three weeks of fieldwork, depending on weather, the amount of additional work performed towards the RI, and property access. If the scope of work for the SC field investigation is expanded to perform RI-level delineation activities, then the duration of the fieldwork will expand by an additional amount of time (most likely one to two additional weeks, based on the limited area in which the investigation can be performed under current access agreements.) National Fuel Gas will notify NYSDEC at least seven days prior to the anticipated start date of the site characterization program.

The anticipated order and schedule for the fieldwork is as follows:

- Sample location mark-out for utility clearance (1 week prior to mobilization)
- Test pit excavation and removal of the tar seep (3-4 days)
- Soil boring drilling and monitoring well installation (7-10 days)
- Soil vapor point installation (1 day, performed prior to the groundwater sampling event)
- Soil vapor and air sampling (1 day, performed during the groundwater sampling event)
- Monitoring well development (1 day)
- Groundwater sampling (1 day approximately 2 weeks following well development)
- Analysis of soil, water, and air/soil vapor samples will be performed on a standard turn-around basis. Data validation will be performed on each analytical data set following receipt of the data packages from the laboratory. Data report preparation will be completed following completion of the DUSR and incorporation of the validated analytical results into final data tables and figures.
- Submit draft data report to National Fuel Gas within one month after validation of the laboratory analytical data is complete.
- Submit data report to NYSDEC within two weeks following completion of the review of the report by National Fuel Gas.

Following submittal and review of the data report, a supplemental or RI work plan will be prepared to address any data gaps in the expedited SC field investigation.

7. References

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Beers, D.G., 1873. Atlas of Steuben County, New York, D.G. Beers & Company, Philadelphia.

Browns Directory of American Gas Companies.

Environmental Data Resources (EDR), 2010. EDR environmental database search, June 2010.

New York State Department of Environmental Conservation (NYSDEC), 2010. DER-10 / Technical Guidance for Site Investigation and Remediation. Issued May 3, 2010.

North State Consultants. 1990. Phase II Environmental Site Investigation, Comfort Inn, Hornell, New York. June 1990.

Tables

Table 1
Site History Summary
Hornell Former MGP Site
Hornell, New York

Date	Observation/Activity	Data Source
Unknown	MGP site is constructed and operations begin	
1873	McDougal & Avery Gas Works present at site with gas holder and associated buildings.	Beers Atlas, City Directory
1887	Hornellsville Gas Light Company listed, with the Lowe process (carbureted water gas) as the production method.	Browns
1888	MGP facility at site, Gas Holder A present. Retorts, purifiers, and coal storage shown on site map.	Sanborn, Browns
1889	Gas production method listed as “English” – most likely a carbureted water gas process.	Browns
1890	Gas production output listed at 6,000,000 cubic foot (cf) per year.	Browns
1892	Gas company listed as “Hornell Gas Company” – no report	Browns
1893	Addition shown attached to gas production building. Gas production output listed at 12,000,000 cf per year. Company owned by the estate of the former owner.	Browns
1894-1898	(Gap in GEI Browns directory holdings)	
1898	Addition or re-construction of former coal storage building, now listed for purifiers. Portion of this building listed as a bottling works (beer brewery located immediately north of the MGP). Gas Holder A label as not used. Gas Holder B shown, with a smaller diameter than Holder A. Boiler shown in addition to original MGP building.	Sanborn
1899	Gas production method listed as coal gas.	Browns
1900	Hornell Gas Light Co. is listed as distributing natural gas. No further references to manufactured gas production.	Browns
1904	Holder B shown in same location but with same diameter as Holder A. Holder B labeled as “natural gas”. Retorts and Holder A labeled as “not used”. Site labeled as “Hornell Gas Light Co., not in operation”.	Sanborn
1906	Hornellsville achieves status as a city, changes name to Hornell	On-line reference
1909	Site features unchanged. Holder A noted as having “walls standing 10’ high”.	Sanborn
1915	Site features mostly unchanged. Portions of the MGP building removed. Purifying house labeled as not used. Holder A “walls 4’ high to be removed”.	Sanborn
1926	Gas Holder A no longer shown. Gas Holder shown at eastern side of property, with 500,000 cf capacity. Holder C is constructed with an above-grade tank. Building at southeast side of Holder C – label on figures cannot be read. Regulator house shown on site. Boilers shown in former purifying building and former bottling building; boiler no longer shown in MGP building.	Sanborn, historic photos
1948	Holder B no longer shown. Site labeled as “Empire Gas & Fuel Co. Natural Gas Booster and Purifying Plant”. Purifier building labeled as “booster pumps”. Small portion of former MGP building labeled as “auto repair”. Building labeled as “garage and warehouse” shown upgradient of site to north-northwest.	Sanborn
1954	Site photo shows Holder C no longer present, with a circular pad or foundation still visible at the site. Former MGP and purifier buildings still present.	Historic photo
1961	Holder C no longer shown. Site buildings otherwise still present.	Sanborn
1970s	Two underground storage tanks removed from the vicinity of Holder C – location and conditions not specified.	City of Hornell
1989	Geotechnical borings advanced at the Site for construction of the Comfort Inn hotel.	City of Hornell
1990	Phase II groundwater investigation of proposed Comfort Inn site.	City of Hornell

Notes:
Beers Atlas – D. G. Beers & Co. Atlas of Steuben County, New York, Hornellsville plate
Browns – Browns Directory of American Gas Companies
cf – cubic foot
Sanborn – Sanborn Fire Insurance Map

Table 2
Property Ownership Information
Hornell Former MGP Site
Hornell, New York

On-Site Properties			
	Tax ID 166.06-03-006.100	Parcel Address	Franklin Street
Owner	City Owned		Hornell, NY 14813
		Occupant/Land Use	Residential
	Tax ID 166.06-03-006.200	Parcel Address	1 Canisteo Street
Owner			Hornell, NY 14813
	Maple City Lodging Partnership	Occupant/Land Use	Hotel
Off-Site Properties			
	Tax ID 151.79-01-028.000	Parcel Address	10 Taylor Street
Owner	SERVU Federal Credit Union		Hornell, NY 14813
		Occupant/Land Use	Bank
	Tax ID 151.79-01-033.000	Parcel Address	23 Franklin Street
Owner	Lloyd and Ruth Fischer		Hornell, NY 14813
		Occupant/Land Use	Residential
	Tax ID 151.79-01-034.000	Parcel Address	25 Franklin Street
Owner	Luther and Tina Stevens		Hornell, NY 14813
		Occupant/Land Use	Residential
	Tax ID 166.06-03-005.000	Parcel Address	26 Franklin Street
Owner	James Shutt		Hornell, NY 14813
		Occupant/Land Use	Residential
	Tax ID 166.06-07-047.000	Parcel Address	194 Canisteo Street
Owner	Malcolm A. Lane		Hornell, NY 14813
		Occupant/Land Use	Warehouse
	Tax ID 166.06-03-014.000	Parcel Address	15 Albion Street
Owner	Katherine Loper		Hornell, NY 14813
		Occupant/Land Use	Residential
	Tax ID 166.06-03-015.000	Parcel Address	19 Albion Street
Owner	Joanne Curran		Hornell, NY 14813
		Occupant/Land Use	Residential
	Tax ID 166.06-03-016.000	Parcel Address	21 Albion Street
Owner	Stephen and Shirley Johnson		Hornell, NY 14813
		Occupant/Land Use	Residential
	Tax ID 166.06-03-017.000	Parcel Address	23 Albion Street
Owner	G. Prentice and K. Bailey		Hornell, NY 14813
		Occupant/Land Use	Residential
	Tax ID 166.06-03-018.000	Parcel Address	25 Albion Street
Owner	Kelly and Bret Flint		Hornell, NY 14813
		Occupant/Land Use	Residential

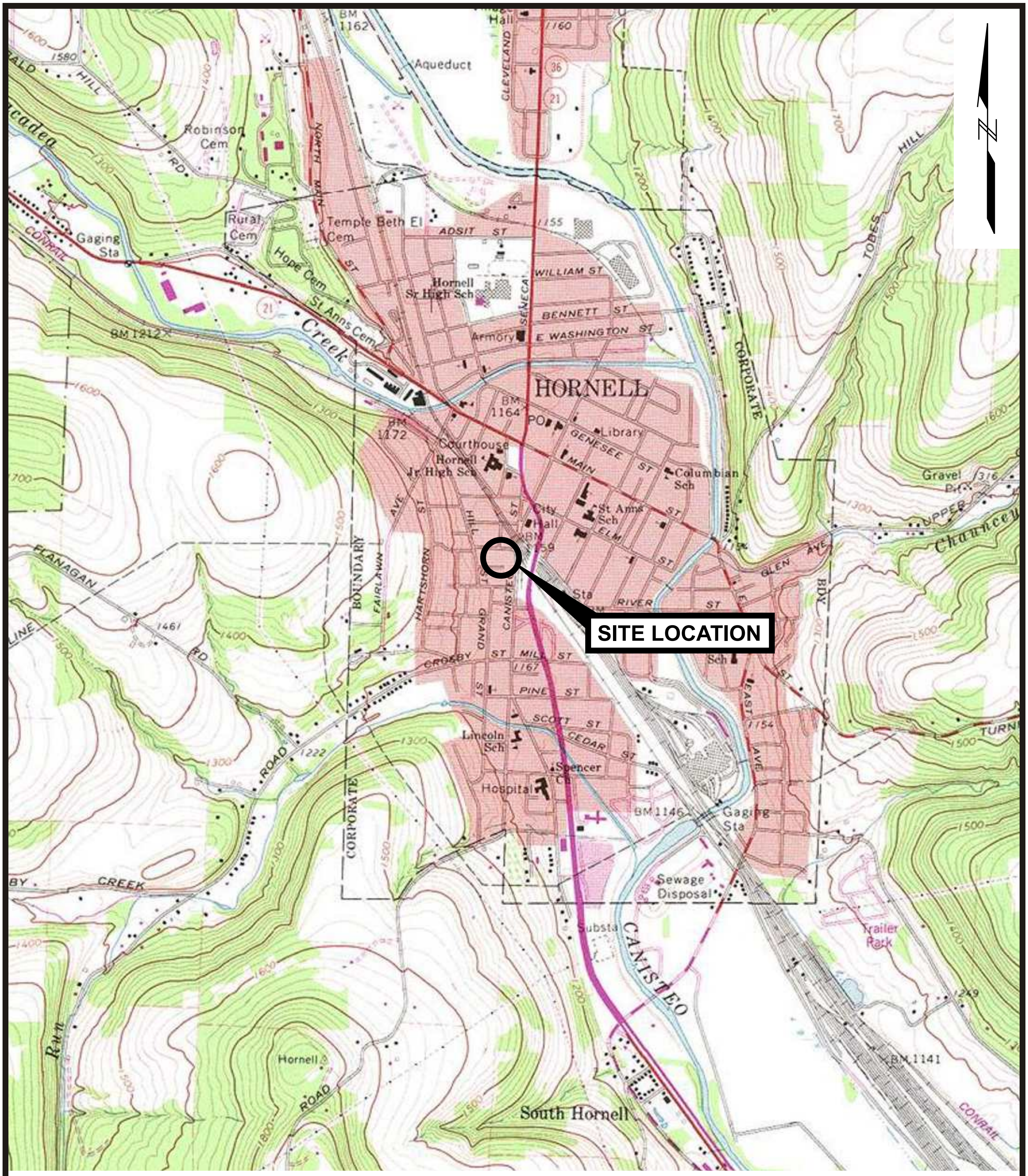
Table 3
Site Characterization Sample Summary and Rationale
Hornell Former MGP Site
Hornell, New York

Type of Sampling	Location	Rationale	Number of Samples	Target Completion Depth	Laboratory Analyses
Soil Sampling					
Test Pit TP-1	Purifier and Retort Building	Evaluate magnitude of impacts and generate soil data	1	10-12 feet bgs	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide Free Cyanide
Test Pit TP-2	Former Gas Holder A	Evaluate magnitude of impacts and generate soil data; determine presence or absence of former feature	1	10-12 feet bgs	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide Free Cyanide
Boring SB1	Former Retort	Evaluate magnitude of impacts from former retort and generate soil data	1	Approx. 30 feet	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide Free Cyanide
Boring SB2	Former Purifier House	Evaluate magnitude of impacts from former purifier house and generate soil data	1	Approx. 30 feet	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide Free Cyanide
Boring SB3	Former Gas Holder A	Evaluate extent of impacts at center of former gas holder	1	Approx. 30 feet	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide Free Cyanide
Boring SB4	Former Large Retort	Evaluate potential impacts within former retort and generate soil data	1	Approx. 30 feet	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide Free Cyanide
Boring SB5	Former Gas Holder B	Evaluate extent of impacts at center of former gas holder	1	Approx. 30 feet	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide free Cyanide
Boring SB6	Former Gas Holder C	Evaluate extent of impacts at center of former gas holder	1	Approx. 30 feet	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide free Cyanide
Well MW1	Adjacent to Former Purifier House	Screen for potential impacts downgradient of former purifier house and retorts	1	Approx. 30 feet	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide Free Cyanide
Well MW2	Adjacent to Former Gas Holder B	Screen for potential impacts downgradient of former gas holder	1	Approx. 30 feet	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide Free Cyanide
Well MW3	Adjacent to Former Gas Holder C	Screen for potential impacts downgradient of former large gas holder	1	Approx. 30 feet	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide Free Cyanide
Well MW4	Upgradient of Hotel	Screen for potential impacts upgradient of potential receptor	1	Approx. 30 feet	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide Free Cyanide

Table 3
Site Characterization Sample Summary and Rationale
Hornell Former MGP Site
Hornell, New York

Type of Sampling	Location	Rationale	Number of Samples	Target Completion Depth	Laboratory Analyses
Groundwater Sampling					
MW1	Center of Screened Interval	To assess shallow groundwater conditions adjacent to former MGP site feature	1	~25 feet bgs	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide Free Cyanide
MW2	Center of Screened Interval	To assess shallow groundwater conditions adjacent to former MGP site feature	1	~25 feet bgs	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide Free Cyanide
MW3	Center of Screened Interval	To assess shallow groundwater conditions adjacent to former MGP site feature	1	~25 feet bgs	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide Free Cyanide
MW4	Center of Screened Interval	To assess shallow groundwater conditions downgradient of former site features	1	~25 feet bgs	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide Free Cyanide
Soil Vapor/Air Sampling					
SV1	Sub-Slab Soil Vapor Sample	Sample at Comfort Inn to analyze potential migration pathways	1	1 foot bgs	VOCs by U.S. EPA Method TO-15+6 Helium by ASTM Method D-1945
IA1	Indoor Air Sample	Sample at Comfort Inn to analyze potential migration pathways	1	3 feet above floor	VOCs by U.S. EPA Method TO-15+6 Helium by ASTM Method D-1945
AA1	Ambient Air Sample	Sample at Comfort Inn to analyze potential migration pathways	1	3-4 feet above ground level	VOCs by U.S. EPA Method TO-15+6 Helium by ASTM Method D-1945

Figures



SOURCE: Map created with TOPO! ® ©2001 National Geographic
(www.nationalgeographic.com/topo)

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SCALE, FEET

SITE CHARACTERIZATION WORK PLAN
HORNELL FORMER MGP SITE
HORNELL, NEW YORK

NATIONAL FUEL GAS DISTRIBUTION COMPANY

GEI Consultants

Project 102260

SITE LOCATION MAP

September 2010

Figure 1

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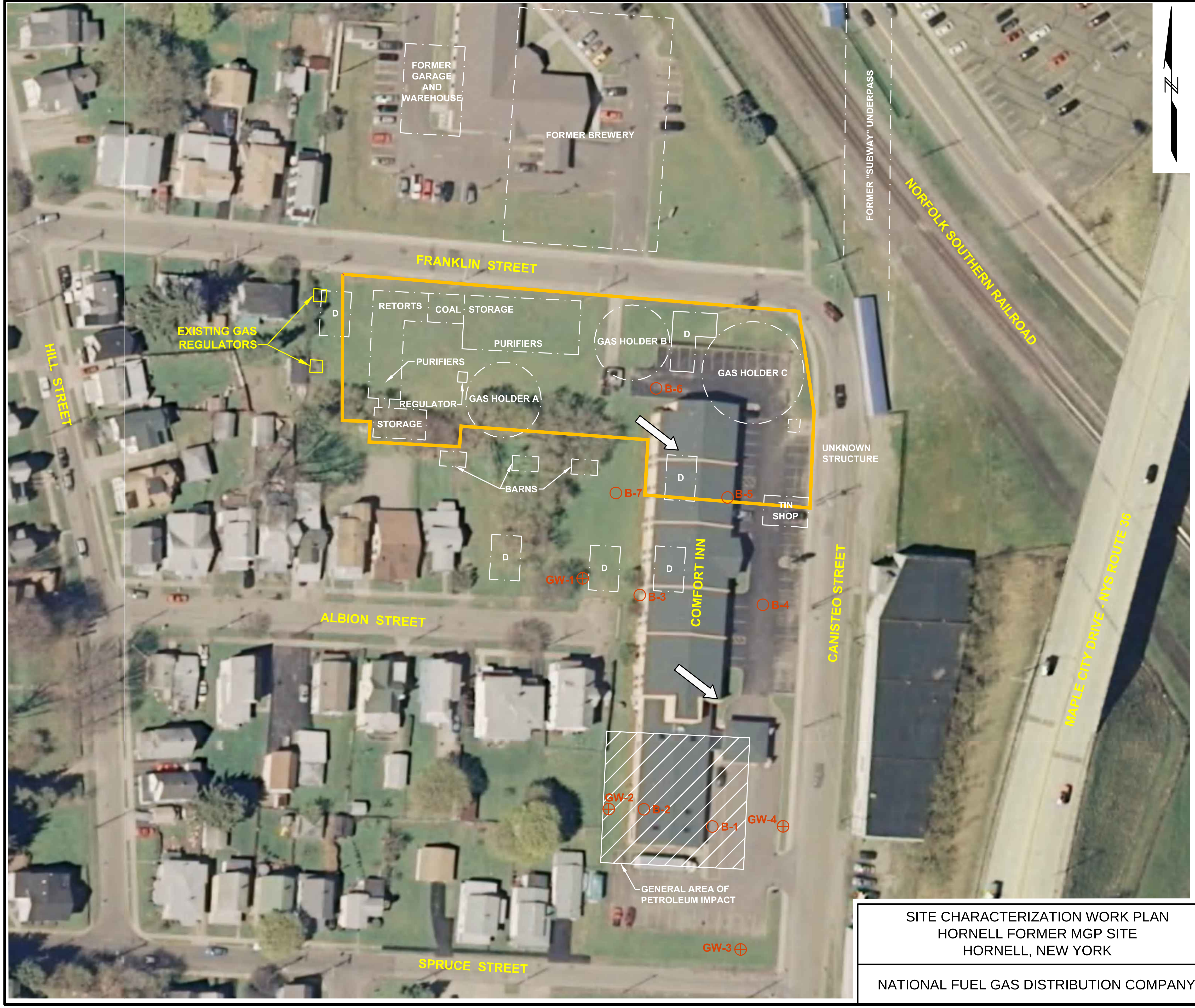

LEGEND

▬	CURRENT SITE BOUNDARY LINE
— · — · —	APPROXIMATE LOCATION OF HISTORICAL STRUCTURES
D	RESIDENTIAL DWELLING

PREVIOUS INVESTIGATION SAMPLES

⊕ GW-1	FORMER MONITORING WELL LOCATION
○ B-1	FORMER SOIL BORING LOCATION
⇨	INFERRED GROUNDWATER FLOW DIRECTION
▨	GENERAL AREA OF FORMER UNDERGROUND STORAGE TANKS

0 80 160

SCALE, FEET

SOURCES:

1. Orthophoto obtained from New York State Interactive Mapping Gateway (http://www1.nysgis.state.ny.us/MainMap.cfm) photo date: 2007, accessed on June 11, 2010.
2. Sanborn Fire Insurance Maps from 1888 to 1961.

SITE CHARACTERIZATION WORK PLAN
HORNELL FORMER MGP SITE
HORNELL, NEW YORK

NATIONAL FUEL GAS DISTRIBUTION COMPANY

GEI Consultants

Project 102260

SITE LAYOUT AND PREVIOUS FINDINGS

September 2010

Figure 2

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LEGEND

━	CURRENT SITE BOUNDARY LINE
— · — · —	APPROXIMATE LOCATION OF HISTORICAL STRUCTURES

PROPOSED REMEDIAL INVESTIGATION SAMPLES

⊕ MW1	PROPOSED MONITORING WELL LOCATION
● B1	PROPOSED SOIL BORING LOCATION
▬ TP1	PROPOSED TEST PIT LOCATION
⬡ IA-1	PROPOSED INDOOR AIR SAMPLE LOCATION
△ AA-1	PROPOSED AMBIENT AIR SAMPLE LOCATION
⊙ SV-1	PROPOSED SOIL VAPOR SAMPLE LOCATION
⊕ GW-1	FORMER MONITORING WELL LOCATION
○ B-1	FORMER SOIL BORING LOCATION

SOURCES:

1. Orthophoto obtained from New York State Interactive Mapping Gateway (http://www1.nysgis.state.ny.us/MainMap.cfm) photo date: 2007, accessed on June 11, 2010.
2. Sanborn Fire Insurance Maps from 1888 to 1961.

SITE CHARACTERIZATION WORK PLAN
HORNELL FORMER MGP SITE
HORNELL, NEW YORK

NATIONAL FUEL GAS DISTRIBUTION COMPANY

GEI Consultants

Project 102260

PROPOSED SITE CHARACTERIZATION SAMPLING LOCATIONS

September 2010

Figure 3

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Appendix A

Community Air Monitoring Plan

Community Air Monitoring Plan
Hornell Former MGP Site

In accordance with NYSDEC and NYSDOH requirements for a Community Air Monitoring Plan (CAMP), a perimeter air monitoring plan will be implemented at the site during each phase of the field activities. The objective of the perimeter air-monitoring plan 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 involved with the site field activities) from potential airborne contaminant releases as a direct result of field activities. The perimeter air monitoring plan is a stand-alone document and will be available on site. The VOC and particulate Monitoring, Response Levels, and Actions are presented as follows.

Air Monitoring Response Levels and Actions

VOCs	
Response Level	**Actions**
>5 ppm above background for 15-minute average	▪ Temporarily halt work activities ▪ Continue monitoring ▪ If VOC levels decrease (per instantaneous readings) below 5 ppm over background, work activities can resume
Persistent levels >5 ppm over background <25 ppm	▪ Halt work activities ▪ Identify source of vapors ▪ Corrective action to abate emissions ▪ Continue monitoring ▪ Resume work activities if VOC levels 200 feet downwind of the property boundary or half the distance to the nearest potential receptor is <5 ppm for a 15-minute average ▪ If VOC levels are >25 ppm at the perimeter of the work area, activities must be shutdown
Particulates	
>100 µg/m^3 above background for 15-minute average or visual dust observed leaving the site	▪ Apply dust suppression ▪ Continue monitoring ▪ Continue work if downwind PM-10 particulate levels are <150 µg/m^3 above upwind levels and no visual dust leaving site
>150 µg/m^3 above background for 15-minute average	▪ Stop work ▪ Re-evaluate activities ▪ Continue monitoring ▪ Continue work if downwind PM-10 particulate levels are <150 µg/m^3 above upwind levels and no visual dust leaving site

Sources:

- NYSDOH Community Air Monitoring Plan, December 2009, as published in NYSDEC DER-10, Appendix 1A, 2010.
- NYSDOH Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures.
- Fugitive Dust and Particulate Monitoring, NYSDEC DER-10, Appendix 1B, 2010.

Notes:

ppm = parts per million.
µg/m^3 = microgram per cubic meter

During drilling, excavating, and materials handling operations, the air in work areas will also be sampled periodically for the presence of contaminants. A portable photoionization detector (PID) will be utilized to periodically monitor the levels of organic vapors in the ambient air and a Mini RAM^{TM} PM-10 (or equivalent) particle detector will be used to count inhalable particles (0.1-10 micrometer range) of dust during the fieldwork. PID and Mini RAM readings will be taken hourly during excavation or more frequently if air quality measurements approach action levels as defined herein. Measurements will be monitored from the breathing zone (4 to 5 feet above ground level) at worker locations to determine working conditions (and whether there is a need to change levels of worker protection).

In order to make a conservative assessment of when different levels of respiratory protection are needed during the fieldwork, it will be assumed that the organic vapors detected by the air monitoring instruments consist of the most toxic volatile compounds expected to be found on the site. Preliminary evaluation of the risks expected at the site indicates that the most toxic volatiles that are probably present are VOCs (particularly benzene, toluene, ethylbenzene, and xylenes [BTEX]). Based on data published by the Occupational Safety and Health Administration (OSHA) and the American Conference of Government Industrial Hygienists (ACGIH), and GEI's experience with MGP wastes, the following personal protective equipment (PPE) will be employed when the given concentrations of organic vapor are detected in the breathing zone.

Compound of Concern	Level D	Level C	Level B
Total photoionizable VOCs	<5 ppm	>5 and <50 ppm	>50 ppm

The PPE requirements may be modified based on compound-specific monitoring results information, with the written approval of the Corporate Health and Safety Specialist (CHSS).

Respiratory protection from dusts will be required when inhalable particulate concentrations from potentially contaminated sources exceed 150 µg/m^3.

Odors or dusts derived from site contaminants may cause nausea in some site workers, even though the contaminants are at levels well below the safety limits as defined above. Workers may use dust masks or respirators to mitigate nuisance odors with the approval of the SSO.

Whenever practical, work areas should be positioned upwind of organic vapor and dust sources to reduce the potential for worker exposure.

Community Air Monitoring Daily Data Sheet

Date:

Site: Hornell MGP Site Characterization

Project Number: 102260

Weather:

Monitoring Start Time:

End Time:

Monitoring Station Location	Time (24 hour)	CAMP PID (ppm)	CAMP Particulate (mg/m3)	Wind Direction	Work Zone PID (ppm)	Work Zone Particulate (mg/m3)	Activity	Comments

Notes:

INSTRUMENT INFORMATION **Time** **Span and Agent**

PID Model: **Serial Number:** **Calibration:**

PID Model: **Serial Number:** **Calibration:**

Dust meter model: **Serial Number:** **Calibration:**

Dust meter model: **Serial Number:** **Calibration:**

Notes for Map on Reverse Side:

Circle Work Area. Show start and end times if there are multiple work areas.

➚ wind direction	**U** Upwind Station	**D** Downwind Station

Monitoring Completed By (print and sign):

N
TAR SEEP
FRANKLIN STREET
SB1
SB4
TP1
SB5
TP2
SB6
SB2
B-6
SB3
MW3
MW1
MW2
B-7
B-5
IA-1
AA-1
SV-1
MW4
GW-1
B-3
COMFORT INN
B-4
CANISTEO STREET
ALBION STREET

Appendix B

Health and Safety Plan

Health and Safety Plan
HORNELL FORMER MANUFACTURED GAS PLANT SITE
HORNELL, NEW YORK

Submitted To:
National Fuel Gas Distribution Corporation

Submitted By:

GEI Consultants, Inc.
1301 Trumansburg Road, Suite N
Ithaca, New York 14850

September 2010

Project No
102260

Bruce Coulombe

Bruce Coulombe
Project Manager

Table of Contents

Abbreviations and Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
ACM	Asbestos containing material
ANSI	American National Standards Institute
BTEX	Benzene, Toluene, Ethylbenzene, Total Xylenes
CHSO	Corporate Health and Safety Officer
CMS	Chip Measurement System
CNS	Central Nervous System
COC	Constituents of Concern
CRZ	Contamination Reduction Zone
CTPV	Coal Tar Pitch Volatiles
EZ	Exclusion Zone
FID	Flame Ionization Detector
GEI	GEI Consultants, Inc.
HASP	Health and Safety Plan
HEPA	High Efficiency Particulate
LEL	Lower Explosive Limit
MGP	Manufactured Gas Plant
MSDS	Material Safety Data Sheet
NAPL	Non-aqueous Phase Liquid
NYSDEC	New York State Department of Environmental Conservation
OSHA	Occupational Safety and Health Administration
PAHs	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated bipenyls
PEL	Permissible Exposure Level
PID	Photoionization Detector
PM	Project Manager
PPE	Personal Protective Equipment
SPF	Sun Protection Factor
SSO	Site Safety Officer
SVOC	Semivolatile Organic Compound
SZ	Support Zone
VOC	Volatile Organic Compounds
WNV	West Nile Virus

1.0 Background Information

1.1 General

Consultant	GEI Consultants, Inc. (GEI) 1301 Trumansburg Road, Suite N Ithaca, New York 14850
Project Name	National Fuel Gas Distribution Corporation (National Fuel) Hornell Former Manufactured Gas Plant (MGP) Site Hornell, New York

This Health and Safety Plan (HASP) establishes policies and procedures to protect GEI personnel from the potential hazards posed by the activities at the Hornell former MGP Site. Reading of the HASP is required of all onsite GEI personnel and GEI subcontractors. All subcontractors will prepare their own site-specific HASP and may use this as a guide. The plan identifies measures to minimize accidents and injuries, which may result from project activities or during adverse weather conditions. This project is conducted under the oversight of the New York State Department of Environmental Conservation (NYSDEC).

1.2 Project Description

This HASP addresses all general activities listed below:

<u>Mobilization/Demobilization</u>
- Mobilization/Demobilization of Equipment and Supplies
- Establishment of Site Security, Work Zones and Staging Areas

<u>Pre- Site Characterization Action Activities</u>
- Location of all utilities to and from the Site

<u>Site Characterization Activities</u>
- Well Survey
- Surface Soil Observations and Sample Collection
- Test Pit Excavation and Sample Collection
- Soil Boring Installation and Sample Collection
- Monitoring Well Installation
- Monitoring Well Development
- Groundwater Sampling
- Soil Vapor Intrusion Evaluation
- Air Monitoring

Post-Site Characterization Activities

- Survey
- Decontamination and Investigation-Derived Waste Management
- Site Restoration

1.3 Site Description

The Hornell Former Manufactured Gas Plant Site is located at the corner of Canisteo and Franklin Streets at the southwest side of the downtown area of Hornell. The site location is depicted on Figure 1. The Site is on the border between the modern and historic commercial/industrial area and a residential area.

The eastern third of the Site is currently developed as part of the Comfort Inn Hotel, with a portion of the building and parking areas present on the property. The central and western portion of the Site is a grassy vacant lot. A line of trees is found along the southern property line which borders residential backyards. The site is generally flat-lying and does not appear to have any surface water features present.

To the north and east across Franklin and Canisteo Streets, respectively, the Site is bordered by commercial properties. Single-family residential properties are found to the northwest, and directly bordering the Site to the west and south sides. Approximately 120 feet to the northeast of the Site is the active Norfolk Southern railroad line.

2.0 Statement of Safety and Health Policy

GEI is committed to providing a safe and healthy work environment for its employees. To maintain a safe work environment, GEI has established an organizational structure and a Corporate Health and Safety Program to promote the following objectives:

- Reduce the risk of injury, illness, and loss of life to GEI employees.
- Maintain compliance with federal, state, and other applicable safety regulations; and minimize GEI employees’ work exposure to potential physical, chemical, biological, and radiological hazards.

3.0 Hazard/Risk Analysis

Physical hazards associated with heavy equipment and demolition operations are present. The heavy equipment associated with this project will include demolition and material removal equipment. Some of the hazards associated with this equipment include crushing of limbs, slipping, tripping, or falling, and heavy lifting.

The Contractor should verify that all electric, gas, water, steam, sewer, and other services lines should be shut off, capped, or otherwise controlled, at or outside the building before demolition work is started. In each case, any utility company that is involved should be notified in advance by the Contractor, and its approval or services, if necessary, shall be obtained.

Smoking is prohibited at or in the vicinity of hazardous operations or materials. Where smoking is permitted, safe receptacles shall be provided for smoking materials. The hazards for this operation are listed in the following Activity Hazard Analysis and Site Hazards sections.

3.1 Personal Safety

Field activities have the potential to take site workers into areas which may pose a risk to personal safety. The following websites (sources) have been researched to identify potential crime activity in the area of the project:

- www.crimereports.com
- www.cityrating.com/crimestatistics.asp
- www.crimemapping.com

Hornell, New York is not listed on the Crime Reports or City Rating websites.

To protect yourself, take the following precautions:

- Use the buddy system (teams of a minimum of two persons present);
- Let the Site Safety Officer (SSO) know when you begin work in these areas and when you leave;
- Call in regularly;
- Pay attention to what is going on around you; and
- If you arrive in an area and it does not look safe to get out of your vehicle, lock the doors and drive off quickly but safely.

Site workers must not knowingly enter into a situation where there is the potential for physical and violent behaviors to occur. If site workers encounter hostile individuals or a confrontation develops in the work area, suspend work activities, immediately leave the area of concern, and contact local 911 for assistance. Notify the SSO and Corporate Health and Safety Officer (CHSO) of any incidents once you are out of potential danger.

In the event of an emergency, prompt communications with local emergency responders is essential. At least one charged and otherwise functioning cell phone to facilitate emergency communications will be on site. Confirmation of cellular phone operation and site worker safety will be confirmed at the start, mid-point, and near the end of each working day.

3.2 Activity Hazard Analysis

The potential hazards for this project have been categorized into site and activity hazards. Site hazards are those hazards associated with site conditions, and activity hazards are associated with GEI on-site activities. The potential hazards and control measures established to reduce the risk of injury or illness are identified in the following tables. Safe operating procedures established for routine hazards and common site conditions are included in the table below, or contained in the GEI Corporate Health and Safety Manual.

3.2.1 Activity Hazard Analysis Table

SITE HAZARDS	
Potential Hazard	**Control Measures**
Construction Safety	▪ Identify yourself and your work location to heavy equipment operators, so they may incorporate you into their operations. Coordinate hand signals with operators. ▪ Stay Alert! Pay attention to equipment backup alarms and swing radii. ▪ Wear a high visibility vest when working near equipment or motor vehicle traffic. ▪ Position yourself in a safe location when filling out logs and talking with the contractor. ▪ Notify the contractor immediately if any problems arise. ▪ Do not stand or sit under suspended loads or near any pressurized equipment lines. ▪ Do not operate cellular telephones in the vicinity of heavy equipment operation.
Physical Injury	▪ Wear work boots in good condition with non-slip soles. ▪ Maintain good visibility of the work area. ▪ Avoid walking on uneven or debris ridden ground surfaces.
Noise	▪ Wear hearing protection when near loud noises. ▪ Wear hearing protection whenever you need to raise your voice above normal conversational speech due to a loud noise source; this much noise indicates the need for protection.
Heat Stress	▪ Increase water intake while working. ▪ Increase number of rest breaks and/or rotate workers in shorter work shifts. Rest in cool, dry areas. ▪ Watch for signs and symptoms of heat exhaustion and fatigue. ▪ In the event of heat stroke, bring the victim to a cool environment, call for help, and initiate first aid procedures. ▪ See Heat Stress Guidelines in Appendix C.
Vehicular Traffic	▪ Wear traffic safety vest at all times. ▪ Use cones, flags, barricades, and caution tape to define work area. ▪ Use a "spotter" to locate oncoming vehicles. ▪ Use vehicle to block work area. ▪ Engage police detail if needed.
Utilities	▪ Check that contractor has cleared underground utilities before any intrusive activities, and that contractor has coordinate with utility locating services, property owner(s) or utility companies (see Utility Clearance Documentation in Appendix E). ▪ Utilities are to be considered live or active until documented otherwise. ▪ For overhead utilities within 50 feet, have contractor determine with the utility company the appropriate safe distance. Minimum distance for clearance is based on voltage of the line. ▪ An observer will be established when operating drilling rigs near overhead utilities.

ACTIVITY HAZARDS		
Activity	**Potential Hazards**	**Protective Equipment / Controls**
Entering Construction Site	Heavy equipment, dust, noise.	Hardhat, orange safety vest, steel-toed, steel-shank boots, safety glasses, nitrile/neoprene gloves, and earplugs.
Drilling	Heavy equipment, dust, noise.	In addition to the PPE listed above for "Entering Construction Site:" hearing protection (ear plugs or ear muffs).
Test Pit Installation and Sample Collection	Heavy Equipment / Proximity to Heavy Equipment	Distancing, safe work practices, inspections, wear hard hat, safety glasses and hearing protection. Maintain eye contact with equipment operator.
	Adverse Weather	Monitor weather daily. Discontinue work as necessary based on lightning, limited visibility, impaired mobility, etc.
	Heat/Cold Stress	Acclimatization, work/rest regimes, drinking warm/cold fluids.
	Slip/Trip/Fall	Maintain safe and orderly work areas. Unloading areas should be on even terrain. Identify and repair potential tripping hazards.
	Noise	Distancing form noise, hearing protection.
	Traffic Hazards	Use traffic cones, signage, and traffic safety vests in accordance with Traffic Regulations. Use a traffic spotter.
	Tool Use	Use proper guarding, inspections, wear safety glasses with side shields, hearing protection.
	Excavation	Maintain proper distance from edge of excavation; be alert for unstable soil conditions/wall collapse.
	Contaminant Contact	Wear protective coveralls (e.g., Tyvek™) (if needed) with shoe covers, nitrile gloves, and safety glasses when handling samples. Dispose of gloves after sampling. Personal protective equipment will be decontaminated and disposed of in general accordance with Section 10 of this HASP.
	Exposure to vapors from contaminated soils	Use work zone air monitoring equipment including photoionization detector and dust monitor to monitor the work zone as specified in Section 8.0 of the HASP. If air monitoring action levels are exceeded, then engineering controls will be implemented. If excursions of the action levels persist, then upgrade to half or full face respirator with HEPA/organic vapor cartridge as indicated in Section 6.0 of the HASP. Community air monitoring of the area immediately surrounding the work zone will be completed in accordance with Appendix D.

ACTIVITY HAZARDS

Activity	Potential Hazards	Protective Equipment / Controls
Subsurface Boring/ Monitoring Well Installation and Sample Collection	Heavy Equipment / Proximity to Heavy Equipment	Distancing, safe work practices, inspections, wear hard hat, safety glasses and hearing protection. Maintain eye contact with equipment operator.
	Adverse Weather	Monitor weather daily. Discontinue work as necessary based on lightning, limited visibility, impaired mobility, etc.
	Heat/Cold Stress	Acclimatization, work/rest regimes, drinking warm/cold fluids.
	Slip/Trip/Fall	Maintain safe and orderly work areas. Unloading areas should be on even terrain. Identify and repair potential tripping hazards.
	Noise	Distancing form noise, hearing protection.
	Traffic Hazards	Use traffic cones, signage, and traffic safety vests in accordance with Traffic Regulations. Use a traffic spotter.
	Tool Use	Use proper guarding, inspections, wear safety glasses with side shields, hearing protection.
	Contaminant Contact	Wear protective coveralls (e.g., Tyvek™) (if needed) with shoe covers, nitrile gloves, and safety glasses when handling samples. Dispose of gloves after sampling. Personal protective equipment will be decontaminated and disposed of in general accordance with Section 10 of this HASP.
	Exposure to vapors from contaminated soils	Use work zone air monitoring equipment including photoionization detector and multiple gas meter (that monitors % oxygen, lower explosive limit, hydrogen sulfide and hydrogen cyanide), and dust monitor to monitor the work zone as specified in Section 8.0 of the HASP. If air monitoring action levels are exceeded, then engineering controls will be implemented. If excursions of the action levels persist, then upgrade to half or full face respirator with HEPA/organic vapor cartridge as indicated in Section 6.0 of the HASP. Community air monitoring of the area immediately surrounding the work zone will be completed in accordance with Appendix E.
Survey	Adverse Weather	Monitor weather daily. Discontinue work as necessary based on lightning, limited visibility, impaired mobility, etc.
	Heat/Cold Stress	Acclimatization, work/rest regimes, drinking warm/cold fluids.

ACTIVITY HAZARDS

Activity	Potential Hazards	Protective Equipment / Controls
	Slip/Trip/Fall	Maintain safe and orderly work areas. Unloading areas should be on even terrain. Identify and repair potential tripping hazards.

Personal Protective Equipment (PPE) is the *initial level of protection* based on the activity hazards and Site conditions which have been identified. *Upgrades to respiratory protection may be required based on the designated action levels.* General on-site provisions shall include: extra nitrile, leather, and/or Kevlar gloves, extra protective coveralls (e.g. Tyvek ®) with boot covers, drinking water and electrolyte fluids, reflective vest, first aid kit, sunscreen, hearing protection and washing facilities.

If site conditions suggest the existence of a situation more hazardous than anticipated, the site personnel shall evacuate the immediate area. The hazard, the level of precautions, and the Personal Protection Equipment (PPE) shall then be reevaluated with the assistance and approval of the GEI Corporate Health and Safety Officer (Robin DeHate) and Project Manager.

3.2.2 Handling Drums and Containers

Regulations for handling drums and containers are specified by Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120(j). Potential hazards associated with handling drums include vapor generation, fire, explosions, and possible physical injury. Handling of drums/containers during the site investigation and remediation activities may be necessary. If drum/container handling is necessary, it will be performed in accordance with all applicable regulations.

3.3 Evaluation of Potential Chemical Hazards

The characteristics of constituents of concern (COC) at the Site are discussed below for information purposes. Adherence to the safety and health guidelines in this HASP should reduce the potential for exposure to the compounds discussed below.

3.3.1 Volatile Organic Compounds (VOCs)

Volatile organic chemicals (VOCs), such as benzene, toluene, ethyl benzene, and xylenes (BTEX) are present as soil and groundwater contaminants and in some cases chemical components in non-aqueous phase liquids (NAPL) such as oil or tar within soils and abandoned pipelines. At high concentrations these compounds generally have a depressant effect on the central nervous system (CNS), may cause chronic liver and kidney damage, and some are suspected human carcinogens. Benzene is a known human carcinogen. Acute exposure may include headache, dizziness, nausea, and skin and eye irritation. The primary route of exposure to VOCs is through inhalation and therefore respiratory protection is the primary control against exposure to VOCs.

3.3.2 Coal Tar and Coal Tar Products

Coal tar products, which are semi-volatile organic compounds (SVOCs) consist of a mixture of acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benz(a)pyrene, benzo(e)pyrene, benzo(g,h,i)peryline, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methyl naphthalene, naphthalene, phenanthrene, phenols, pyrene.

Coal tar products and other SVOCs are present at the Site within impacted soil and groundwater and as a dense non-aqueous phase liquid (DNAPL) by-product of gas production within soils, former MGP structures, and abandoned pipelines.

Coal tar products such as those listed above may cause contact dermatitis. Direct contact can be irritating to the skin and produce itching, burning, swelling and redness. Direct contact or exposure to the vapors may be irritating to the eyes. Conjunctivitis may result from prolonged exposure. Coal tar is considered to be very toxic, if ingested. High levels of exposure to coal tar, though not anticipated during work activities conducted during this project, may increase the risk of cancer including lung, kidney and skin cancer. Naphthalene is also an eye and skin irritant and can cause nausea, headache, fever anemia, liver damage, vomiting convulsions and coma. Poisoning may occur by ingestion of large doses, inhalation or skin absorption.

The major route of entry for the work activities to be conducted at this site is through direct contact. Exposure is most likely when handling soil and water samples. Inhalation may occur when the soil is disturbed causing respirable and nuisance dust particles to become airborne.

3.3.3 Heavy Metals

The Site contains elevated levels of metals including arsenic, chromium, lead, mercury, and selenium.

Exposure to high concentrations of arsenic can cause dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, and hyperpigmentation of skin. Chronic exposure to arsenic has resulted in lung cancer in humans.

Exposure to high concentrations of lead may cause acute symptoms such as eye irritation, weakness, weight loss, abdominal pain, and anemia. Chronic exposure to lead may result in kidney disease, effects to the reproductive system, blood forming organs, and CNS.

Both lead and arsenic are regulated by specific OSHA standards. They are 29 CFR 1910.1025/1926.52 and 29 CFR 1910.1018/1926.1118, respectively. These standards include specific requirements for air monitoring, signs and labels, training and medical surveillance.

Exposure to high concentrations of chromium can cause acute symptoms such as irritation of the eyes, nose and throat as well as wheezing and coughing. Chronic effects include nosebleeds, nasal congestion, dermatitis, and loss of sight.

Exposure to high concentrations of mercury can cause dizziness, salivation nausea, vomiting, diarrhea, constipation, emotional disturbance, and kidney injury. Chronic exposure to mercury can cause CNS damage.

Exposure to high concentrations of selenium can cause mucous membrane irritation, coughing, sneezing, shortness of breath, chills, headaches, hypotension, and CNS depression. Chronic exposure to selenium could cause bronchial irritation, gastrointestinal distress, excessive fatigue, and skin discoloration.

As with SVOCs, the primary route of exposure is through inhalation of dust particles when soil is disturbed and becomes airborne.

3.3.4 Asbestos-Containing Materials

The Site potentially contains asbestos containing materials (ACM) in the forms of demolition debris within the relief holder, ACM pipe insulation and asbestos cement pipe. Chronic exposure to asbestos may cause asbestosis and mesothelioma. The primary route of exposure for asbestos is inhalation during the disturbance and/or removal of asbestos from the pipe insulation and cement pipes.

Asbestos is strictly regulated under OSHA 29 CFR 1910.1001/1926.1101. Employees that may be potentially exposed to ACM must participate in a medical surveillance program, have specific training in the hazards and controls of exposure to asbestos and wear respirators with high efficiency particulate (HEPA) filters. All work must be conducted in demarcated regulated areas to minimize the amount of people within the exposure area. Employers must conduct air sampling and provide signs and labels regarding the presence of asbestos.

3.3.5 Polychlorinated Biphenyls

Polychlorinated Biphenyls (PCBs) have previously been encountered during MGP site investigations at other sites. Analysis of soils from the Site did not indicate elevated PCB concentrations.

3.3.6 Cyanide

Cyanide compounds are common by-products of manufactured gas production. Hydrogen cyanide is toxic because it is a chemical asphyxiant. It replaces the oxygen in the blood and thereby suffocates the cells. Ferrocyanides are not considered toxic because the hydrogen cyanide ion is bound to tightly to the iron and cannot therefore replace the oxygen. It takes a great amount of heat and/or acid to release cyanide gas from the ferrocyanide molecule, therefore hydrogen cyanide is not a concern at this site.

3.3.7 Evaluation of Organic Vapor Exposure

Air monitoring reduces the risk of overexposure by indicating when action levels have been exceeded and when personal protective equipment (PPE) must be upgraded or changed. Action levels for volatile organic compounds and associated contingency plans for the work zone are discussed within Section 8.0 of this Health and Safety Plan.

Exposure to organic vapors shall be evaluated and/or controlled by:

- Monitoring air concentrations for organic vapors in the breathing zone with a photo-ionization detector (PID).
- When possible, engineering control measures will be utilized to suppress the volatile organic vapors. Engineering methods can include utilizing a fan to promote air circulation, utilizing volatile suppressant foam, providing artificial ground cover or covering up the impacted material with a tarp to mitigate volatile odors.
- When volatile suppression engineering controls are not effective and organic vapor meters indicate concentrations above the action levels, then appropriate respiratory protection (i.e. air purifying respirator with organic vapor cartridge) will be employed.

3.3.8 Evaluation of Skin Contact and Absorption

Skin contact by contaminants may be controlled by use of proper hygiene practices, PPE, and good housekeeping procedures. The proper PPE (e.g., Tyvek®, gloves, safety glasses) as described in Section 1.8 will be worn for all activities where contact with potential contaminated media or materials are expected.

Material Safety Data Sheets (MSDS) (as available) and/or Occupational Health Guidelines for decontamination chemicals and laboratory reagents that may be used on site are included in Appendix B. Specific chemical hazards information from the MSDS and Occupational Health Guidelines are summarized in Table 1.

Table 1
Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data
Asbestos	1332-21-4	0.1 f/cc	0.1 f/cc over 8 hr period or 1.0f/cc over 30 min.	Inhalation Ingestion Skin Contact	Asbestosis (chronic exposure); mesothelioma, breathing difficulty, interstitial fibrosis' restricted pulmonary function, finger clubbing; irritate eyes, known human carcinogen	Respiratory system, eyes	White, greenish, blue, or gray-green fibrous solids FP: NA LEL: NA UEL NA VP: 0 mm
Arsenic	7440-38-2	0.01 mg/m^3	0.01 mg/m^3 A.L. .005mg/m3	Inhalation Skin Absorption Ingestion Skin Contact	Ulceration of nasal septum, dermatitis, GI disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, potential carcinogen	Liver, kidneys, skin, lungs, lymphatic system	Metal: Silver-gray or tin-white, brittle, odorless solid FP: NA LEL: NA UEL: NA VP: 0 mm
Benzene	71-43-2	0.5 ppm (Skin)	1 ppm TWA 5 ppm STEL	Inhalation Skin Absorption Ingestion Skin Contact	Irritation of eyes, skin, nose, respiratory system, giddiness, headache, nausea; staggering gait, fatigue, anorexia, weakness, dermatitis, bone marrow depression, known human carcinogen	Eyes, skin, CNS, bone marrow, blood	FP: 12^o F LEL: 1.2% UEL:7.8% VP: 75 mm
Chromium (Chromic Acid and Chromates)	1333-82-0	0.05 mg/m^3	0.1 mg/m^3	Inhalation Ingestion Skin Contact	Irritates respiratory system, nasal, septum perforation, liver and kidney damage, leucocytosis (increased blood leucocytes), leukopenia (reduced blood leucocytes), moncytosis (increased monocytes), Eosinophilia, eye injury, conjunctivitis, skin ulcer, sensitivity dermatitis, potential carcinogen	Blood, respiratory system, liver, kidney, eyes, skin, lung cancer	FP:NA VP: Very Low LEL: NA UEL: NA

Table 1
Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data
Ethylbenzene	100-41-4	100 ppm	100 ppm	Inhalation Ingestion Skin Contact	Eye, skin, mucous membrane irritation; headache; dermatitis, narcosis; coma	Eyes, skin, respiratory system, Central Nervous System	FP: 55^o F LEL: 0.8% UEL:6.7% VP: 7 mm
Lead	7439-92-1	0.050 mg/m^3	0.05 mg/m^3 A.L. 0.03 mg/m3	Inhalation Ingestion Skin Contact	Weakness, insomnia; facial pallor; pal eye, anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis of wrist and ankles; irritates eyes, hypo tension	Eyes, GI tract, Central Nervous System, kidneys, blood, gingival tissue	A heavy, ductile, soft, gray solid. FP: NA LEL: NA UEL: NA VP: 0 mm
Mercury	7439-97-6	0.025 mg/m^3	0.10 mg/m3	Inhalation Ingestion Skin Contact Skin Absorption	Irritates eyes and skin, chest pain, cough, difficulty breathing, bronchitis, pneumonitis, tremor, insomnia, irritability, indecision, headache, fatigue, weakness, stomatitis, salivation, Gastrointestinal disturbance, weight loss, proteinuria	Eyes, skin, respiratory tract, central nervous system	Silver-white, heavy odorless liquid FP: NA LEL: NA UEL:NA VP: 0.0012 mm
Naphthalene	91-20-3		10 ppm (50 mg/m^3) TWA	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes; headache, confusion, excitement, malaise (vague feeling of discomfort); nausea, vomiting, abdominal pain; irritation bladder; profuse sweating; jaundice; hematuria (blood in the urine), renal shutdown; dermatitis, optical neuritis, corneal damage	Eyes, skin, blood, liver, kidneys, central nervous system	FP: 174 F IP: 8.12 eV, LEL: 0.8% UEL:6.7%, VP: 0.08 mm

Table 1
Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data
PAH's as Coal tar pitch Volatiles (CTPV)	65996-93-2	0.2 mg/m3	0.2 mg/m3	Inhalation Skin contact Ingestion	Irritant to eyes, swelling, acne contact dermatitis, chronic bronchitis	Respiratory system, Central Nervous System, liver, kidneys, skin, bladder,	Black or dark brown amorphous residue.
PCBs	11097-69-1	0.5 mg/m^3 (Skin)	0.5 mg/m^3 (Skin)	Inhalation Skin Absorption Ingestion Skin Contact	Irritate eyes; chloracne; liver damage;	Skin, eyes, liver, reproductive system	Colorless liquid or solid with a mild, hydro-carbon odor VP = 0.00006 mm
Phenol	108-95-2	10 ppm (skin)	5 ppm (19 mg/m^3) [skin]	Inhalation Skin Absorption Ingestion Skin Contact	Irritates eyes, nose, throat, anorexia, weight loss, weakness, muscle ache, pain, dark urine, cyanosis, liver and kidney damage, skin burns, dermatitis, tremors, convulsions, twitching,	Eyes, skin, respiratory system, liver, kidneys	Colorless to light pink crystalline solid with sweet, acrid odor. FP:175 ^{o}F IP:8.5 LEL:1.8% UEL: 8.6% VP: 0.4 mm
Selenium	7782-49-2	0.2 mg/m^3	0.2 mg/m^3	Inhalation Ingestion Skin Contact	Irritant to eyes, skin, nose and throat, visual disturbance, headache, chills, fever, breathing difficulty, bronchitis, metallic taste, garlic breath, GI disturbance, dermatitis, eye and skin burns,	Eyes, skin, respiratory system, liver, kidneys, blood spleen	Amphorous or crystalline, red to gray solid FP: NA LEL: NA UEL: NA VP: 0 mm
Toluene	108-88-3	50 ppm	200 ppm	Inhalation Skin Absorption Ingestion Skin Contact	Eye, nose irritation; fatigue, weakness, confusion, euphoria, dizziness, headache; dilated pupils, tearing of eyes; nervousness, muscle fatigue, insomnia, tingling in limbs; dermatitis	Eyes, skin, respiratory system, Central Nervous System, liver, kidneys	FP: 40^{o}F LEL: 1.1% UEL:7.1% VP: 21 mm

Table 1
Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data
Xylene	1330-20-7	100 ppm	100 ppm	Inhalation Skin Absorption Ingestion Skin Contact	Eye, skin, nose, throat irritation; dizziness, excitement, drowsiness; incoordination, staggering gait; corneal damage; appetite loss, nausea, vomiting, abdominal pain; dermatitis	Eyes, skin, respiratory system, Central Nervous System, GI tract, blood, liver, kidneys	FP: 90° F LEL: 0.9% UEL: 6.7% VP: 9 mm

Abbreviations	
A.L. Action Level	ppm = parts per million
C = ceiling limit, not to be exceeded	STEL = Short-term exposure limit (15 minutes)
FP = Flash point	TWA = Time-weighted average (8 hours)
GI = Gastro-intestinal	UEL = Upper explosive limit
LEL = Lower explosive limit	VP = vapor pressure approximately 68° F in mm Hg (mercury)
mm = millimeter	

3.4 Biological Hazards

Areas of the site may be wooded or surrounded with brush. Therefore, employees working on this project should be aware of the potential biological hazards at this site. Each is discussed in detail below.

3.4.1 Poisonous Plants

Persons working on the site should be aware of the possible presence of poisonous plants and insects. Poison ivy is a climbing plant with leaves that consist of three glossy, greenish leaflets. Poison ivy has conspicuous red foliage in the fall. Small yellowish-white flowers appear in May through July at the lower leaf axils of the plant. White berries appear from August through November. Poison ivy is typically found east of the Rockies. Poison oak is similar to poison ivy but its leaves are oak-like in form. Poison oak occurs mainly in the south and southwest. Poison sumac typically occurs as a small tree or shrub and may be 6-20 feet in height. The bark is smooth, dark and speckled with darker spots. Poison sumac is typically found in swampy areas and east of the Mississippi. The leaves have 7-13 smooth-edged leaflets and drooping clusters of ivory-white berries appear in August and last through spring.

The leaves, roots, stems and fruit of these poisonous plants contain urushiol. Contact with the irritating oil causes an intensely itching skin rash and characteristic, blister-like lesions. The oil can be transmitted on soot particles when burned and may be carried on the fur of animals, equipment and apparel.

Proper identification of these plants is the key to preventing contact and subsequent dermatitis. Wear long sleeves and pants when working in wooded areas. In areas of known infestation, wear Tyvek coveralls and gloves. Oils are easily transferred from one surface to another. If you come in contact with these poisonous plants, wash all exposed areas immediately with cool water to remove the oils. Some commercial products such as Tecnu's Poison Oak-n-Ivy Cleanser claim to further help with the removal of oils.

3.4.2 Ticks

Lyme Disease
Ticks are bloodsuckers, attaching themselves to warm-blooded vertebrates to feed. Deer ticks, are associated with the transmission the bacteria that causes Lyme Disease. Female deer ticks are about one-quarter inch in length and are black and brick red in color. Males are smaller and all black. If a tick is not removed, or if the tick is allowed to remain for days feeding on human blood, a condition known as tick paralysis can develop. This is due to a neurotoxin, which the

tick apparently injects while engorging. This neurotoxin acts upon the spinal cord causing incoordination, weakness and paralysis.

The early stages of Lyme disease, which can develop within a week to a few weeks of the tick bite, are usually marked by one or more of these signs and symptoms:

- Tiredness
- Chills and fever
- Headache
- Muscle and/or join pain
- Swollen lymph glands
- Characteristic skin rash (i.e. bullseye rash)

Rocky Mountain Spotted Fever

Rocky Mountain spotted fever is spread by the American dog tick, the lone-star tick, and the wood tick, all of which like to live in wooded areas and tall, grassy fields. The disease is most common in the spring and summer when these ticks are active, but it can occur anytime during the year when the weather is warm.

Initial signs and symptoms of the disease include sudden onset of fever, headache, and muscle pain, followed by development of rash. Initial symptoms may include fever, nausea, vomiting, severe headache, muscle pain, lack of appetite.

The rash first appears 2-5 days after the onset of fever and is often not present or may be very subtle. Most often it begins as small, flat, pink, non-itchy spots on the wrists, forearms, and ankles. These spots turn pale when pressure is applied and eventually become raised on the skin. Later signs and symptoms include rash, abdominal pain, joint pain, diarrhea.

The characteristic red, spotted rash of Rocky Mountain spotted fever is usually not seen until the sixth day or later after onset of symptoms, and this type of rash occurs in only 35% to 60% of patients with Rocky Mountain spotted fever. The rash involves the palms or soles in as many as 50% to 80% of patients; however, this distribution may not occur until later in the course of the disease.

Prevention

Tick season lasts from April through October; peak season is May through July. You can reduce your risk by taking these precautions:

- During outside activities, wear long sleeves and long pants tucked into socks. Wear a hat, and tie hair back.

- Use insecticides to repel or kill ticks. Repellents containing the compound DEET can be used on exposed skin except for the face, but they do not kill ticks and are not 100% effective in discouraging ticks from biting. Products containing permethrin kill ticks, but they cannot be used on the skin -- only on clothing. When using any of these chemicals, follow label directions carefully.
- After outdoor activities, perform a tick check. Check body areas where ticks are commonly found: behind the knees, between the fingers and toes, under the arms, in and behind the ears, and on the neck, hairline, and top of the head. Check places where clothing presses on the skin.
- Remove attached ticks promptly. Removing a tick before it has been attached for more than 24 hours greatly reduces the risk of infection. Use tweezers, and grab as closely to the skin as possible. Do not try to remove ticks by squeezing them, coating them with petroleum jelly, or burning them with a match. Keep ticks in a zip-lock baggie in case testing needs to be performed.
- Report any of the above symptoms and all tick bites to the CHSO and Project Manager (PM) for evaluation.

3.4.3 Mosquito- Borne Disease - West Nile Virus

West Nile encephalitis is an infection of the brain caused by the West Nile virus (WNV), which is transmitted by infected mosquitoes. Following transmission from an infected mosquito, West Nile virus multiplies in the person's blood system and crosses the blood-brain barrier to reach the brain. The virus interferes with normal central nervous system functioning and causes inflammation of the brain tissue. However, most infections are mild and symptoms include fever, headache and body aches. More severe infections may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis and rarely, death. Persons over the age of 50 have the highest risk of severe disease.

Prevention centers on public health action to control mosquitoes and on individual action to avoid mosquito bites. To avoid being bitten by the mosquitoes that cause the disease, use the following control measures:

If possible, stay inside between dusk and dark. This is when mosquitoes are most active. When outside between dusk and dark, wear long pants and long-sleeved shirts. Spray exposed skin with an insect repellent, preferably containing DEET.

3.4.4 Wasps and Bees

Wasps (hornets and yellow-jackets) and bees (honeybees and bumblebees) are common insects that may pose a potential hazard to the field team if work is performed during spring, summer or fall. Bees normally build their nests in the soil. However, they use other natural holes such as abandoned rodent nests or tree hollows. Wasps make a football-shaped, paper-like nest either below or above the ground. Yellow-jackets tend to build their nests in the ground but hornets tend to build their nests in trees and shrubbery. Bees are generally more mild-mannered than wasps and are less likely to sting. Bees can only sting once while wasps sting multiple times because their stinger is barbless. Wasps sting when they feel threatened. By remaining calm and not annoying wasps by swatting, you lessen the chance of being stung.

Wasps and bees inject a venomous fluid under the skin when they sting. The venom causes a painful swelling that may last for several days. If the stinger is still present, carefully remove it with tweezers. Some people may develop an allergic reaction (i.e. anaphylatic shock) to a wasp or bee sting. If such a reaction develops, seek medical attention at once.

3.4.5 Sun Exposure

Employees are encouraged to liberally apply sunscreen, with a minimum sun protection factor (SPF) of 15, when working outdoors to avoid sunburn and potential skin cancer, which is associated with excessive sun exposure to unprotected skin. Additionally, employees should wear safety glasses that offer protection from UVA/UVB rays.

4.0 Personal Protective Equipment

The PPE specified in Table 2 represents PPE selection required by 29 CFR 1910.132, and is based on the AHA of Section 3. Specific information on the selection rationale activity can be found in the GEI Health and Safety Manual.

The PPE program addresses elements, such as PPE selection based on site hazards, use and limitations, donning and doffing procedures, maintenance and storage, decontamination and disposal, training and proper fitting, inspection procedures prior to / during / and after use, evaluation of the effectiveness of the PPE program, and limitations during temperature extremes, heat stress, and other appropriate medical considerations.

A summary of PPE for each level of protection is as follows:

Table 2

Safety Equipment	**Level A**	**Level B**	**Level C**	**Level D**
Tyvek™ suit or work overalls				●
Hard hats with splash shields or safety glasses			●	●
Steel-toe/shank boots with overboots			●	●
Chemical-resistant gloves as appropriate for work being performed and materials handled			●	●
Half- or full-face respirators with appropriate cartridges as approved by the CHSO			●	
TyvekTM splash-resistant suit			●	
Chemical-resistant clothing		●		
Pressure-demand, full-face SCBA or pressure-demand supplied air respirator with escape SCBA	●	●		
Inner and outer chemical-resistant gloves	●	●		
Chemical-resistant safety boots or shoes	●	●		
Two-way radio	●	●		
Hard hat	●	●		
Fully encapsulating chemical-resistant suit	●			
Reflective vest	●	●	●	●

PPE requirements for field activities are as follows.

TASK	HEAD	EYE/FACE	FEET	HANDS	BODY	HEARING	RESPIRATOR
Mobilization/Demobilization							
Mobilization/demobilization of equipment and supplies	HH as needed	SG as needed	STB	LWG as needed	WC	EP as needed	Level D
Establishment of site security, work zones and staging area	HH as needed	SG as needed	STB	LWG as needed	WC	EP as needed	Level D
Locate all utilities to and from the site	HH as needed	SG as needed	STB	LWG as needed	WC	EP as needed	Level D
Locate all active utility lines on site	HH as needed	SG as needed	STB	LWG as needed	WC	EP as needed	Level D
Investigation Activities							
Surface Soil Sampling	HH as needed	SG	STB, OB as needed	Nit	WC	EP as needed	Level D
Sediment Sampling	HH as needed	SG	STB, OB as needed	Nit	WC	EP as needed	Level D
Test Pit Installation and Sampling	HH	SG	STB, OB as needed	Nit	WC	EP	Level D initially, Level C-If action levels exceeded (see Section 8.0 of HASP)
Subsurface Soil Boring and Monitoring Well Installation and Sampling	HH	SG	STB, OB as needed	Nit	WC, Poly as needed	EP	Level D initially, Level C-If action levels exceeded (see Section 8.0 of HASP)
Survey	HH as needed	SG as needed	STB	LWG as needed	WC	EP as needed	Level D
Monitoring Well Development	HH as needed	SG as needed	STB	Nit	WC	EP as needed	Level D
Groundwater Sampling	HH as needed	SG	STB, OB as needed	Nit	WC, Poly as needed	EP as needed	Level D
Waste Handling	HH	SG	STB, OB as needed	LWG and Nit as needed	WC, Poly as needed	EP as needed	Level D initially, Level C-If action levels exceeded (see Section 8.0 of HASP)

PPE Abbreviations

HEAD PROTECTION
HH = Hard Hat

HEARING PROTECTION
EP = ear plugs
EM = ear muffs

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

FOOT PROTECTION
Neo = Neoprene
OB = Overboot
Poly = Polyethylene coated boot
Rub = Rubber slush boots
STB = Leather work boots with steel toe/shank

HANDPROTECTION
Neo = Neoprene
Nit = Nitrile
LWG = Leather Work Glove
Rub = Rubber

Use of Level A or Level B PPE is not anticipated. If conditions indicating the need for Level A or Level B PPE are encountered, personnel will leave the exclusion zone and this HASP will be revised with oversight of the CHSO or GEI personnel will not re-enter the exclusion zone until conditions allow.

OSHA Requirements for Personal Protective Equipment

All personal protective equipment used during the course of this field investigation must meet the following OSHA standards:

Type of Protection	Regulation	Source
Eye and Face	29 CFR 1910.133	ANSI Z87.1 1968
Respiratory	29 CFR 1910.134	ANSI Z88.1 1980
Head	29 CFR 1910.135	ANSI Z89.1 1969
Foot	29 CFR 1910.136	ANSI Z41.1 1967

ANSI = American National Standards Institute

5.0 Key Project Personnel/Responsibilities and Lines of Authority

5.1 GEI Personnel

Bruce Coulombe, P.G.	GEI Project Manager
Garrett Schmidt	GEI Site Safety Officer
Garrett Schmidt	GEI Field Representative
Robin DeHate	GEI Corporate Health and Safety Officer
Steve Hawkins	Regional Health and Safety Officer

The implementation of health and safety at this project location will be the shared responsibility of the GEI Project Manager (PM), the GEI Corporate Health and Safety Officer (CHSO), the GEI Project Site Safety Officer (SSO), other GEI personnel implementing the proposed scope of work.

5.1.1 GEI Project Manager

The GEI Project Manager is responsible for ensuring that the requirements of this HASP are implemented. Some of the PM's specific responsibilities include:

- Verifying that the GEI staff selected to work on this program are sufficiently trained for the sampling activities;
- Assuring that all personnel to whom this HASP applies, including subcontractor personnel, have received a copy of it;
- Providing the CHSO with updated information regarding conditions at the site and the scope of site work;
- Providing adequate authority and resources to the on-site SSO to allow for the successful implementation of all necessary safety procedures;
- Supporting the decisions made by the SSO and CHSO;
- Maintaining regular communications with the SSO and, if necessary, the CHSO;
- Verifying that the subcontractors selected by GEI to work on this program have completed GEI environmental, health and safety requirements and has been deemed acceptable for the proposed scope of work; and,
- Coordinating the activities of all GEI subcontractors and ensuring that they are aware of the pertinent health and safety requirements for this project.

5.1.2 GEI Corporate Health and Safety Officer

The GEI CHSO, Robin DeHate, is the individual responsible for the review, interpretation and modification of this HASP. Modifications to this HASP which may result in less stringent precautions cannot be undertaken by the PM or the SSO without the approval of the CHSO. Specific duties of the CHSO include:

1. Writing, approving and amending the HASP for this project;
2. Advising the PM and SSO on matters relating to health and safety on this site;
3. Recommending appropriate PPE and safety equipment to protect personnel from potential site hazards;
4. Conducting accident investigations; and,
5. Maintaining regular contact with the PM and SSO to evaluate site conditions and new information which might require modifications to the HASP.

5.1.3 GEI Site Safety Officer

All GEI field staff are responsible for implementing the safety requirements specified in this HASP. However, one person will serve as the SSO. For this program, the Field Team Leader will serve as the SSO. The SSO will be on-site during all activities covered by this HASP. The SSO is responsible for enforcing the requirements of this HASP once work begins. The SSO has the authority to immediately correct all situations where noncompliance with this HASP is noted and to immediately stop work in cases where an immediate danger is perceived. Some of the SSO's specific responsibilities include:

- Assuring that all personnel to whom this HASP applies, including subcontractors, have submitted a completed copy of the HASP receipt and acceptance form;
- Conducting the pre-entry briefing prior to beginning work, and subsequent safety meetings as necessary;
- Assuring that all personnel to whom this HASP applies have attended and actively participated in a pre-entry briefing and any subsequent safety meetings that are conducted during the implementation of the program;
- Maintaining a high level of health and safety consciousness among employees implementing the proposed activities;
- Procuring the air monitoring instrumentation required and performing air monitoring for investigative activities;

- Procuring and distributing the PPE and safety equipment needed for this project for GEI employees;
- Verifying that all PPE and health and safety equipment used by GEI is in good working order;
- Verifying that the selected contractors are prepared with the correct PPE and safety equipment and supplies;
- Notifying the PM of all noncompliance situations and stopping work in the event that an immediate danger situation is perceived;
- Monitoring and controlling the safety performance of all personnel within the established restricted areas to ensure that required safety and health procedures are being followed;
- Stopping work in the event that an immediate danger situation is perceived; and
- Conducting accident/incident investigations and preparing accident/incident investigation reports.

5.1.4 GEI Field Personnel

All GEI field personnel covered by this HASP are responsible for following the health and safety procedures specified in this HASP and for performing their work in a safe and responsible manner. Some of the specific responsibilities of the field personnel are as follows:

- Reading the HASP in its entirety prior to the start of on-site work;
- Submitting a completed HASP Acceptance Form to the GEI SSO prior to the start of work;
- Attending and actively participating in the required pre-entry briefing prior to beginning on-site work and any subsequent safety meetings that are conducted during the implementation of the program;
- Stopping work in the event that an immediate danger situation is perceived;
- Bringing forth any questions or concerns regarding the content of the HASP to the PM or the SSO prior to the start of work;
- Reporting all accidents, injuries and illnesses, regardless of their severity, to the GEI SSO; and,
- Complying with the requirements of this HASP and the requests of the SSO and boat captain.

Lines of Authority will be as follows:

On site – GEI will have responsibility for safety of its employees during the work performed at the Hornell former MGP Site. GEI's field representative will have a cell phone available to contact the appropriate local authorities, in the event of an emergency. GEI's field representative will be available for communication with the GEI Project Manager and with the National Fuel representative.

5.2 Subcontractors

GEI has subcontracted the following firms to assist in performing work on this project:

GeoLogic	37 Copeland Avenue, Homer, NY 13077 607.749.5000
Delta Engineers, Architects, and Land Surveyors	4873 NYS Route 5, Vernon, NY 13476 315.953.4200

GEI requires its subcontractors to work in a responsible and safe manner. Subcontractors for this project will be required to develop their own HASP for protection of their employees but at a minimum must adhere to applicable requirements set forth in this HASP.

5.3 Emergency Contact List

Emergency Phone List **Hornell Former MGP Site**	
Medical Emergencies	
Emergency Medical Services	
Emergency	911
All other communications	(607) 324-1233
Nearest Emergency Room (St James Mercy Hospital)	
411 Canisteo St., Hornell, NY 14834	(607) 324-8000
Fire and Rescue Emergencies	
Emergency	911
All other communications	(607) 324-6161
Police Emergencies	
Hornell Police Department	
110 Broadway, Hornell, NY 14834	
Emergency	911
All other communications	311
Switchboard	(607) 324-2860

Utility Emergencies	
Electric (New York State Electric and Gas Company)	(800) 572-1131
Water/Sewer (City of Hornell Dept of Public Works)	(607) 324-7421
Natural Gas (National Fuel)	(800) 444-3130
Underground Utilities (Dig Safely New York)	(800) 962-7962
Spill Incident	
New York State Department of Environmental Conservation	(800) 457-7362
National Response Center	(800) 424-8802
National Information Centers	
Chemtrec	(800) 424-9300
Poison Control Center	(800) 222-1222
Project Contacts Corporate Health and Safety Officer Robin DeHate	(813) 774-6564 office (813) 323-6220 cell
Regional Health and Safety Officer Steve Hawkins	(860) 368-5348
Client Contact (National Fuel) Tanya Alexander	(716) 857-7410
Project Manager Bruce Coulombe	(607) 216-8959 office (607) 793-3426 cell
Utility Clearance Permit #	
Nearest Telephone Location: Onsite cellular	

6.0 Training Program

6.1 HAZWOPER Training

In accordance with 29 CFR 1910.120, hazardous waste site workers shall, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations. At a minimum, the training shall have consisted of instruction in the topics outlined in the standard. Personnel who have not met the requirements for initial training shall not be allowed to work in any site activities in which they may be exposed to hazards (chemical or physical). Proof of training shall be submitted to the GEI CHSO or her representative prior to the start of field activities.

6.2 Annual Eight-Hour Refresher Training

Annual eight-hour refresher training will be required of all hazardous waste site field personnel in order to maintain their qualifications for fieldwork. The training will cover a review of 29 CFR 1910.120 requirements and related company programs and procedures. Proof of current 8-hour refresher training shall be submitted to the GEI CHSO or her representative prior to the start of field activities.

6.3 Supervisor Training

Personnel acting in a supervisory capacity shall have received 8 hours of instruction in addition to the initial 40 hours training. In addition supervisors shall have one year of field experience and training specific to work activities (i.e., sampling, construction observation, etc.)

6.4 Site-Specific Training

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

6.5 On-Site Safety Briefings

Other GEI personnel will be given health and safety briefings daily by GEI's field representative to assist GEI personnel in safely conducting work activities. The briefings will include information on new operations to be conducted, changes in work practices or changes in the site's environmental conditions, as well as periodic reinforcement of previously discussed topics. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety inspections. Documentation of these briefings will be recorded in the GEI field book. The meetings will also be an opportunity to periodically update the workers on monitoring results. In addition, all GEI personnel shall sign the HASP to document that they understand the hazards and control measures presented and agree to comply with the procedures established in the plan.

6.6 First Aid and CPR

The PM will identify individuals certified in first aid and CPR, or identify individuals for such training in order to ensure that emergency medical treatment is available during field activities. The training will be consistent with the requirements of the American Red Cross Association.

7.0 Medical Surveillance Program

GEI maintains a continuous, corporate, medical surveillance program that includes a plan designed specifically for field personnel engaged in work at sites where hazardous or toxic materials may be present. Dr. Robin DeHate is GEI’s CHSO and is responsible for the administration and coordination of medical evaluations conducted for GEI’s employees at all branch office locations. Comprehensive examinations are given to all GEI field personnel participating in hazardous waste operations on an annual or biennial basis (as determined to be appropriate by the CHSO). The medical results of the examinations aid in determining the overall fitness of employees participating in field activities.

Dr. Robin DeHate’s telephone number is:
Telephone: (813) 774-6564 (office) or (813) 323-6220 (cell)

Under the CHSO’s supervision, all field personnel undergo a complete initial physical examination, including a detailed medical and occupational history, before they participate in hazardous waste site investigations. Extensive annual/biennial reexaminations are also performed. Upon completion of these tests, personnel are certified by an occupational health physician as to whether they are fit for field work in general, and fit to use all levels of respiratory protection, in particular.

If a GEI employee or other project worker shows symptoms of exposure to a hazardous substance and wishes to be rechecked, he/she will be directed to the nearest area hospital or medical facility.

All GEI subcontractor personnel that will enter any active waste handling or other active non-“clean” area must certify that they are participating in a medical surveillance program that complies with OSHA regulations for hazardous waste operations (i.e., 29 CFR 1910.120 and 29 CFR 1926.65). Proof of medical clearance shall be submitted to the GEI CHSO or her representative prior to the start of field activities.

8.0 Air Monitoring

Air monitoring shall be performed to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine the appropriate level of worker protection needed on site.

GEI will conduct perimeter air monitoring, and work zone monitoring for on-site workers. GEI will monitor and document daily site conditions and operations and inform field representative of results. If action levels are exceeded GEI's field representative will immediately implement dust suppression activities and notify GEI's Project Manager.

GEI will provide the following equipment for health and safety monitoring of on-site personnel:

- Particulate Meter (PM-10 capable)
- Sound Level Meter if deemed necessary by the CHSO or PM (type to be appropriate to the activities performed)

The perimeter and work zone air monitoring will be conducted during demolition activities. Table 3 provides a summary of real time air monitoring action levels and contingency plans for work zone activities.

Table 3
Work Zone Air Monitoring Action Levels

Air Monitoring Instrument	**Monitoring Location**	**Action Level**	**Site Action**
PID	Breathing Zone	0.5 ppm	Use Dräger Chip Measurement System (CMS) tube for benzene or Z-nose® to verify if concentration is benzene.
PID	Breathing Zone	0 - 10 ppm	No respiratory protection is required.
		10 - 250 ppm	Stop work, withdrawal from work area, institute engineering controls, if levels persist Upgrade to Level C.
		> 250 ppm	Stop work, withdraw from work area; notify PM & CHSO.
Particulate Meter	Excavation/ Work Zone	0.150 ug/m^3	Implement work practices to reduce/minimize airborne dust generation, e.g., spray/misting of soil with water.

9.0 Site Control Measures

9.1 Site Zones

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

This project is being conducted under the requirements of 29 CFR 1910.120, and any personnel working in an area where the potential for exposure to site contaminants exists, will only be allowed access after proper training and medical documentation.

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

Support Zone - The SZ is an uncontaminated area that will be the field support area for most operations. The SZ provides for field team communications and staging for medical emergency. Appropriate sanitary facilities and safety equipment will be located in this zone. Potentially contaminated personnel/materials are not allowed in this zone. The SZ should be established up-wind of the work area if possible.

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

Exclusion Zone - All activities which may involve exposure to site contaminants, hazardous materials and/or conditions should be considered an exclusion zone. This zone will be clearly delineated by cones, tapes or other means. The Contractor may establish more than one EZ where different levels of protection may be employed or different hazards exist. The size of the EZ shall be determined by the Contractor allowing adequate space for the activity to be completed, field members and emergency equipment.

The Contractor is responsible for constructing, maintaining, and enforcing the zones.

9.2 Buddy System

GEI personnel should be in line-of-site or communication contact with another on-site person. The other on-site personnel should be aware of their role as a "buddy" and be able to provide assistance in the event of an emergency. A copy of this plan shall be given to any person acting as a GEI "buddy" for informational purposes.

9.3 Sanitation for Temporary Work Sites

Temporary sanitary facilities including toilets will be available on site.

9.4 Illumination

Illumination requirements identified by OSHA are directed to work efforts inside buildings and/or during non-daylight hours. All activities planned for the site are anticipated to occur outside during daylight hours. However, if yard areas are used after dark they will be equipped with illumination that meets or exceeds requirements specified in 29 CFR 1926.56, Illumination.

9.5 Utilities

The site may have shallow, buried utilities and also overhead utilities in certain areas. It will be necessary for all parties disturbing the existing ground surface and conducting operations with heavy equipment having high clearances to exercise a high degree of caution in performing project-related work with respect to the presence of utilities. Utility companies with active buried lines in the site area will be asked to mark all of their facilities as necessary. Site workers will use these data to choose apparently safe work locations.

9.5.1 Underground Utilities

No excavating, drilling, boring or other intrusive activities will be performed until a thorough underground utility survey, conducted by knowledgeable persons or agencies, has been made and it is found safe to begin (see the Utility Clearance Documentation in Appendix E). This survey will identify any underground and in-workplace utilities such as the following.

- Electrical lines and appliances
- Telephone lines
- Cable television lines
- Gas lines
- Pipelines
- Steam lines
- Water lines
- Sewer lines

- Pressurized air lines

The location of any utility that could pose a risk to workers must be communicated to all workers during site safety indoctrination. Utilities should be marked or access otherwise restricted to avoid change of accidental contact.

Even when a utility search has been completed, drilling, boring and excavation should commence with caution until advanced beyond the depth at which such utilities are usually located. All utilities shall be considered “live” or active until reliable sources demonstrate otherwise.

9.5.2 Overhead Utilities

Overhead transmission and distribution lines will be carried on towers and poles which provide adequate safety clearance over roadways and structures. Clearances will be adequate for the safe movement of vehicles and for the operation of construction equipment.

Overhead or above-ground electric lines should be considered active until a reliable source has documented them to be otherwise. Elevated work platforms, ladders, scaffolding, man-lifts, and drill or vehicle superstructures shall be erected a minimum of 20 feet (the actual distance is dependent upon the voltage of the line) from overhead electrical lines until the line is de-energized, grounded or shielded and a competent electrician has certified that arcing cannot occur between the work location or superstructure.

10.0 Accident Reporting

GEI will report incidents involving GEI personnel or subcontractor personnel, such as: lost time injuries, injuries requiring medical attention, near miss incidents, fires, fatalities, accidents involving the public, and property damage. The report shall be made to the GEI Project Manager verbally within 2 hours of the incident. The Project Manager will immediately inform the CHSO and the Director of Human Resources of the incident. An Accident Report Form will be completed and submitted to the CHSO and the Director of Human Resources within 24 hours of the incident (Appendix D).

11.0 Decontamination Procedures

A decontamination pad has been established for personnel decontamination and equipment decontamination.

11.1 Personnel Decontamination Station

A personnel decontamination station where workers can drop equipment and remove PPE will be set up at the decontamination pad by the Contractor. It will be equipped with basins for water and detergent, and trash bag(s) or cans for containing disposable PPE and discarded materials. Once personnel have decontaminated at this station and taken off their PPE, they will proceed to a sink where they will wash themselves wherever they have potentially been exposed to any contaminants (e.g., hands, face, etc.)

The following specific decontamination procedure will be used as necessary by GEI personnel or subcontractor personnel wearing PPE from Level D through Level C.

Step 1 Equipment drop (respirator, tools, monitoring equipment, etc.)
Decontaminate as appropriate (per GEI's field representative's instructions).

Step 2 Boot wash/rinse (wash with non-foaming detergent, rinse with fresh water spray). Remove boots. If inner and outer gloves are worn, wash outer gloves, remove and save for later use, or remove and discard outer gloves and place in trash bag/can provided in the decontamination area.

Step 3 Hard hat removal, wash if visibly contaminated (use same wash as in Step 2).

Step 4 If Tyvek™ (or equivalent) suit was worn and is visibly contaminated, remove and place in trash bag/can provided in the decontamination area or decontaminate (wash) and store for reuse.
Contaminated washable coveralls should be removed and bagged for washing.

Step 5 Respirator and/or eye protection removal (as applicable). Wash (per Step 2) to remove visible contamination.

Step 6 Remove outer gloves.

Step 7 Wash potentially exposed skin (use water and soap at indoor sink).

Step 8 Disinfect respirator per manufacturer's recommendations.

Contaminated PPE (gloves, suits, etc.) will be decontaminated and stored for reuse or placed in plastic bags (or other appropriate container) and disposed of in an approved facility.

Decontamination wastewater and used cleaning fluids will be collected and disposed of in accordance with all applicable state and federal regulations.

11.2 Heavy Equipment Decontamination

Heavy equipment decontamination will be performed by the Contractor within the limits of the on-site decontamination pad in accordance with the contract specifications. A steam generator and brushes will be used to clean demolition equipment and other tools. No heavy equipment will be permitted to leave the site unless it has been thoroughly decontaminated.

Wastewater from the heavy equipment and personnel decontamination areas will be collected and disposed of in accordance with all applicable state and federal regulations. The Contractor will be responsible for ultimate disposal of investigation-derived wastes.

11.3 Decontamination Equipment Requirements

The following equipment, if required, should be in sufficient supply to implement decontamination procedures for GEI’s equipment.

- Buckets
- Alconox™ detergent concentrate
- Hand pump sprayers
- Long handle soft bristle brushes
- Large sponges
- Cleaning wipes for respirators
- Bench or stool(s)
- Methanol
- Liquid detergent and paper towels
- Plastic trash bags

The Contractor performing decontamination procedures is responsible for ensuring that the above materials, as required for their operation, are in sufficient supply.

12.0 Supplemental Contingency Plan Procedures

12.1 Hazard Communication Plan

GEI personnel have received hazard communication training as part of their 40-hour HAZWOPER training. All hazardous materials used on the site will be properly labeled, stored, and handled. Material Safety Data sheets (MSDS) will be available to all potentially exposed employees.

12.2 Fire

In the event of a fire all personnel will evacuate the area. GEI's field representative will contact the local fire department with jurisdiction and report the fire. Notification of evacuation will be made to the GEI Project Manager and the CHSO. The field representative will account for GEI personnel and subcontractor personnel and report their status to the GEI Project Manager.

12.3 Medical Support

In case of minor injuries, on site care shall be administered with the site first aid kit. For serious injuries, call 911 and request emergency medical assistance. Seriously injured persons should not be moved, unless they are in immediate danger.

Section 5 of this HASP contains detailed emergency information, including directions to the nearest hospital, and a list of emergency services and their telephone numbers. GEI field personnel will carry a cellular telephone.

12.4 Severe Weather

The contingency plan for severe weather includes reviewing the expected weather to determine if severe weather is in the forecast. Severe weather includes high winds over 30 mph, heavy rains or snow squalls, thunderstorms, hurricanes, and lightning storms. If severe weather is approaching, the decision to evacuate GEI personnel and subcontractor personnel from the site will be the responsibility of GEI's field representative. Notification of evacuation will be made to the GEI Project Manager and the CHSO. The field representative will account for GEI personnel and subcontractor personnel and report their status to the GEI Project Manager.

12.5 Spills or Material Release

If a hazardous waste spill or material release, the SSO or his representative will immediately assess the magnitude and potential seriousness of the spill or release based on the following.

- MSDS for the material spilled or released
- Source of the release or spillage of hazardous material
- An estimate of the quantity released and the rate at which it is being released
- The direction in which the spill or air release is moving
- Personnel who may be or may have been in contact with the material, or air release, and possible injury or sickness as a result
- Potential for fire and/or explosion resulting from the situation
- Estimates of area under influence of release

If the spill or release is determined to be within the on-site emergency response capabilities, the SSO will ensure implementation of the necessary remedial action. If the release is beyond the capabilities of the site personnel, all personnel will be evacuated from the immediate area and the local fire department will be contacted. The SSO will notify the PM and the CHSO.

12.6 Alcohol and Drug Abuse Prevention

Alcohol and drugs will not be allowed on the work site. Project personnel under the influence of alcohol or drugs will not be allowed to enter the site.

Health and Safety Plan Sign-Off

All GEI personnel conducting site activities must read the Health and Safety Plan, be familiar with its requirements, and agree to its implementation.

Once the Health and Safety Plan has been read, complete this sign-off sheet, and return it to the Project Manager.

Site Name:
Hornell Former Manufactured Gas Plant Site, Hornell, New York

Activity:
Investigation

GEI Project No: 102260

I have received and read the Health and Safety Plan, been briefed on it, and agree to its implementation.

Name:	Signature:	Date:
Name:	Signature:	Date:
Name:	Signature:	Date:
Name:	Signature:	Date:
Name:	Signature:	Date:
Name:	Signature:	Date:
Name:	Signature:	Date:
Name:	Signature:	Date:
Name:	Signature:	Date:
Name:	Signature:	Date:

APPENDIX A

MAP TO HOSPITAL

Directions from Hornell Former MGP Site to St. James Mercy Hospital:

St. James Mercy Hospital
Hornell, NY 14843
(607) 324-8000

0.9 miles approximately 3 minutes

1. Head **East** on **Canisteo Street/Franklin Street** towards **Canisteo Square** Continue to follow **Canisteo Street**
2. Turn **Right** on **West Van Scoter Street**
3. Take the first **Left** onto **Portland Avenue**
4. Destination will be on the **Left**

APPENDIX B

MATERIAL SAFETY DATA SHEETS

Material Safety Data Sheet

from Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 300

ACETONE
(Revision E)
Issued: September 1985
Revised: November 1988

SECTION 1. MATERIAL IDENTIFICATION

Material Name: ACETONE

Description (Origin/Uses): Used as a solvent for fats, oils, waxes, resins, rubber, plastics, varnishes, and rubber cements; also used in the manufacture of methyl isobutyl ketone, mesityl oxide, acetic acid, diacetone alcohol, chloroform, iodoform, bromoform, explosives, rayon, photographic films, and isoprene. Used to store acetylene gas. Widely used in the chemical process industry (CPI).

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NFPA

Other Designations: Dimethylformaldehyde; Dimethylketal; Dimethyl Ketone; Ketone Propane; Pyroacetic Acid; Pyroacetic Ether; C_3H_6O; CAS No. 0067-64-1

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

HMIS		
H 1		R 1
F 3		I 1
R 0		S 2
PPG*		K 4
*See sect. 8		

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Acetone, CAS No. 0067-64-1 *See NIOSH, *RTECS* (AL3150000), for additional data with references to reproductive, mutagenic, and irritative effects.	Ca 100	**OSHA PELs** 8-Hr TWA: 750 ppm, 1800 mg/m³ STEL: 1000 ppm, 2400 mg/m³ **ACGIH TLVs, 1988-89** TLV-TWA: 750 ppm, 1780 mg/m³ TVL-STEL: 1000 ppm, 2375 mg/m³ **Toxicity Data*** Man, Inhalation, TD_{Lo}: 440 µg/m³ (6 Mins) Man, Inhalation, TD_{Lo}: 10 mg/m³ (6 Hrs)

SECTION 3. PHYSICAL DATA

Boiling Point: 134°F (56°C)
Melting Point: -137°F (-94°C)
Vapor Density (Air = 1): 2
Vapor Pressure: 180 Torrs at 68°F (20°C)
Evaporation Rate: Faster than That of *n*-Butyl Acetate

Molecular Weight: 58 Grams/Mole
Solubility in Water (%): Complete
Specific Gravity (H_2O = 1): 0.778 at 77°F (25°C)
% Volatile by Volume: 100

Appearance and Odor: A clear, colorless, highly flammable, volatile liquid with a characteristic, pleasant, sweetish odor.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point: 1.4°F (-17°C) CC	Autoignition Temperature: 869°F (465°C)	LEL: 2.9% v/v	UEL: 12.8% v/v

Extinguishing Media: Use "alcohol" foam, dry chemical, or carbon dioxide. Use a blanketing effect to smother flames. Use water spray to reduce the rate of burning and to cool containers. Water will probably not be effective in directly extinguishing an acetone fire.

Unusual Fire or Explosion Hazards: Acetone vapor is heavier than air and may travel a considerable distance to a low-lying source of ignition and flash back.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Acetone is stable in closed containers during routine operations. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Acetone can react dangerously with strong oxidizing agents such as nitrates, perchlorates, permanganates, and concentrated sulfuric acid; chromic anhydride; chromyl chloride; hydrogen peroxide; hexachloromelamine; nitrosyl chloride; permonoulfuric acid; mixtures of sulfuric acid and nitric acid; mixtures of nitric acid and acetic acid; and potassium *tert*-butoxide.

Conditions to Avoid: Do not expose acetone to sources of ignition and incompatible chemicals.

Hazardous Products of Decomposition: Carbon monoxide and carbon dioxide can be produced during acetone fires.

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity: Acetone is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: Inhalation of high concentrations of acetone vapor can cause dryness of the mouth and throat; dizziness, nausea, incoordination, slurred speech, drowsiness, and, in severe exposures, coma. Inhalation of small quantities of acetone vapor for an extended period causes irritation of the respiratory tract, coughing, and headache. Prolonged or repeated skin contact with acetone has a defatting effect causing dryness, irritation, and mild dermatitis. Under routine operating conditions the amount of acetone absorbed through the skin is small. Ingestion of acetone may cause irritation of the gastrointestinal tract and narcosis. Acetone acts primarily as a depressant to the central nervous system (CNS) when exposures are severe or prolonged. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** Skin, eyes, respiratory system, and CNS. **Primary Entry:** Inhalation, skin contact. **Acute Effects:** See Summary of Risks, above. **Chronic Effects:** None reported. **FIRST AID:** **Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes. **Skin.** Rinse the affected area with flooding amounts of water, then wash it with soap and water. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. Monitor the exposed person for symptoms of depression of the CNS such as incoordination and drowsiness. **Ingestion.** Unlikely.* If a small amount is ingested, dilute it slowly with 1 to 2 glasses of water or milk. **Get medical help (in plant, paramedic, community) for all exposures.** Seek prompt medical assistance for further treatment, observation, and support after first aid. ***Note to Physician:** Treatment for accidental ingestion of a small amount of acetone is unnecessary. If a large amount has been ingested, administer a charcoal slurry, either aqueous or mixed with a saline cathartic or sorbital.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate unnecessary personnel, eliminate all sources of ignition immediately, and provide adequate ventilation. Cleanup personnel need protection against this liquid's contact with skin or eyes as well as inhalation of its vapor (see sect. 8). Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways.
Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations. Consider saving the waste hydrochloric acid for use as a neutralizing agent during cleanup operations of basic materials.

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste, No. U002
CERCLA Hazardous Substance, Reportable Quantity: 5000 lbs (2270 kg), per the Resource Conservation and Recovery Act, § 3001.

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Use a NIOSH-approved respirator per Genium reference 88 r the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious butyl or natural rubber gloves, boots, aprons, and gauntlets, etc., to prevent prolonged or repeated contact with this material. **Ventilation:** Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of acetone below the OSHA PEL standard cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from your shoes and equipment. **Other:** Automatic sprinkler systems for fire protection are desirable in work areas. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale acetone vapor.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store acetone in closed containers (carbon steel is recommended) in a cool, dry, well-ventilated area away from sources of ignition and strong oxidizers. Protect containers from physical damage. **Engineering Controls:** Make sure all engineering systems (production, transportation) are of maximum explosion-proof design. Electrically ground and bond all containers and pipelines, etc., used in shipping, transferring, reacting, production, and sampling operations to prevent generating static sparks. **Other Precautions:** Use labeled safety cans when handling small amounts of acetone. Acetone presents a dangerous fire hazard; perform all work operations involving it carefully and in a way that will prevent exposing the liquid or its vapor to sources of ignition.

Transportation Data (49 CFR 172.101-2)
DOT Shipping Name: Acetone
DOT Hazard Class: Flammable Liquid
ID No. UN1090
DOT Label: Flammable Liquid

IMO Hazard Class: 3.1
IMO Label: Flammable Liquid
IMDG Packaging Group: II

ferences: 1, 26, 38, 84-94, 100, 116, 117, 120, 122.

Prepared by PJ Igoe, BS

Industrial Hygiene Review: DJ Wilson, CIH

Medical Review: MJ Hardies, MD

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 420
Acetone Solvent Blend

Issued: 4/79 Revision: A, 9/91

Section 1. Material Identification

Acetone Solvent Blend Description: A mixture of acetone and isopropanol. Used as a solvent for fats, oils, waxes, rubber, plastics, varnishes, gums, resins and rubber cements.
Other Designations: Acetone, CAS No. 0067-64-1; isopropyl alcohol, CAS No. 0067-63-0.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemical Week Buyers' Guide*(TM) for a suppliers list.

R 1
I 1
S 2
K 3

NFPA
3
1 0
-

HMIS
H 1
F 3
R 0
PPG†
† Sec. 8

Cautions: Acetone solvent blend is a skin, eye, and mucous membrane irritant. It may be narcotic in high concentrations.

Section 2. Ingredients and Occupational Exposure Limits

Acetone, >60%
Isopropanol, 10 to 30%

1990 OSHA PELs
Acetone: 8-hr TWA: 750 ppm, 1800 mg/m^3
15-min STEL: 1000 ppm, 2400 mg/m^3
Isopropyl alcohol: 8-hr TWA: 400 ppm, 980 mg/m^3
15-min STEL: 500 ppm, 1225 mg/m^3

1990-91 ACGIH TLVs
Acetone: TWA: 750 ppm, 1,780 mg/m^3
STEL: 1000 ppm, 2400 mg/m^3
Isopropyl alcohol: TWA: 400 ppm, 985 mg/m^3
STEL: 500 ppm, 1,230 mg/m^3

1990 NIOSH RELs
Acetone: TWA: 250 ppm, 590 mg/m^3
Isopropyl alcohol: 400 ppm, 980 mg/m^3

1985-86 Toxicity Data*
Acetone: Man, oral, TD$_{Lo}$: 2857 mg/kg
Man, inhalation, TD$_{Lo}$: 440 μg/m^3/6 min
Isopropyl alcohol: Man, oral, LD$_{Lo}$: 5272 mg/kg
Human, oral, LD$_{Lo}$: 3570 mg/kg; toxic effects include central nervous system, pulmonary, and gastrointestinal

Calculated TLV for Acetone (70%) Isopropanol (30%) Mixture: 596 ppm

* See NIOSH, *RTECS* (AL3150000, NT8050000) for additional toxicity data on acetone and isopropyl alcohol, respectively.

Section 3. Physical Data

Boiling Point: 133 to 181 °F (56 to 83 °C) at 1 atm
Vapor Pressure: ca 225 mm Hg at 77 °F (25 °C)
Vapor Density (air = 1): ca 2
Density/Specific Gravity (20 °C/20 °C): 0.79
Water Solubility: Completely soluble
% Volatile by Volume: ca 100*

Appearance and Odor: A clear, colorless liquid with an acetone odor.

* Acetone solvent blend is a very volatile liquid that increases fire/explosion risk, especially at elevated temperatures.

Section 4. Fire and Explosion Data

Flash Point: 0 to 53 °F (-17.8 to 11.7 °C), CC	**Autoignition Temperature:** >750 °F (399 °C)*	**LEL:** 2.0% v/v	**UEL:** 12.0% v/v

Extinguishing Media: Alcohol foam, dry chemical, or carbon dioxide (CO$_2$). Use smothering effect to extinguish fire. Waterspray may be ineffective for extinguishing, but it is useful in cooling fire-exposed containers, in reducing fire intensity, and for diluting and flushing solvent.
Unusual Fire or Explosion Hazards: Acetone solvent blend is an OSHA Class 1B liquid. Fire and explosion hazards exist when this material is exposed to heat or ignition sources. Vapors may travel to an ignition source and flash back.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Stay upwind. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode, and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

* An estimated value.

Section 5. Reactivity Data

Stability/Polymerization: Acetone solvent blend is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Acetone solvent blend is incompatible with strong oxidizing agents, strong acids, and strong alkalies.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of acetone solvent blend can produce carbon monoxide.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA do not list acetone solvent blend as a carcinogen.
Summary of Risks: Excessive vapor inhalation can cause mucous membrane and respiratory tract irritation. Eye contact can cause severe irritation. Prolonged or repeated skin contact can defat skin. It may be narcotic in high concentrations.
ical Conditions Aggravated by Long-Term Exposure: None reported.
get Organs: Skin, eyes, respiratory system, and central nervous system (CNS).
Primary Entry Routes: Inhalation, skin contact.
Acute Effects: Symptoms include respiratory tract irritation, nasal irritation, conjunctiva irritation, cough, headache, fatigue, dizziness, narcosis, and even asphyxiation. Skin contact causes dryness, irritation, and mild dermatitis. Ingestion produces gastrointestinal (GI) tract irritation and nausea. Injury to the kidneys is associated with ingestion of isopropyl alcohol and could potentially occur with significant ingestions of acetone solvent blend. Aspiration of vomitus into the lungs is a hazard and can result in severe illness or even death.
Chronic Effects: None reported.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If a small amount is ingested, have that *conscious and alert* person drink 1 to 2 glasses of water. Consult a physician.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Accidental or intentional ingestion may result in a state of intoxication difficult to distinguish from ethanol ingestion. Serum acetone and alcohol levels may be necessary to diagnose and monitor such a patient's status. In severe intoxication, arterial blood gases and pH, blood electrolytes, liver function studies, a baseline creatinine, blood counts, and urinalysis may be indicated. Watch for deteriorating CNS and respiratory function.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of large spills, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide maximum, explosion-proof ventilation. Cleanup personnel should protect against inhalation and skin or eye contact. For small spills, 1) absorb liquid with a noncombustible, absorbent material, and dispose; or 2) absorb on paper and burn. For large spills, dike far ahead to contain and collect for recycle or disposal. Use nonsparking tools to place waste liquid or absorbent in closable containers for disposal. Keep waste out of sewers, watersheds, or waterways. Follow applicable OSHA regulations (29 CFR 1910.120).
Environmental Degradation: When released on soil, acetone solvent blend probably both volatilizes and leaches into the ground and probably biodegrades. If released into water, it probably also biodegrades.
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

A Designations

d as a RCRA Hazardous Waste (40 CFR 261.21): Ignitable Waste
Acetone is listed as a RCRA Hazardous Waste (40 CFR 261.33)
Acetone is listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 5000 lb (2270 kg) [* per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Acetone and isopropyl alcohol are listed as SARA Toxic Chemicals (40 CFR 372.65)

OSHA Designations

Acetone and isopropyl alcohol are listed as Air Contaminants (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles where necessary, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious natural rubber gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(10)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

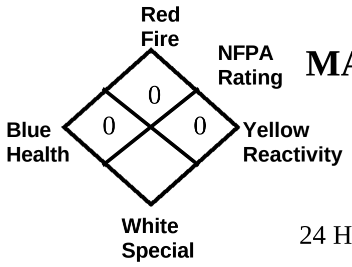
Storage Requirements: Store in a clean, cool, well-ventilated area away from heat and ignition sources, oxidizing agents, strong acids, and bases. Protect containers from physical damage. Emptied containers may still be hazardous from residual liquid or vapors. Store and handle as an OSHA Class 1B flammable liquid.
Engineering Controls: Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Make sure all engineering systems are of maximum explosion-proof design. Acetone solvent blend presents a dangerous fire and explosion hazard; form all work operations involving it carefully and in a way that prevents exposing liquid or its vapor to ignition sources. To prevent static s, electrically ground and bond all containers and pipelines used in shipping, transferring, reacting, production, and sampling operations. ider automatic sprinkler systems for fire protection in work areas.

Transportation Data (49 CFR 172.101, .102): See acetone and isopropyl alcohol (*MSDS Collection*, Nos. 300 and 324)

MSDS Collection **References:** 1, 2, 26, 38, 73, 84-94, 100, 101, 103, 116, 117, 120, 122, 124, 126, 132, 136, 138, 143, 146, 148, 159
Prepared by: M Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD ; **Edited by:** JR Stuart, MS

ALCONOX MSDS - ALCONOX MSDS - ALCONOX MSDS - ALCONOX MSDS - ALCONOX MSDS

Alconox ®



MATERIAL SAFETY DATA SHEET

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

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

I. IDENTIFICATION

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

II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

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

III. PHYSICAL/CHEMICAL CHARACTERISTICS

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

IV. FIRE AND EXPLOSION DATA

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

V. REACTIVITY DATA

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

VI. HEALTH HAZARD DATA

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

VII. PRECAUTIONS FOR SAFE HANDLING AND USE

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

VIII. CONTROL MEASURES

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

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Material Safety Data Sheets Collection:

Sheet No. 316
Benzene

Issued: 11/78 Revision: E, 8/90

Section 1. Material Identification

32

Benzene (C_6H_6) Description: Derived by fractional distillation of coal tar, hydrodealkylation of toluene or pyrolysis of gasoline, catalytic reforming of petroleum, and transalkylation of toluene by disproportionation reaction. Used as a fuel; a chemical reagent; a solvent for a large number of materials such as paints, plastics, rubber, inks, oils, and fats; in manufacturing phenol, ethylbenzene (for styrene monomer), nitrobenzene (for aniline), dodecylbenzene (for detergents), cyclohexane (for nylon), chlorobenzene, diphenyl, benzene hexachloride, maleic anhydride, benzene-sulfonic acid, artificial leather, linoleum, oil cloth, varnishes, and lacquers; for printing and lithography; in dry cleaning; in adhesives and coatings; for extraction and rectification; as a degreasing agent; in the tire industry; and in shoe factories. Benzene has been banned as an ingredient in products intended for household use and is no longer used in pesticides.
Other Designations: CAS No. 0071-43-2, benzol, carbon oil, coal naphtha, cyclohexatriene, mineral naphtha, nitration benzene, phene, phenyl hydride, pyrobenzol.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(7) for a suppliers list.

R	1
I	4
S	2*
K	4

*Skin absorption

NFPA

HMIS

H	3
F	3
R	0
PPG†	

† Sec. 8

Cautions: Benzene is a confirmed *human carcinogen* by the IARC. *Chronic low-level exposure may cause cancer (leukemia) and bone marrow damage, with injury to blood-forming tissue.* It is also a dangerous fire hazard when exposed to heat or flame.

Section 2. Ingredients and Occupational Exposure Limits

Benzene, ca 100%*

1989 OSHA PELs
(29 CFR 1910.1000, Table Z-1-A)
8-hr TWA: 1 ppm, 3 mg/m³
15-min STEL: 5 ppm, 15 mg/m³

(29 CFR 1910.1000, Table Z-2)
8-hr TWA: 10 ppm
Acceptable Ceiling Concentration: 25 ppm
Acceptable Maximum Peak: 50 ppm (10 min)†

1989-90 ACGIH
TLV-TWA: 10 ppm, 32 mg/m³

1988 NIOSH RELs
TWA: 0.1 ppm, 0.3 mg/m³
Ceiling: 1 ppm, 3 mg/m³

1985-86 Toxicity Data‡
Man, oral, LD_{Lo}: 50 mg/kg; no toxic effect noted
Man, inhalation, TC_{Lo}: 150 ppm inhaled intermittently over 1 yr in a number of discrete, separate doses affects the blood (other changes) and nutritional and gross metabolism (body temperature increase)
Rabbit, eye: 2 mg administered over 24 hr produces severe irritation

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* OSHA 29 CFR 1910.1000, Subpart Z, states that the final benzene standard in 29 CFR 1910.1028 applies to all occupational exposures to benzene except in some subsegments of industry where exposures are consistently under the action level (i.e., distribution and sale of fuels, sealed containers and pipelines, coke production, il and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsegments, the benzene limits in Table Z-2 apply.
† Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift.
‡ See NIOSH, *RTECS* (CY1400000), for additional irritative, mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 176 °F (80 °C)
Melting Point: 42 °F (5.5 °C)
Vapor Pressure: 100 mm Hg at 79 °F (26.1 °C)
Vapor Density (Air = 1): 2.7
Evaporation Rate (Ether = 1): 2.8
Molecular Weight: 78.11
Specific Gravity (15 °C/4 °C): 0.8787
Water Solubility: Slightly (0.180 g/100 g of H_2O at 25 °C)
% Volatile by Volume: 100
Viscosity: 0.6468 mPa at 20 °C

Appearance and Odor: A colorless liquid with a characteristic sweet, aromatic odor. The odor recognition threshold (100% of panel) is approximately 5 ppm (unfatigued) in air. Odor *is not* an adequate warning of hazard.

Section 4. Fire and Explosion Data

Flash Point: 12 °F (-11.1 °C), CC	**Autoignition Temperature:** 928 °F (498 °C)	**LEL:** 1.3% v/v	**UEL:** 7.1% v/v

Extinguishing Media: Use dry chemical, foam, or carbon dioxide to extinguish benzene fires. Water may be ineffective as an extinguishing agent since it can scatter and spread the fire. Use water spray to cool fire-exposed containers, flush spills away from exposures, disperse benzene vapor, and protect personnel attempting to stop an unignited benzene leak.
Unusual Fire or Explosion Hazards: Benzene is a Class 1B flammable liquid. A concentration exceeding 3250 ppm is considered a potential fire explosion hazard. Benzene vapor is heavier than air and can collect in low lying areas or travel to an ignition source and flash back. Explosive and flammable benzene vapor-air mixtures can easily form at room temperature. Eliminate all ignition sources where benzene is used, handled, or stored.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Structural firefighter's protective clothing provides limited protection. Stay out of low areas. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Runoff to sewer can create pollution, fire, and explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Benzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Benzene explodes on contact with diborane, permanganic acid, bromine pentafluoride, peroxodisulfuric acid, and eroxomonosulfuric acid. It ignites on contact with dioxygen difluoride, dioxygenyl tetrafluoroborate, iodine heptafluoride, and sodium peroxide water. Benzene forms sensitive, explosive mixture with iodine pentafluoride, ozone, liquid oxygen, silver perchlorate, nitryl perchlorate, nitric cid, and arsenic pentafluoride + potassium methoxide (explodes above 30 °C). A vigorous or incandescent reaction occurs with bromine rifluoride, uranium hexafluoride, and hydrogen + Raney nickel [above 410 °F (210 °C)]. Benzene is incompatible with oxidizing materials.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of benzene can produce toxic gases and vapors such as carbon monoxide.

Section 6. Health Hazard Data

Carcinogenicity: The ACGIH, OSHA, and IARC list benzene as, respectively, a supected human carcinogen, a cancer hazard, and, based on sufficient human and animal evidence, a human carcinogen (Group 1).

Summary of Risks: Prolonged skin contact or excessive inhalation of benzene vapor may cause headache, weakness, appetite loss, and fatigue. e most important health hazards are cancer (leukemia) and bone marrow damage with injury to blood-forming tissue from chronic low-level osure. Higher level exposures may irritate the respiratory tract and cause central nervous system (CNS) depression.

edical Conditions Aggravated by Long-Term Exposure: Exposure may worsen ailments of the heart, lungs, liver, kidneys, blood, and CNS.

Target Organs: Blood, central nervous system, bone marrow, eyes, upper respiratory tract, and skin.

Primary Entry Routes: Inhalation, skin contact.

Acute Effects: Symptoms of acute overexposure include irritation of the eyes, nose, and respiratory tract, breathlessness, euphoria, nausea, drowsiness, headache, dizziness, and intoxication. Severe exposure may lead to convulsions and unconsciousness. Skin contact may cause a drying rash (dermatitis).

Chronic Effects: Long-term chronic exposure may result in many blood disorders ranging from aplastic anemia (an inability to form blood cells) to leukemia.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin: *Quickly* remove contaminated clothing. Immediately rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.

Inhalation: Remove exposed person to fresh air. Emergency personnel should protect against inhalation exposure. Provide CPR to support breathing or circulation as necessary. Keep awake and transport to a medical facility.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* since aspiration may be fatal. Call a physician immediately.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Physician's Note: Evaluate chronic exposure with a CBC, peripheral smear, and reticulocyte count for signs of myelotoxicity. Follow up any early indicators of leukemia with a bone marrow biopsy. Urinary phenol conjugates may be used for biological monitoring of recent exposure. Acute management is primarily supportive for CNS depression.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a benzene spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel, eliminate all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation, eye contact, and skin absorption. Absorb as much benzene as possible with an inert, noncombustible material. For large spills, dike far ahead of spill and contain liquid. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of confined spaces such as sewers, watersheds, and waterways because of explosion danger. Follow applicable OSHA regulations (29 CFR 1910.120).

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U019

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 307 (a), 311 (b)(4), 112; and per RCRA, Sec. 3001]

ARA Extremely Hazardous Substance (40 CFR 355): Not listed

d as SARA Toxic Chemical (40 CFR 372.65)

IA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Tables Z-1-A and Z-2)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations at least below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all heat and ignition sources and incompatible materials. *Caution! Benzene vapor may form explosive mixtures in air.* To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas. When opening or closing benzene containers, use nonsparking tools. Keep fire extinguishers readily available.

Engineering Controls: Because OSHA specifically regulates benzene (29 CFR 1910.1028), educate workers about its potential hazards and dangers. Minimize all possible exposures to carcinogens. If possible, substitute less toxic solvents for benzene; use this material with extreme caution and only if absolutely essential. Avoid vapor inhalation and skin and eye contact. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Designate regulated areas of benzene use (see legend in the box below) and label benzene containers with "DANGER, CONTAINS BENZENE, CANCER HAZARD."

Other Precautions: Provide preplacement and periodic medical examinations with emphasis on a history of blood disease or previous exposure.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Benzene (*benzol*)
DOT Hazard Class: Flammable liquid
No.: UN1114
Label: Flammable liquid
Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Benzene
IMO Hazard Class: 3.2
ID No.: UN1114
IMO Label: Flammable liquid
IMDG Packaging Group: II

DANGER
BENZENE
CANCER HAZARD
FLAMMABLE–NO SMOKING
AUTHORIZED PERSONNEL ONLY
RESPIRATOR REQUIRED

MSDS Collection References: 1, 2, 12, 26, 73, 84-94, 100, 101, 103, 109, 124, 126, 127, 132, 134, 136, 138, 139, 143

Prepared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: MJ Upfal, MD, MPH; Edited by: JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 757
Coal Tar Creosote

Issued: 7/91

Section 1. Material Identification

34

Coal Tar Creosote (molecular formula varies with purity) Description: Three main derivations: by distillation of coal tar produced by high-temperature carbonization of bituminous coal; by mixing strained naphthalene oil, wash oil, and strained or light anthracene oil; as a by-product of conventional coal coking. It typically contains up to 160 chemicals, mainly aromatic compounds such as phenol, pyrol and pyridine. Used mainly as a wood preservative for railroad ties, poles, fence posts, marine pilings, and other lumber for outdoor use; as a water-proofing agent, fuel oil constituent, frothing agent for mineral separation, hop defoliant, and lubricant for die molds; in manufacturing chemicals; and in medicine as an antiseptic, disinfectant, antipyretic, astringent, germicide, and styptic.
Other Designations: CAS No. 8001-58-9, Awpa,® brick oil, Caswell No. 225,® coal tar oil, creosote, creosote oil, creosotum, cresylic creosote, heavy oil, liquid pitch oil, naphthalene oil, Preserv-o-sote,® Sakresote,® tar oil, wash oil.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.
Cautions: Flammable, liquid coal tar creosote is toxic by inhalation, ingestion, and skin contact. The IARC and NTP classify it as *a human carcinogen.*

R 1
I 4
S 4*
K 2
* Skin absorption

NFPA
2
2 0
-

HMIS
H 2
F 2
R 0
PPG†
† Sec. 8

* Skin absorption can occur with phenol, a major component of coal tar creosote.

Section 2. Ingredients and Occupational Exposure Limits

Coal tar creosote, ca 100%

1990 OSHA PEL
8-hr TWA: 0.2 mg/m³*

1990-91 ACGIH TLV
TWA: 0.2 mg/m³*

1987 IDLH Level
700 mg/m³

1990 NIOSH REL
0.1 mg/m³ (cyclohexane extractable portion)

1985-86 Toxicity Data†
Rat, oral, LD_{50}: 725 mg/kg; toxic effects not yet reviewed
Dog, oral, LD_{Lo}: 600 mg/kg; toxic effects not yet reviewed
Rat, TD_{Lo}: 52,416 mg/kg administered during 91 days prior to mating produces reproductive effects on fallopian tubes and ovaries
Mouse, skin, TD_{Lo}: 99 g/kg produces tumors in skin and appendages

* As coal tar pitch volatiles.
† See NIOSH, *RTECS* (GF8615000), for additional mutation, reproductive, tumorigenic, and other toxicity data.

Section 3. Physical Data

Boiling Point: 381 to 752 °F (194 to 400 °C)
Distillation Range: 446 to 554 °F (230 to 290 °C)
Heat of Combustion: -12,500 Btu/lb
Heat of Vaporization: 107 Btu/lb
Molecular Weight: Varies with purity
Density/Specific Gravity: 1.07 to 1.08 at 68 °F (20 °C)
Water Solubility: Slightly soluble
Appearance and Odor: Pure coal tar creosote is colorless, but the industrial product is a yellow to black oily liquid with an aromatic smoky smell and a burning caustic taste.

Section 4. Fire and Explosion Data

Flash Point: 165.2 °F (74 °C), CC	**Autoignition Temperature:** 637 °F (336 °C)	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO_2), or regular foam. For large fires, use fog or regular foam. Since water is least effective, use it as an extinguishing agent only when the preferred measures are unavailable. However, use water spray to cool fire-exposed containers.
Unusual Fire or Explosion Hazards: Vapors may travel to an ignition source and flash back. Containers may explode in heat of fire. Coal tar creosote presents a vapor explosion hazard indoors, outdoors, and in sewers.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Also, wear full protective clothing. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Immediately leave area if you hear a rising sound from venting safety device or notice any fire-caused tank discoloration. Isolate area for 1/2 mile in all directions if fire involves tank, rail car or tank truck. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Fully decontaminate or properly dispose of personal protective clothing.

Section 5. Reactivity Data

Stability/Polymerization: Coal tar creosote is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Creosote oil mixed with chlorosulfonic acid in a closed container causes an increase in temperature and pressure.
Conditions to Avoid: Avoid excessive heat and contact with chlorosulfonic acid.
Hazardous Products of Decomposition: Thermal oxidative decomposition of coal tar creosote can produce oxides of carbon and thick, black, acrid smoke.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA list coal tar creosote as a carcinogen.
Summary of Risks: Coal tar creosote is toxic by inhalation, ingestion, and skin contact. It contains a variety of hydrocarbons such as phenol and polycyclic aromatic hydrocarbons such as benzo[a]pyrene, benzanthracene, and phenol derivatives. The range of toxicity depends on the exposure [illegible]ration, amount, and duration. Effects may include irritation, burns, and several forms of cancer.
[illegible]l Conditions Aggravated by Long-Term Exposure: Chronic respiratory or skin diseases.
Target Organs: Eyes, skin, bladder, kidneys, and respiratory system.
Primary Entry Routes: Inhalation, ingestion, and skin contact.
Acute Effects: Skin contact may cause irritation, burning, itching, redness, pigment changes, dermatitis (a rash of redness and small bumps), or urns. Photosensitization (worsening of rash with exposure to sunlight) may occur. Inhalation may be irritating to the respiratory tract. Eye ontact may cause conjunctivitis (inflammation of the eye's lining), keratitis (corneal inflammation), or corneal burns with scarring. Ingestion may esult in nausea, vomiting, abdominal pain, rapid pulse, respiratory distress, and shock. Systemic absorption by any route (including skin bsorption) may cause trouble breathing, thready (continuous or drawn out) pulse, dizziness, headache, nausea, vomiting, salivation, and onvulsions. Exposure to large doses (particularly by ingestion) may be fatal.
hronic Effects: Dermatitis, skin cancer, and lung cancer.

IRST AID

yes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical acility. *Do not* let victim rub eyes or keep them tightly closed. Consult a physician immediately.
kin: *Quickly* remove contaminated clothing. Wash affected area with soap and flooding amounts of water for at least 15 min. For reddened or listered skin, consult a physician.
nhalation: Remove exposed person to fresh air and support breathing as needed.
ngestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of ilk or water. *Do not induce vomiting!*
fter first aid, get appropriate in-plant, paramedic, or community medical support.
ote to Physicians: Cresol may be detected in urine.

ection 7. Spill, Leak, and Disposal Procedures

pill/Leak: Notify safety personnel. Isolate hazard area, deny entry, and stay upwind of spills. Shut off all ignition sources—no flares, smoking, or lames in hazard area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. If possible with no risk, stop leak. Water pray may be used to reduce vapor but it may not prevent ignition in closed spaces. For small spills, take up with earth, sand, vermiculite, or other bsorbent, noncombustible material and place in suitable containers for later disposal. For large spills, dike far ahead of liquid spill for later isposal. Follow applicable OSHA regulations (29 CFR 1910.120).
nvironmental Degradation: Coal tar creosote is fouling to shoreline. Ecotoxicity values are: TL$_{m}$, goldfish (*Carassius auratus*), 3.51 ppm/24 hr 60:40) mixture of creosote and coal tar; LD$_{50}$, bob white quail (*Colinus virginianus*), 1,260 ppm/8 days (60:40) mixture of creosote and coal tar.
isposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

PA Designations

isted as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Material No. U051
isted as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per RCRA, Sec. 3001]
AR A Extremely Hazardous Substance (40 CFR 355): Not listed
L[illegible] a SARA Toxic Chemical (40 CFR 372.65)

[illegible]esignations

isted (as coal tar pitch volatiles) as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

ection 8. Special Protection Data

oggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since ontact lens use in industry is controversial, establish your own policy.
espirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if ecessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an CBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
ther: Wear impervious gloves, boots, aprons, and gauntlets to prevent all skin contact. Applying a layer of petroleum jelly or lanolin castor oil intment to the face reduces vapor contact and penetration through skin. Frequent change of protective garments is an additional protective easure.
entilation: Provide general and local exhaust ventilation systems equipped with high-efficiency particulate filters to maintain airborne concentations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by ontrolling it at its source.(103)
afety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
ontaminated Equipment: Take particular care to avoid any contamination of drains or ventilation ducts. Remove this material from your shoes d equipment. Launder contaminated clothing before wearing.
omments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, noking, using the toilet, or applying cosmetics.

ection 9. Special Precautions and Comments

torage Requirements: Avoid physical damage to containers. Store in a cool, dry, well-ventilated area. Store coal tar creosote as close to area of e as possible to minimize transporting distance.
ngineering Controls: Use engineering controls to keep airborne concentrations below the OSHA PEL. Institute a respiratory protection ogram that includes regular training, maintenance, inspection, and evaluation. Always perform synthesis and purification procedures under a rtical ventilation hood and make regular operational safety checks. Label doors to rooms where coal tar creosote is produced, used, or stored as ntaining a carcinogen. Locate emergency equipment at well-marked and clearly identified stations in case emergency escape is necessary.
ther Precautions: Preplacement and periodic medical examinations of exposed workers emphasizing respiratory, skin, liver, and kidney sorders, including comprehensive work and medical history, physical examination, CXR, PFTs, urinalysis, LFT, and sputum cytology as the ending physician considers appropriate. Educate workers about coal tar creosote's carcinogenicity and proper handling procedures to avoid posure.
ther Comments: Caution is in order when handling or sawing old creosote-treated lumber since it retains a considerable portion of creosote for to 25 to 30 years.

ransportation Data (49 CFR 172.101)
C[illegible]pping Name: Creosote
O[illegible]ard Class: Flammable liquid
No.: UN1136
OT Label: Flammable liquid

SDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 139, 140, 142, 143, 146, 148, 153, 159
epared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** Mark Upfal, MD, MPH; **Edited by:** JR Stuart, MS

Occupational Health Guideline for Coal Tar Pitch Volatiles

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

Anthracene

- Formula: $C_{14}H_{10}$
- Synonyms: None
- Appearance and odor: Pale green solid with a faint aromatic odor.

Phenanthrene

- Formula: $C_{14}H_{10}$
- Synonyms: None
- Appearance and odor: Colorless solid with a faint aromatic odor.

Pyrene

- Formula: $C_{16}H_{10}$
- Synonyms: None
- Appearance: Bright yellow solid

Carbazole

- Formula: $C_{12}H_{9}N$
- Synonyms: None
- Appearance and odor: Colorless solid with a faint aromatic odor.

Benzo(a)pyrene

- Formula: $C_{20}H_{12}$
- Synonyms: BaP, 3,4-benzopyrene
- Appearance and odor: Colorless solid with a faint aromatic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for coal tar pitch volatiles is 0.2 milligram of coal tar pitch volatiles per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit for coal tar products be reduced to 0.1 mg/m^3 (cyclohexane-extractable fraction) averaged over a work shift of up to 10 hours per day, 40 hours per week, and that coal tar products be regulated as occupational carcinogens. The NIOSH Criteria Document for Coal Tar Products and NIOSH Criteria Document for Coke Oven Emissions should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Coal tar pitch volatiles can affect the body if they are inhaled or if they come in contact with the eyes or skin.

- **Effects of overexposure**

Repeated exposure to coal tar pitch volatiles has been associated with an increased risk of developing bronchitis and cancer of the lungs, skin, bladder, and kidneys. Pregnant women may be especially susceptible to exposure effects associated with coal tar pitch volatiles. Repeated exposure to these materials may also cause sunlight to have a more severe effect on a person's skin. In addition, this type of exposure may cause an allergic skin rash.

- **Reporting signs and symptoms**

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to coal tar pitch volatiles.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to coal tar pitch volatiles at potentially hazardous levels:

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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Public Health Service Centers for Disease Control
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U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

1. *Initial Medical Examination:*

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to tablish a baseline for future health monitoring. Exami- ation of the oral cavity, respiratory tract, bladder, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders, for premalignant and malignant lesions, and evidence of hyperpigmentation or photosensitivity.

—Urinalysis: Coal tar pitch volatiles are associated with an excess of kidney and bladder cancer. A urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment, as well as a test for red blood cells.

—Urinary cytology: Coal tar pitch volatiles are associated with an excess of kidney and bladder cancer. Employees having 5 or more years of exposure or who are 45 years of age or older should have a urinary cytology examination.

—Sputum cytology: Coal tar pitch volatiles are associated with an excess of lung cancer. Employees having 10 or more years of exposure or who are 45 years of age or older should have a sputum cytology examination.

—14" x 17" chest roentgenogram: Coal tar pitch volatiles are associated with an excess of lung cancer. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Coal tar pitch volatiles are reported to cause an excess of bronchitis. Periodic surveillance is indicated.

—A complete blood count: Due to the possibility of nzene exposure associated with coal tar pitch vola- ies, a complete blood count is considered necessary to search for leukemia and aplastic anemia.

—Skin disease: Coal tar pitch volatiles are defatting agents and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of these agents.

2. *Periodic Medical Examination:* The aforementioned medical examinations should be repeated on an annual basis, and semi-annually for employees 45 years of age or older or with 10 or more years' exposure to coal tar pitch volatiles.

- **Summary of toxicology**

Coal tar pitch volatiles (CTPV) are products of the destructive distillation of bituminous coal and contain polynuclear aromatic hydrocarbons (PNA's). These hydrocarbons sublime readily, thereby increasing the amounts of carcinogenic compounds in working areas. Epidemiologic evidence suggests that workers intimately exposed to the products of combustion or distillation of bituminous coal are at increased risk of cancer at many sites. These include cancer of the respiratory tract, kidney, bladder, and skin. In a study of coke oven workers, the level of exposure to CTPV and the length of time exposed were related to the development of cancer. Coke oven workers with the highest risk of ancer were those employed exclusively at topside jobs r 5 or more years, for whom the increased risk of dying from lung cancer was 10-fold; all coke oven workers had a 7-½-fold increase in risk of dying from kidney cancer. Although the causative agent or agents of the cancer in coke oven workers is unidentified, it is suspected that several PNA's in the CTPV generated during the coking process are involved. Certain industrial populations exposed to coal tar products have a demonstrated risk of skin cancer. Substances containing PNA's which may produce skin cancer also produce contact dermatitis; examples are coal tar, pitch, and cutting oils. Although allergic dermatitis is readily induced by PNA's in guinea pigs, it is only rarely reported in humans from occupational contact with PNA's; these have resulted largely from the therapeutic use of coal tar preparations. Components of pitch and coal tar produce cutaneous photosensitization; skin eruptions are usually limited to areas exposed to the sun or ultraviolet light. Most of the phototoxic agents will induce hypermelanosis of the skin; if chronic photodermatitis is severe and prolonged, leukoderma may occur. Some oils containing PNA's have been associated with changes of follicular and sebaceous glands which commonly take the form of acne. There is evidence that exposures to emissions at coke ovens and gas retorts may be associated with an increased occurrence of chronic bronchitis. Coal tar pitch volatiles may be associated with benzene, an agent suspected of causing leukemia and known to cause aplastic anemia.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data—Anthracene**

1. Molecular weight: 178.2
2. Boiling point (760 mm Hg): 340 C (644 F)
3. Specific gravity (water = 1): 1.24
4. Vapor density (air = 1 at boiling point of anthracene): 6.15
5. Melting point: 217 C (423 F)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Physical data—Phenanthrene**

1. Molecular weight: 178.2
2. Boiling point (760 mm Hg): 340 C (644 F)
3. Specific gravity (water = 1): 1.18
4. Vapor density (air = 1 at boiling point of phenanthrene): 6.15
5. Melting point: 100.5 C (213 F)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Physical data—Pyrene**

1. Molecular weight: 202.3
2. Boiling point (760 mm Hg): Greater than 360 C (greater than 680 F)

3. Specific gravity (water = 1): 1.28
4. Vapor density (air = 1 at boiling point of pyrene): 6.9
5. Melting point: 150.4 C (303 F)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Physical data—Carbazole**

1. Molecular weight: 167.2
2. Boiling point (760 mm Hg): 355 C (671 F)
3. Specific gravity (water = 1): Greater than 1
4. Vapor density (air = 1 at boiling point of carbazole): 5.8
5. Melting point: 246 C (475 F)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Physical data—Benzo(a)pyrene**

1. Molecular weight: 252.3
2. Boiling point (760 mm Hg): Greater than 360 C (greater than 680 F)
3. Specific gravity (water = 1): Greater than 1
4. Vapor density (air = 1 at boiling point of benzo(a)pyrene): 8.7
5. Melting point: 179 C (354 F)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Reactivity**

1. Conditions contributing to instability: None hazardous
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: None
4. Special precautions: None

- **Flammability**

1. Flash point: Anthracene: 121 C (250 F) (closed cup); Others: Data not available
2. Autoignition temperature: Anthracene: 540 C (1004 F); Others: Data not available
3. Flammable limits in air, % by volume: Anthracene: Lower: 0.6; Others: Data not available
4. Extinguishant: Foam, dry chemical, and carbon dioxide

- **Warning properties**

Grant states that "coal tar and its various crude fractions appear principally to cause reddening and squamous eczema of the lid margins, with only small erosions of the corneal epithelium and superficial changes in the stroma, which disappear in a month following xposure. Chronic exposure of workmen to tar fumes ıd dust has been reported to cause conjunctivitis and discoloration of the cornea in the palpebral fissure, either near the limbus or, in extreme cases, across the whole cornea. Occasionally, epithelioma of the lid margin has been attributed to contact with coal tar."

MONITORING AND MEASUREMENT PROCEDURES

- **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Method**

Coal tar products may be sampled by collection on a glass fiber filter with subsequent ultrasonic extraction and weighing. An analytical method for coal tar pitch volatiles is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 1, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00267-3).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent skin contact with condensed coal tar pitch volatiles, where skin contact may occur.
- If employees' clothing may have become contaminated with coal tar pitch volatiles, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing contaminated with coal tar pitch volatiles

should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of coal tar pitch volatiles from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the coal tar pitch volatiles, the person performing the operation should be informed of coal tar pitch volatiles's hazardous properties.

- Employees should be provided with and required to use splash-proof safety goggles where condensed coal tar pitch volatiles may contact the eyes.

SANITATION

- Workers subject to skin contact with coal tar pitch volatiles should wash with soap or mild detergent and water any areas of the body which may have contacted coal tar pitch volatiles at the end of each work day.
- Employees who handle coal tar pitch volatiles should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.
- Areas in which exposure to coal tar pitch volatiles may occur should be identified by signs or other appropriate means, and access to these areas should be limited to authorized persons.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in hich exposure to coal tar pitch volatiles may occur and control methods which may be effective in each case:

Operation	Controls
Liberation from extraction and packaging from coal tar fraction of coking	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a binding agent in manufacture of coal briquettes used for fuel; use as a dielectric in the manufacture of battery electrodes, electric-arc furnace electrodes, and electrodes for alumina reduction	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in manufacture of roofing felts and papers and roofing	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use for protective coatings for pipes for underground conduits and drainage; use as a coating on concrete as waterproofing and corrosion-resistant material; use in road paving and sealing	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in manufacture and repair of refractory brick; use in production of foundry cores; use in manufacture of carbon ceramic items	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

- **Eye Exposure**

If condensed coal tar pitch volatiles get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with these chemicals.

- **Skin Exposure**

If condensed coal tar pitch volatiles get on the skin, wash the contaminated skin using soap or mild detergent and water. Be sure to wash the hands before eating or smoking and to wash thoroughly at the close of work.

- **Breathing**

If a person breathes in large amounts of coal tar pitch volatiles, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

- **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of releases until cleanup has been completed.
- If coal tar pitch volatiles are released in hazardous concentrations, the following steps should be taken:

1. Ventilate area of spill.

2. Collect released material in the most convenient and safe manner for reclamation or for disposal in sealed containers in a secured sanitary landfill.

- Waste disposal method:

Coal tar pitch volatiles may be disposed of in sealed containers in a secured sanitary landfill.

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RESPIRATORY PROTECTION FOR COAL TAR PITCH VOLATILES

Condition	Minimum Respiratory Protection* Required Above 0.2 mg/m³
Particulate and Vapor Concentration	
2 mg/m³ or less	A chemical cartridge respirator with an organic vapor cartridge(s) and with a fume or high-efficiency filter. Any supplied-air respirator. Any self-contained breathing apparatus.
10 mg/m³ or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s) and with a fume or high-efficiency filter. A gas mask with a chin-style or a front- or back-mounted organic vapor canister and with a full facepiece and a fume or high-efficiency filter. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
200 mg/m³ or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode. A powered air-purifying respirator with an organic vapor cartridge and a high-efficiency particulate filter.
400 mg/m³ or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 400 mg/m³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and particulates, including pesticide respirators which meet the requirements of this class. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for Cyanide

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

APPLICABILITY

The general guidelines contained in this document apply to all cyanides. Physical and chemical properties of two specific compounds are provided for illustrative purposes.

SUBSTANCE IDENTIFICATION

Potassium cyanide

- Formula: KCN
- Synonyms: None
- Appearance and odor: White solid with a faint almond odor.

Sodium cyanide

- Formula: NaCN
- Synonyms: None
- Appearance and odor: White solid with a faint almond odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for cyanide is 5 milligrams of cyanide per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit be changed to a ceiling of 5 milligrams cyanide per cubic meter of air averaged over a 10-minute period. The NIOSH Criteria Document for Hydrogen Cyanide and Cyanide Salts should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- Routes of exposure

Cyanide can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. Sufficient cyanide may be absorbed through the skin, especially if there are cuts to cause fatal poisoning.

- Effects of overexposure

1. *Short-term Exposure:* Inhalation or ingestion of cyanide salts may be rapidly fatal. Larger doses by inhalation or swallowing may cause the person to rapidly lose consciousness, stop breathing, and die. In some cases, there are convulsions. At lower levels of exposure, the earlier symptoms include weakness, headache, confusion, nausea, and vomiting. These symptoms may be followed by unconsciousness and death. Occasionally, convulsions occur. Milder forms of intoxication may result only in weakness, dizziness, headache, and nausea. The dust of cyanide salts is irritating to the eyes. In the presence of tears, it may cause the symptoms of poisoning described above. The dust of cyanide salts may produce irritation of the nose and skin. Strong solutions of cyanide salts are corrosive and may produce ulcers.
2. *Long-term Exposure:* Effects from chronic exposure to cyanide are non-specific and rare.
3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to cyanide.

- Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to cyanide at potentially hazardous levels:

1. *Initial Medical Examination:*

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of fainting spells, such as occur in various types of cardiovascular and nervous disorders,

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Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

September 1978

and those unusually susceptible to effects of anoxia or with anemia would be expected to be at increased risk from exposure. Examination of the cardiovascular, nervous, and upper respiratory systems, and thyroid should be stressed. The skin should be examined for evidence of chronic disorders.

—Skin disease: Cyanide is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—14" x 17" chest roentgenogram: Cyanide causes human lung damage. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Cyanide is a respiratory irritant. Persons with impaired pulmonary function may be at increased risk from exposure. Periodic surveillance is indicated.

2. *Periodic Medical Examination:* The aforementioned medical examinations should be repeated on an annual basis.

3. *First Aid Kits:* First aid kits should be readily available in workplaces where there is a potential for the release of cyanide. These kits should contain a minimum of 48 ampules, each of 0.3 ml amyl nitrate, and complete instructions for use. In addition, 2 physician's kits should be immediately available to trained medical personnel. These kits should contain the above quantity of amyl nitrate as well as sterile sodium nitrite solution (3%) and sterile sodium thiosulfate solution (25%). All of the above drugs should be replaced at least biannually to ensure their potency.

- Summary of toxicology

The dust of cyanide salts, a source of cyanide ion, is an asphyxiant due to an inhibitory action on metabolic enzyme systems and can be rapidly fatal. Cyanide exerts this effect because it inactivates certain enzymes by forming very stable complexes with the metal in them. Cytochrome oxidase is probably the most important of these, since it occupies a fundamental position in the respiratory process and is involved in the ultimate electron transfer to molecular oxygen. Since cytochrome oxidase is present in practically all cells that function under aerobic conditions, and since the cyanide ion diffuses easily to all parts of the body, it is capable of suddenly bringing to a halt practically all cellular respiration. In the presence of even weak acids, hydrocyanic acid (HCN) gas is liberated from cyanide salts; a few inhalations of higher concentrations of HCN may be followed by almost instantaneous collapse and cessation of respiration; 270 ppm HCN is immediately fatal to humans, 181 ppm is fatal after 10 minutes, 135 ppm after 30 minutes, and 110 ppm may be fatal in 1 hour. The ingestion by humans of 50 to 100 mg of sodium or potassium cyanide may also be fatal. At lower levels of exposure to HCN, the earliest symptoms of intoxication may include weakness, headache, confusion, and occasionally nausea and vomiting; respiratory rate and depth is usually increased initially and at later stages becomes slow and gasping; if cyanosis is present, it usually indicates that respiration has either ceased or has been very inadequate for a few minutes. Humans tolerate 45 to 54 ppm for ½ to 1 hour without immediate or delayed effects, while 18 to 36 ppm may result in some symptoms after an exposure of several hours. Sodium cyanide dust is irritating to the eyes; in the presence of tears it may liberate HCN, which can be absorbed and cause systemic intoxication. Skin contact with dust may be irritating; strong solutions on the skin produce ulcers which are slow in healing. Cyanide is one of the few toxic materials for which an antidote exists; it functions as follows: First, amyl nitrite (inhalation) and sodium nitrite (intravenously) are administered to form methemoglobin, which binds firmly with free cyanide ions. This traps any circulating cyanide ions. The formation of 10 to 20% methemoglobin usually does not involve appreciable risk, yet provides a large amount of cyanide-binding substance. Second, sodium thiosulfate is administered intravenously to increase the rate of conversion of cyanide to the less toxic thiocyanate. Methylene blue should not be administered, because it is a poor methemoglobin former and, moreover, promotes the conversion of methemoglobin back to hemoglobin.

CHEMICAL AND PHYSICAL PROPERTIES

- Physical data—Potassium cyanide

1. Molecular weight: 65.1
2. Boiling point (760 mm Hg): Data not available
3. Specific gravity (water = 1): 1.55
4. Vapor density (air = 1 at boiling point of potassium cyanide): Not applicable
5. Melting point: 635 C (1175 F)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F): 71.6
8. Evaporation rate (butyl acetate = 1): Not applicable

- Physical data—Sodium cyanide

1. Molecular weight: 49
2. Boiling point (760 mm Hg): 1500 C (2732 F) (extrapolated)
3. Specific gravity (water = 1): 1.6
4. Vapor density (air = 1 at boiling point of sodium cyanide): Not applicable
5. Melting point: 560 C (1040 F)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F): 58
8. Evaporation rate (butyl acetate = 1): Not applicable

- Reactivity

1. Conditions contributing to instability: None. Hazardous if kept in closed containers. It may form toxic concentrations of hydrogen cyanide gas when in prolonged contact with air in a closed area.

2. Incompatibilities: Contact with strong oxidizers such as nitrates and chlorates may cause fires and

explosions. Contact with acids and acid salts causes immediate formation of toxic and flammable hydrogen cyanide gas.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen cyanide and carbon monoxide) may be released when cyanide decomposes.

4. Special precautions: Cyanide may react with carbon dioxide in ordinary air to form toxic hydrogen cyanide gas.

- Flammability

1. Not combustible

- Warning properties

1. Odor Threshold: No quantitative information is available concerning the odor threshold of sodium or potassium cyanide. HCN, however, is evolved from these substances in the presence of moisture. The Manufacturing Chemists Association states that "although HCN has a characteristic odor, its toxic action at hazardous concentrations is so rapid that it is of no value as a warning property."

2. Eye Irritation Level: Cyanide (as CN) is not known to be an eye irritant. However, according to Grant, HCN can produce eye irritation after chronic exposures.

3. Evaluation of Warning Properties: Although cyanide (as CN) has a negligible vapor pressure, in the presence of moisture HCN can be given off. HCN does not have adequate warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- Eight-Hour Exposure Evaluation

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- Ceiling Evaluation

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of cyanide. Each measurement should consist of a ten (10) minute sample or series of consecutive samples totalling ten (10) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

- Method

Sampling and analyses may be performed by collection of cyanide with a cellulose membrane filter and an impinger containing sodium hydroxide, followed by analysis by direct potentiometry. An analytical method for cyanide is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with cyanide or liquids containing cyanide.
- If employees' clothing has had any possibility of being contaminated with cyanide, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing which has had any possibility of being contaminated with cyanide should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of cyanide from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the cyanide, the person performing the operation should be informed of cyanide's hazardous properties.
- Where there is any possibility of exposure of an employee's body to cyanide or liquids containing cyanide, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Non-impervious clothing which becomes contaminated with cyanide should be removed immediately and not reworn until the cyanide is removed from the clothing.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of cyanide or liquids containing cyanide contacting the eyes.

- Where there is any possibility that employees' eyes may be exposed to cyanide or liquids containing cyanide, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with cyanide should be immediately washed or showered with soap or mild detergent and water to remove any cyanide.
- Workers subject to skin contact with cyanide should wash with soap or mild detergent and water any areas of the body which may have contacted cyanide at the end of each work day.
- Eating and smoking should not be permitted in areas where cyanide or liquids containing cyanide are handled, processed, or stored.
- Employees who handle cyanide or liquids containing cyanide should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to cyanide may occur and control methods which may be effective in each case:

Operation	Controls
Use as fumigants and pesticides in greenhouses, ships, mills, and warehouses; use of cyanogen chloride as a warning agent in fumigant gases	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in metal treatment in nitriding, tempering, and case hardening steel; coloring of metals by chemical or electrolytic process; cleaning and coating metals; welding and cutting of heat-resistant metals; liberation during ore extraction and metal purification	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use of calcium cyanamid in fertilizer on soil; during chemical synthesis for manufacture of intermediates in pharmaceuticals, dyes, vitamins, plastics, and sequestering agents; preparation of nitriles, carbylamines, cyano fatty acids, and inorganic cyanides	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in cellulose technology; paper manufacture; in dyeing; as cement stabilizers; use in photography as fixatives, and in blueprinting and process engraving; liberation in blast furance gases or in handling of illuminating gas	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

- Eye Exposure

If cyanide gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with cyanides.

- Skin Exposure

If cyanide gets on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If cyanide penetrates through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention immediately.

- Breathing

If a person breathes in large amounts of cyanide, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

- Swallowing

When cyanide has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

- Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.
- If cyanide is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. Collect spilled material in the most convenient and safe manner for reclamation, or for treatment in a cyanide disposal system.

- Waste disposal method:

After treatment as in above, cyanide may be disposed of in a secured sanitary landfill.

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RESPIRATORY PROTECTION FOR CYANIDE

Condition	Minimum Respiratory Protection* Required Above 5 mg/m³
Particulate Concentration	
50 mg/m³ or less	Any supplied-air respirator. Any self-contained breathing apparatus.
Greater than 50 mg/m³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against hydrogen cyanide and particulates. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Material Safety Data Sheet

from Genium's Reference Collection
Genium Publishing Corporation
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GENIUM PUBLISHING CORP.

No. 385

ETHYL BENZENE
(Revision A)
Issued: August 1978
Revised: November 1988

SECTION 1. MATERIAL IDENTIFICATION

27

Material Name: ETHYL BENZENE

Description (Origin/Uses): Used as a solvent and as an intermediate in the production of styrene monomer.

Other Designations: Phenylethane; Ethylbenzol; $C_2H_5C_6H_5$; CAS No. 0100-41-4

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

3
2 0
-
NFPA

HMIS
H 2
F 3
R 0
PPG*
*See sect. 8

R 1
I 3
S 2
K 4

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Ethyl Benzene, CAS No. 0100-41-4 *See NIOSH, *RTECS* (DA0700000), for additional data with references to reproductive, irritative, and mutagenic effects.	Ca 100	**OSHA PELs** 8-Hr TWA: 100 ppm, 435 mg/m³ 15- Min STEL: 125 ppm, 545 mg/m³ **ACGIH TLVs, 1988-89** TLV-TWA: 100 ppm, 435 mg/m³ TLV-STEL: 125 ppm, 545 mg/m³ **Toxicity Data*** Human, Inhalation, TC_{Lo}: 100 ppm (8 Hrs) Rat, Oral, LD_{50}: 3500 mg/kg

SECTION 3. PHYSICAL DATA

Boiling Point: 277°F (136°C)
Melting Point: -139°F (-95°C)
Vapor Pressure: 7.1 Torrs at 68°F (20°C)
Vapor Density (Air = 1): 3.7
% Volatile by Volume: Ca 100

Molecular Weight: 106 Grams/Mole
Solubility in Water (%): Slight
Specific Gravity (H_2O = 1): 0.86258 at 77°F (25°C)

Appearance and Odor: A clear, colorless, flammable liquid; characteristic aromatic hydrocarbon odor.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method: 64°F (18°C) CC	Autoignition Temperature: 810°F (432.22°C)	LEL: 1% v/v	UEL: 6.7% v/v

Extinguishing Media: Use foam, dry chemical, or carbon dioxide to put out ethyl benzene fires. A water spray may be ineffective in extinguishing the fire, because it can scatter and spread the burning liquid. Use water spray to cool fire-exposed containers of ethyl benzene, to disperse ethyl benzene vapor, and to protect personnel attempting to stop an ethyl benzene leak. **Unusual Fire or Explosion Hazards:** This liquid can readily form explosive vapor-air mixtures, especially when heated. Ethyl benzene vapor is heavier than air and may travel a considerable distance to a low-lying source of ignition and flash back to its origin. **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Ethyl benzene is stable in closed containers during routine operations. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Hazardous chemical reactions can occur between ethyl benzene and strong oxidizing agents, acids, ammonia, and bases. **Conditions to Avoid:** Avoid any exposure to sources of ignition such as heat, sparks, open flame, and lighted tobacco products, etc., and to incompatible chemicals. Use caution when entering confined spaces, particularly low-lying areas where explosive concentrations of ethyl benzene vapor may be present. Provide good ventilation to such areas to prevent the concentration of this vapor. **Hazardous Products of Decomposition:** Thermal-oxidative degradation can include toxic gases such as carbon monoxide and/or aromatic hydrocarbon gases.

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity: Ethyl benzene is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: Ethyl benzene vapor is severely irritating to the eyes and to the mucous membranes of the respiratory system. Sustained inhalation of excessive levels can cause depression of the central nervous system (CNS) characterized by dizziness, headache, narcosis, and coma. Skin contact with liquid ethyl benzene causes irritation; dermatitis and defatting can also develop. The acute oral toxicity of ethyl benzene is low; however, ingestion of it presents a serious aspiration hazard. Aspirating even a small amount into the lungs can result in extensive edema (lungs filled with fluid) and hemorrhaging of the lung tissue. No systemic effects are expected at the levels that produce pronounced, unignorable, disagreeable skin and eye irritation. The TLVs cited in section 2 are set to prevent this intolerable irritation. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** Skin, eyes, respiratory system, and CNS. **Primary Entry:** Inhalation, skin contact **Acute Effects:** Irritation of the skin, eyes, and respiratory system. Also, cardiac-rhythm disturbance due to sensitization; acute bronchitis, bronchospasm, pulmonary and laryngeal edema; euphoria; headache; giddiness; dizziness; and incoordination, as well as possible depression; confusion; and coma. **Chronic Effects:** None reported. **First Aid:** Eyes. Immediately

SECTION 6. HEALTH HAZARD INFORMATION, cont.

flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes. **Skin.** Rinse the affected area with plenty of water, then wash it with soap and water. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. **Ingestion.** Unlikely. Should this type of exposure occur, the aspiration hazard must be considered. Do not induce vomiting unless directed to do so by a physician. To prevent aspiration by spontaneous vomiting, keep the victim's head low (between his or her knees). **Get medical help (in plant, paramedic, community) for all exposures.** Seek prompt medical assistance for further treatment, observation, and support after first aid. **Note to Physician:** Professional judgment is required as to whether or not to induce vomiting because of the possibility of aspiration. A gastric lavage may be administered, followed by saline catharsis, if this procedure is appropriate to the specific incident. Monitor cardiac and pulmonary functions.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate unnecessary personnel, eliminate all sources of ignition immediately, and provide adequate explosion-proof ventilation. Cleanup personnel need protection against skin or eye contact with this liquid as well as inhalation of its vapor (see sect. 8). Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways. Waste **Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).

EPA Designations (40 CFR 302.4)

CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg), per the Clean Water Act (CWA), §§ 311 (b) (4) and 307 (a).

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Wear a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, and gauntlets, etc., to prevent prolonged or repeated skin contact with this material. **Ventilation:** Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of this material below the OSHA PEL standard cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale ethyl benzene vapor.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store ethyl benzene in closed containers in a cool, dry, well-ventilated area away from sources of ignition and strong oxidizers. Protect containers from physical damage. **Special Handling/Storage:** Outside, isolated, detached, or remote storage is recommended for large quantities of ethyl benzene. Isolate bulk storage areas from acute fire hazards. **Engineering Controls:** Make sure all engineering systems (production, transportation) are of maximum explosion-proof design. To prevent static sparks, electrically ground and bond all containers, pipelines, etc., used in shipping, transferring, reacting, production, and sampling operations. **Other:** Use safety cans for transferring small amounts of ethyl benzene.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Ethyl Benzene
DOT Hazard Class: Flammable Liquid
ID No. UN1175
DOT Label: Flammable Liquid
DOT Packaging Exceptions: 49 CFR 173.118
DOT Packaging Requirements: 49 CFR 173.119

IMO Shipping Name: Ethylbenzene
IMO Hazard Class: 3.2
IMO Label: Flammable Liquid
IMDG Packaging Group: II

References: 1, 26, 38, 84-94, 100, 116, 117, 120, 122.

Prepared by PJ Igoe; BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: W Silverman, MD

Material Safety Data Sheet

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GENIUM PUBLISHING CORP.

No. 30A

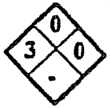
HYDROCHLORIC ACID
(Revision B)
Issued: October 1977
Revised: November 1988

SECTION 1. MATERIAL IDENTIFICATION

27

Material Name: HYDROCHLORIC ACID

Description (Origin/Uses): Used in the production of chlorides; in refining ore in the production of tin and tantalum; for the neutralization of bases; for pickling and cleaning metal products; for oil- and gas-well treatments; and in removing scale from boilers and heat-exchange equipment.



NFPA

Other Designations: Aqueous Hydrogen Chloride; Muriatic Acid; HCl/H_2O; CAS No. 7647-01-0

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

HMIS			
H	3	R	1
F	0	I	4
R	0	S	4
PPG*		K	0

*See sect. 8

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Hydrogen Chloride, CAS No. 7647-01-0	38 or Less	**OSHA PEL** Ceiling: 5 ppm, 7 mg/m³ **ACGIH TLV, 1988-89** TLV-Ceiling: 5 ppm, 7 mg/m³
Water	Balance*	
*Impurities such as iron, chlorine, and traces of organic matter may be present in small amounts, depending on the grade of acid. **See NIOSH, *RTECS* (MW4025000), for additional data with references to reproductive and mutagenic effects. Continue to monitor NIOSH, *RTECS* (MW40300000), for toxicity data on hydrochloric acid itself.		**Toxicity Data**** Human, Inhalation, LC_{Lo}: 1300 ppm (30 Mins) Rat, Inhalation, LC_{50}: 3124 ppm (1 Hr) Rabbit, Oral, LD_{50}: 900 mg/kg

SECTION 3. PHYSICAL DATA

Boiling Point: 227°F (109°C) (20.22%)
Melting Point: -85°F (-65°C) (20.69%)
Vapor Density (Air = 1): 1.268
pH: Strong Mineral Acid

Molecular Weight: Not Applicable
Solubility in Water (%): Complete
Specific Gravity (H_2O = 1): >1
% Volatile by Volume: Ca 100

Appearance and Odor: A clear, colorless-to-lightly yellowed, fuming liquid; sharp, pungent, characteristic, irritating odor of hydrogen chloride gas. This odor is detectable at 1 to 5 ppm and becomes unpleasant and irritating at 5 to 10 ppm; however, the odor serves as a good warning property.

Comments: The specific physical properties of aqueous hydrochloric acid solutions vary with the amount of dissolved hydrogen chloride gas. Hydrochloric acid forms a constant boiling azeotrope (a mixture of hydrochloric acid and water that behaves like a single substance in that its vapor has the same composition as the mixture itself) with water (at 227°F or 109°C) that contains 20.22% hydrogen chloride and has a density of 1.096. Boiling weaker or stronger aqueous solutions results in the loss of either component until the constant boiling acid is produced.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	LEL	UEL
*	*	*	*

Extinguishing Media: *Hydrochloric acid solutions do not burn. Use extinguishing agents that will put out the surrounding fire. **Unusual Fire or Explosion Hazards:** Use a water spray to cool fire-exposed containers of hydrochloric acid to prevent ruptures. Explosive hydrogen gas can be produced by the reaction of hydrochloric acid with metals such as iron. Neutralize spilled hydrochloric acid with limestone, slaked lime, or soda ash to minimize the possible generation of hydrogen gas. **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Special neutralization procedures, if applicable, include the application of chemically basic substances such as soda ash or slaked lime.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Hydrochloric acid is stable in closed containers during routine operations at room temperature. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Hydrochloric acid reacts dangerously with acetic anhydride, 2-aminoethanol, ammonium hydroxide, calcium phosphide, chlorosulfonic acid, ethylene diamine, ethylenimine, oleum, perchloric acid, ß-propiolactone, propylene oxide, silver perchlorate and carbon tetrachloride, sodium hydroxide, sulfuric acid, uranium phosphide, vinyl acetate, sodium, and many carbide compounds (Genium ref. 84). This material is a strong mineral acid that is very reactive with bases. **Conditions to Avoid:** Avoid exposure to incompatible chemicals and to any other material whose compatibility with hydrochloric acid or its vapor has not yet been established. The corrosive action of hydrochloric acid on most metals can liberate extremely flammable/explosive hydrogen gas (H_2); piping stems and containment systems must be chosen carefully. **Hazardous Products of Decomposition:** During fires hydrochloric acid may ecompose by reacting with certain metals to produce very flammable and explosive hydrogen gas (H_2). Significant amounts of hydrogen chloride gas (HCl) are given off at room temperature; the rate of this generation increases as the temperature and the strength (1%) by weight of HCl in H_2O increase. **Comments:** Reactions between hydrochloric acid and cyanides, sulfides, and formaldehyde, will produce extremely toxic hydrogen cyanide (HCN), hydrogen sulfide (H_2S), sulfur dioxide (SO_2), and *bis*chloromethylether, respectively.

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity: Hydrochloric acid is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: See Genium Industrial MSDS 30 for details of the health effects of hydrogen chloride gas. Hydrochloric acid solutions will generate hydrogen chloride gas with all its health effects. These are irritating to the skin, eyes, and mucous membranes of the upper respiratory tract (URT). The severity of eye injury from splashes depends upon quantity, concentration/strength, and duration of the contact. ermanent visual damage has been reported. Ingestion of hydrochloric acid causes corrosion of the mucous membranes, esophagus, and omach, as well as nausea, vomiting, intense thirst, and diarrhea. Erosion of exposed teeth may occur. Circulatory collapse and death are possible. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** Skin, eyes, URT. **Primary Entry:** Inhalation, skin contact. **Acute Effects:** Corrosive skin and eye burns, tissue damage, and severe irritation of the URT. **Chronic Effects:** None reported. **FIRST AID:** Eyes. Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. **Skin.** Rinse the affected area with flooding amounts of water and then wash it with soap and water. Remove contaminated clothing under a safety shower. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. **Ingestion.** Not likely. Should this type of exposure occur, and the exposed person is responsive, give him or her 2 to 3 glasses of water, then milk of magnesia or limewater to drink. Do not induce vomiting. Spontaneous laryngeal spasms can occur. Never give anything by mouth to someone who is unconscious or convulsing. **Get medical help (in plant, paramedic, community) for all exposures.** Seek prompt medical assistance for further treatment, observation, and support after first aid. **Note to physician:** Treatment for respiratory effects following inhalation of hydrogen chloride gas includes using a 5% sodium bicarbonate solution as an aerosol; maintaining a proper fluid balance (diuretics may be useful); and decreasing the inflammatory response of the lungs by administering steroids on a short-term basis (2 to 4 days). Severe inhalation exposure requires hospitalization and observation (72-hour minimum) for the delayed onset of pulmonary edema. Serial chest X rays and respiratory support, including intubation, may be required as an early intervention.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate unnecessary personnel, eliminate all sources of ignition immediately (hydrogen gas may be generated), and provide adequate ventilation. Cleanup personnel need a full set of protective clothing, including a self-contained breathing apparatus (SCBA). Small spills and residue can be covered with an excess of a mixture of soda ash and slaked lime. After neutralization, do not flush waste directly to a sewer or into lakes, ponds, or streams. **Waste Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. The allowable concentration of neutral salt in the effluent discharge is apt to be regulated; study and follow Federal, state, and local regulations. Consider saving the waste hydrochloric acid for use as a neutralizing agent during cleanup operations of basic materials.

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).
EPA Designations (40 CFR 302.4)
CERCLA Hazardous Substance, Reportable Quantity: 5000 lbs (2270 kg), per the Clean Water Act (CWA), §311 (b) (4)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Wear a NIOSH-approved respirator per Genium reference 88 r the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). or emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. All respirators must be acid resistant. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, gauntlets, etc., to prevent any contact with this material. All clothing must be acid resistant. **Ventilation:** Install and operate general and local maximum-explosion-proof ventilation systems powerful enough to maintain airborne levels of hydrogen chloride below the OSHA PEL cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. Make ventilation system ductwork and exposed fan components acid resistant. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from your shoes and equipment. **Other:** Design all engineering systems to be acid resistant and explosion proof (hydrogen gas may be accidentally generated). **Comments:** Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale hydrochloric acid vapor.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store hydrochloric acid in closed containers in a cool, dry, well-ventilated area away from sources of ignition, strong oxidizers, strong bases, out of direct sunlight, and away from incompatible chemicals (see sect. 5). Protect containers from physical damage. **Special Handling/Storage:** Storage areas should have acid-resistant floors and approved drainage facilities. Use nonsparking tools in areas around tanks and pipes where hydrogen gas may be generated. **Engineering Controls:** Make sure all engineering systems (production, transportation) are of maximum-explosion-proof design. Ground and bond all containers and pipelines, etc., used in shipping, transferring, reacting, production, and sampling operations to prevent static sparks. Hydrogen gas may become concentrated inside metal equipment; perform operations to search out possible hidden areas of hydrogen gas carefully. **Other Precautions:** Carefully follow your supplier's recommendations concerning the proper handling and storage procedures for hydrochloric acid. Provide emergency neutralization materials (soda ash, limestone, or slaked lime) and equipment near storage and use areas.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Hydrochloric Acid
DOT Hazard Class: Corrosive Material
ID No. UN1789
DOT Label: Corrosive
DOT Packaging Requirements, DOT Packaging Exceptions: 49 CFR 173.263

IMO Shipping Name: Hydrochloric Acid, Solution
IMO Hazard Class: 8
IMO Label: Corrosive
IMDG Packaging Group: II

eferences: 1, 26, 38, 84-94, 100, 116, 117, 120, 122.

Prepared by PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: W Silverman, MD

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Material Safety Data Sheets Collection:

Sheet No. 354
Methyl Alcohol

Issued: 11/77 Revision: D, 11/91

Section 1. Material Identification

36

Methyl alcohol (CH_3OH) Description: Derived from destructive distillation of wood, oxidation of hydrocarbons, or high-pressure catalytic synthesis from hydrogen and carbon dioxide or carbon monoxide. Used as a solvent in manufacturing industrial chemicals and chemical pharmaceuticals, a raw material for making formaldehyde and methyl esters, a softening agent for pyroxylin plastics, a dehydrator for natural gas, a feedstock for manufacturing synthetic proteins by continuous fermentation, an octane booster in gasoline, an extractant for animal and vegetable oils; in antifreeze for automotive radiators, air brakes, gasoline, and diesel oil; and in denaturing ethanol.

Other Designations: CAS No. 67-56-1, carbinol, Columbian spirits, methanol, methyl hydroxide, methylol, monohydroxymethane, pyroxylic spirit, wood alcohol, wood naphtha, wood spirit.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(TM) for a suppliers list.

Cautions: Methyl alcohol is moderately toxic by ingestion and mildly toxic by inhalation and skin absorption. It is flammable, volatile, and a dangerous fire hazard.

R 1
I 2
S 1*
K 4
* Skin absorption

NFPA

HMIS
H 2
F 3
R 0
PPG†
† Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Methyl alcohol, ca 100%

1990 OSHA PELs (Skin)
8-hr TWA: 200 ppm (260 mg/m³)
15-min STEL: 250 ppm (310 mg/m³)

1990 IDLH Level
25,000 ppm

1991-92 ACGIH TLVs (Skin)
TWA: 200 ppm (262 mg/m³)
STEL: 250 ppm (328 mg/m³)

1990 DFG (Germany) MAK
200 ppm (260 mg/m³)

1990 NIOSH RELs (Skin)
TWA: 200 ppm (260 mg/m³)
Ceiling: 250 ppm (325 mg/m³)

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 300 ppm caused eye (visual field change), CNS (headache), and pulmonary effects
Human, oral, LD_{Lo}: 428 mg/kg causes CNS (headache) and pulmonary (respiratory change) effects
Rat, oral, TD_{Lo}: 7500 mg/kg administered continuously to the female during the 17th to 19th day of gestation produced behavioral effects on newborns
Rat, inhalation, TC_{Lo}: 20,000 ppm/7 hr administered continuously to the female during the 1st to 22nd day of gestation produced specific developmental abnormalities

* See NIOSH, *RTECS* (PC1400000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: 148 °F (64.5 °C)
Freezing Point: -144.04 °F (-97.8 °C)
Vapor Pressure: 29 mm Hg at 68 °F (20 °C)
Vapor Density (air = 1): 1.11
Viscosity: 0.00593 P at 68 °F (20 °C)

Molecular Weight: 32.05
Density: 0.7924 at 68 °F (20 °C)
Water Solubility: Soluble
Other Solubilities: Soluble in ethanol, ether, benzene, ketones, and most organic solvents

Appearance and Odor: Clear, colorless, volatile liquid with a slight alcohol odor when pure, a disagreeably pungent odor when crude, and a low 10-ppm odor threshold.

Section 4. Fire and Explosion Data

Flash Point: 54 °F (12 °C), CC	**Autoignition Temperature:** 878 °F (470 °C)	**LEL:** 6% v/v	**UEL:** 36.5% v/v

Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO_2), water spray, or alcohol-resistant foam. For large fires, use water spray, fog, or alcohol-resistant foam. Do not scatter material with any more water than needed to extinguish fire.

Unusual Fire or Explosion Hazards: Methyl alcohol is a dangerous fire hazard when exposed to heat, flame, or oxidizers. It is explosive in its vapor form when exposed to heat or flame. Vapors may travel to an ignition source and flash back.

Special Fire-fighting Procedures: Since fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Also, wear full protective clothing. Structural firefighters' protective clothing is *ineffective* for fires involving methyl alcohol. If possible without risk, remove container from fire area. Apply cooling water to sides of fire-exposed container until fire is well out. Stay away from ends of tanks. Leave area immediately if you hear a rising sound from venting safety device or see any tank discoloration due to fire. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Methyl alcohol is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Methyl alcohol is incompatible with beryllium dihydride, metals (such as potassium or magnesium), oxidants (such as barium perchlorate, bromine, chlorine, hydrogen peroxide, and sodium hypochlorite), potassium tertbutoxide, carbon tetrachloride + metals; reacts explosively with chloroform + heat, and diethyl zinc; and reacts violently with alkyl aluminum salts, acetyl bromide, chloroform + sodium hydroxide, cyanuric chloride, and nitric acid.

Conditions to Avoid: Avoid vapor inhalation and contact with oxidizers and other incompatibles.

Hazardous Products of Decomposition: Thermal oxidative decomposition of methyl alcohol can produce carbon oxides (CO and CO_2), possible formaldehyde (HCHO) and acrid smoke, and irritating fumes.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA do not list methyl alcohol as a carcinogen.
Summary of Risks: Methyl alcohol is toxic mainly to the nervous system, particularly optic nerves, where damage can progress to permanent blindness. Poisoning may also result in metabolic acidosis. Methyl alcohol oxidizes in the body to form formaldehyde and formic acid. These ivatives are believed responsible for many of methyl alcohol's poisonous and toxic effects. Since it is eliminated slowly from the body, methyl hol is considered a cumulative poison. The fatal ingestion dose is 100 to 250 ml, although death is reported from less than 33 ml.
Medical Conditions Aggravated by Long-Term Exposure: None reported
Target Organs: Eyes, central nervous system, skin, and digestive tract.
Primary Entry Routes: Inhalation, ingestion, skin absorption.
Acute effects: Inhalation can cause irritation of eyes and nose, headache, fatigue, nausea, visual impairment (optic nerve neuropathy or visual field changes) or complete and possibly permanent blindness, acidosis, convulsions, circulatory collapse, respiratory failure, and death. Ingestion can cause gastrointestinal (GI) irritation followed by the symptoms described for inhalation and possible kidney impairment. Skin contact results in a feeling of coldness, dryness, and cracking possibly leading to dermatitis. Methyl alcohol can absorb through skin and may cause headache, fatigue, and visual disturbances. Eye contact causes irritation and watering of eyes, inflamed lids, and painful sensitization to light.
Chronic Effects: Chronic inhalation or skin absorption may produce visual impairment or complete blindness.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Do not let victim rub or keep eyes tightly shut. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Since methyl alcohol is volatile and flammable, carefully dispose of contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Consider administering 10% ethanol in D5W intravenously to maintain ethyl alcohol blood level at 100 mg/dl. Check formic acid in urine and measure blood pH and plasma bicarbonate. After ingestion, there is typically an 18- to 48-hr latency period before clinical toxicity

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate area, deny entry, and stay upwind. Shut off all ignition sources—no flares, smoking, or flames in hazard area. Cleanup personnel should wear fully encapsulating, vapor-protective clothing for spills or leaks with no fire. Water spray may reduce vapor, but not prevent ignition in closed spaces. For small spills, use nonsparking tools to take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers for later disposal. For large spills, dike far ahead of spill and await disposal. Follow applicable OSHA regulations (29 CFR 1910.120).
Environmental Degradation: Aquatic toxicity rating: TLm 96, over 1000 ppm.
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33): Hazardous Waste No. U154
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
Extremely Hazardous Substance (40 CFR 355): Not listed
Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Select the respirator based on its suitability to provide adequate worker protection for the given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent all skin contact.
Ventilation: Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Seperate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean personal protective equipment.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Avoid physical damage to containers. Store in cool, dry, well-ventilated flammables storage area, away from strong oxidizers and other incompatibles. To prevent static sparks, electrically ground all equipment used in methyl alcohol storage, manufacture, and ransportation. Use nonsparking tools.
Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control hazardous airborne ontaminants and to maintain concentrations at the lowest practical level.
Other Precautions: Consider preplacement and periodic medical examinations of exposed workers emphasizing neurological, kidney, liver, and visual function. Practice good personal hygiene and housekeeping procedures. If respirators are used, institute a respiratory protection program hat includes regular training, maintenance, inspection, and evaluation.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Methyl alcohol
DOT Hazard Class: Flammable liquid
D No.: UN1230
abel: Flammable liquid
ackaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Methanol
IMO Hazard Class: 3.2
ID No.: UN1230
IMO Label: Flammable Liquid, Poison
IMDG Packaging Group: II

MSDS Collection References: 26, 38, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 140, 143, 146, 148, 149, 153, 159, 163
repared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MD, MPH; **Edited by:** JR Stuart, MS

Material Safety Data Sheet

From Genium's Reference Collection
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GENIUM PUBLISHING CORP.

No. 624

NAPHTHALENE

Issued: November 1987

SECTION 1. MATERIAL IDENTIFICATION

Material Name: NAPHTHALENE

Description (Origin/Uses): Used as a moth repellant and in many industrial processes.

Other Designations: Naphthalin; Naphthene; Tar Camphor; $C_{10}H_8$; NIOSH *RTECS* No. QJ0525000; CAS No. 0091-20-3

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyer's Guide* (Genium ref. 73) for a list of suppliers.

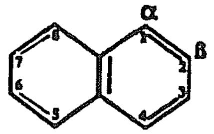
2
2 0
-

HMIS
H 2
F 2
R 0
PPG*
*See sect. 8

R 1
I 4
S 1
K 2

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Naphthalene, CAS No. 0091-20-3	ca 100	IDLH* Level: 500 ppm **ACGIH TLVs, 1987-88** TLV-TWA: 10 ppm, 50 mg/m³ **OSHA PEL** 8-Hr TWA: 10 ppm, 50 mg/m³ **Toxicity Data**** Child, Oral, LD_{Lo}: 100 mg/kg Man, Unknown, LD_{Lo}: 74 mg/kg Rat, Oral, LD_{50}: 1250 mg/kg



*Immediately dangerous to life and health

**See NIOSH *RTECS* for additional data with references to irritative, mutagenic, reproductive, and tumorigenic effects.

SECTION 3. PHYSICAL DATA

Boiling Point: 424°F (218°C)
Vapor Density (Air = 1): 4.4
Vapor Pressure: 0.087 Torr at 77°F (25°C)
Water Solubility: Insoluble

Specific Gravity (H_2O = 1): 1.162 at 68°F (20°C)
Melting Point: 176°F (80°C)
Molecular Weight: 128 Grams/Mole
% Volatile by Volume: ca 100

Appearance and Odor: White crystalline flakes; strong coal tar odor.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
174°F (79°C) OC; 190°F (88°C) CC	979°F (526°C)	% by Volume	0.9	5.9

Extinguishing Media: Use water spray, dry chemical, or carbon dioxide to fight fires involving naphthalene. **Caution:** Foam or direct water spray applied to molten naphthalene may cause extensive foaming.

Unusual Fire or Explosion Hazards: Naphthalene is a volatile solid that gives off flammable vapor when heated (as in fire situations). This vapor is much denser than air and will collect in enclosed or low-lying areas like sumps. In these areas an explosive air-vapor mixture may form, and extra caution is required to prevent any ignition sources from starting an explosion or fire.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Naphthalene is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.

Chemical Incompatibilities: Naphthalene is incompatible with strong oxidizing agents, chromic anhydride, and mixtures of aluminum trichloride and benzoyl chloride.

Conditions to Avoid: Ignition sources like open flame, unprotected heaters, excessive heat, lighted tobacco products, and electric sparks must not occur in work areas where naphthalene vapor may become concentrated.

Hazardous Products of Decomposition: Toxic gases like carbon monoxide are produced during fire conditions. Irritating, flammable vapor forms below the melting point because even solid naphthalene has a significant vapor pressure.

SECTION 6. HEALTH HAZARD INFORMATION

Naphthalene is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: Renal shutdown (kidney failure), hemolytic effects (breakdown of red blood cells), hematuria (blood in the urine), oliguria (low volume of urine), jaundice, eye damage, and depression of the central nervous system (CNS) are the primary health concerns associated with exposure to naphthalene. The ACGIH TLVs in section 2 are set to prevent eye damage. These recommended exposure limits may not be low enough to prevent blood changes in genetically hypersensitive individuals.
Medical Conditions Aggravated by Long-Term Exposure: Diseases of the blood, liver, and kidneys. Administer medical exams emphasizing these organs. **Target Organs:** Eyes, skin, kidneys, liver, blood (red blood cell effects), and CNS.
Primary Entry: Inhalation, skin contact. **Acute Effects:** Inhalation of naphthalene vapor causes excitement, confusion, headache, nausea, and loss of appetite. **Chronic Effects:** Increased incidence of cataracts.

FIRST AID

Eye Contact: Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes to remove particles.
Skin Contact: Immediately wash the affected area with soap and water.
Inhalation: Remove victim to fresh air; restore and/or support his breathing as needed.
Ingestion: Call a poison control center. Never give anything by mouth to someone who is unconscious or convulsing. Administer a gastric lavage followed by saline catharsis. Monitor blood and electrolytic balance. Other sources recommend giving the victim several glasses of water to drink.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, provide ventilation, and eliminate all ignition sources immediately. Cleanup personnel need protection against contact and inhalation of vapor (see sect. 8). Contain large spills and collect waste. Use nonsparking tools to place naphthalene into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways.
Waste Disposal: Consider reclamation, recycling, or destruction rather than disposal in a landfill. Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z)
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste, No. U165
CERCLA Hazardous Substance, Reportable Quantity: 100 lbs (45.4 kg)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Follow the eye- and face-protection guidelines of 29 CFR 1910.133. **Respirator:** Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* (Genium ref. 88) for the maximum-use concentrations and/or the exposure limits cited in section 2. Respirator usage must be in accordance with the OSHA regulations of 29 CFR 1910.134. IDLH or unknown concentrations require an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres.
Other Equipment: Wear impervious gloves, boots, aprons, gauntlets, etc., as required by the specific work environment to prevent skin contact. **Ventilation:** Install and operate general and local maximum explosion-proof ventilation systems of sufficient power to maintain airborne levels of naphthalene below the OSHA PEL standard cited in section 2. **Safety Stations:** Make eyewash stations, washing facilities, and safety showers available in areas of use and handling. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove and launder contaminated clothing before wearing it again; clean this material from shoes and equipment.
Comments: Practice good personal hygiene; always wash thoroughly after using this material. Keep this material off of your clothing and equipment. Avoid transferring this material from hands to mouth while eating, drinking, or smoking. Do *not* smoke, eat, or drink in any immediate work area. Avoid inhalation of vapor!

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage Segregation: Store naphthalene in a cool, dry, well-ventilated area away from chemical incompatibles (see sect. 5).
Special Handling/Storage: Protect containers from physical damage. All bulk storage facilities must be built with an explosion-proof design. All containers used in shipping/transferring operations must be electrically grounded to prevent static sparks. Use monitoring equipment to measure the extent of vapor present in any storage facility containing naphthalene because of potential fire and explosion hazards.
Comments: All operations with naphthalene must be done carefully to prevent accidental ignition of its flammable/explosive vapor. If the weather is warm, more naphthalene vapor forms and the potential for explosion increases. Do *not* smoke in any use or storage area!
Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Naphthalene
DOT Hazard Class: ORM-A
IMO Class: 4.1

DOT ID No. UN1334
IMO Label: Flammable Solid
DOT Label: None

References: 1, 2, 12, 73, 84-94, 103 PH

Approvals
Indust. Hygiene/Safety
Medical Review

Material Safety Data Sheet

From Genium's Reference Collection
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GENIUM PUBLISHING CORP.

No. 7

NITRIC ACID
(Revision C)
Issued: October 1980
Revised: August 1988

SECTION 1. MATERIAL IDENTIFICATION

Material Name: NITRIC ACID

Description (Origin/Uses): Used to dissolve noble metals, for etching and cleaning metals, to make organic nitrates and nitrocompounds, to destroy residues of organic matter, and in explosives.

Other Designations: Red Fuming Nitric Acid; HNO_3; CAS No. 7697-37-2

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

NFPA: 0 / 3 / 0 / oxy

HMIS	
H	3
F	0
R	1
PPG*	

*See sect. 8

R	1
I	4
S	4
K	0

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Nitric Acid, CAS No. 7697-37-2	*	**OSHA PEL** 8-Hr TWA: 2 ppm, 5 mg/m³ **ACGIH TLVs, 1987-88** TLV-TWA: 2 ppm, 5 mg/m³ TLV-STEL: 4 ppm, 10 mg/m³ **Toxicity Data**** Mouse, Inhalation, LC_{50}: 67 ppm/4 Hrs

*Contact your supplier to determine the percent by weight of nitric acid in the purchased product. Water is the other component of the product.
**See NIOSH, *RTECS* (QU5775000, QU5900000), for additional data with references to reproductive effects.

SECTION 3. PHYSICAL DATA

Boiling Point: Ca 251°F (122°C)*
Specific Gravity (H_2O = 1): 1.4*
pH: Very Acidic

Water Solubility (%): Complete
Molecular Weight: 63 Grams/Mole
Melting Point: Ca -30°F (-34°C)*

Appearance and Odor: A water white to slightly yellow liquid that darkens to a brownish color on aging and exposure to light; characteristic nitrogen dioxide (NO_2) odor.

*These properties are for the approximately 68%-by-weight nitric acid that is commercially available.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
*	*	% by Volume	*	*

Extinguishing Media: *Nitric acid does not burn. Use extinguishing agents that will put out the surrounding fire. Use a water spray to dilute nitric acid during fires and to absorb liberated oxides of nitrogen.

Unusual Fire or Explosion Hazards: Although nitric acid does not burn, it is a strong oxidizing agent that can react with combustible materials to cause fires. Also, it can react with metals to liberate extremely flammable hydrogen gas. If this happens, direct fire-fighting procedures at this evolved hydrogen gas.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Choose protective equipment carefully (see sect. 5, Conditions to Avoid).

SECTION 5. REACTIVITY DATA

Nitric acid is stable in closed containers at room temperature under normal storage and handling conditions. It cannot undergo hazardous polymerization.

Chemical Incompatibilities: Nitric acid reacts explosively with metallic powders, carbides, hydrogen sulfide, and turpentine. Contact with organic materials such as wood, paper, sawdust, or alcohol, etc., may cause fires. Combustible materials can attain an increased mability after being exposed to nitric acid even if they do not immediately catch fire.

nditions to Avoid: Avoid any contact with incompatible chemicals. Because it is so reactive, always establish another material's ompatibility with nitric acid before mixing the two materials. This applies to the selection of safety and handling equipment, because nitric acid can attack some forms of coatings, plastics, and rubber.

Hazardous Products of Decomposition: Various nitrogen oxides, including nitric oxide (NO), nitrogen dioxide (NO_2), nitrous oxide (N_2O), as well as nitric acid mist or vapor, can be produced by the decomposition reactions that can affect the nitric acid during fires.

SECTION 6. HEALTH HAZARD INFORMATION

Nitric acid is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: This material is corrosive to any body tissue it contacts. Dental erosion is also reported.
Medical Conditions Aggravated by Long-Term Exposure: None reported. **Target Organs:** Skin, eyes, mucous membranes of the respiratory tract, teeth. **Primary Entry:** Inhalation, skin contact. **Acute Effects:** Irritation and/or corrosive burns of skin, eyes, and upper respiratory tract (URT), delayed pulmonary edema, pneumonitis, bronchitis, and dental erosion. **Chronic Effects:** None reported.

FIRST AID: Eyes. Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. Treat for eye burns. **Skin.** Immediately wash the affected area with soap and water. Watch for chemical skin burns and treat them accordingly. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. If the exposure is severe, hospitilization with careful monitoring by trained medical personnel to detect the delayed onset of severe pulmonary edema (lungs filled with fluid) is recommended for at least 72 hours. **Ingestion.** Call a poison control center. Never give anything by mouth to someone who is unconscious or convulsing. Do not induce vomiting. If the exposed person is responsive, give him or her one or two glasses of milk or water to drink as quickly as possible after exposure.
GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. **NOTE TO PHYSICIAN:** Wash affected skin areas with a 5% solution of sodium bicarbonate (NaHCO$_3$). If ingested, the risk versus the benefit of the passage of a naso-gastric tube is debatable. Activated charcoal is of *no* value. Do *not* give the exposed person bicarbonate to neutralize the material.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, provide ventilation, and eliminate all sources of ignition immediately in case contact with metals should produce highly flammable hydrogen gas. Cleanup personnel need protection against contact with and inhalation of nitric acid (see sect. 8). Contain large spills and collect waste. Use water sprays to direct nitric acid away from incompatible chemicals (see sect. 5). Neutralize the spilled nitric acid with soda ash or sodium bicarbonate. Use an absorbent such as sand, earth, or vermiculite on the resulting slurry and place the neutralized nitric acid material into containers suitable for eventual disposal, reclamation, or destruction.
Waste Disposal: Consider reclamation, recycling, or destruction rather than disposal in a landfill. Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.
OSHA Designations
Air Contaminant (29 CFR 1910.1000 Subpart Z)
EPA Designations (40 CFR 302.4)
CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg), per Clean Water Act (CWA), Section 311 (b) (4)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing of nitric acid solution is possible, wear a full face shield as a supplementary protective measure. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Consult the *NIOSH Pocket Guide to Chemical Hazards* (Genium ref. 88) for general recommendations on proper respiratory procedures. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine use (leaks or cleaning reactor vessels and storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, gauntlets, etc., to prevent skin contact with nitric acid. Choose protective equipment carefully (see sect. 5, Conditions to Avoid).
Ventilation: Install and operate both general and local exhaust-ventilation systems powerful enough to maintain airborne concentrations of nitric acid below the OSHA PEL standard cited in section 2. Construct exhaust ducts and systems with material such as fiberglass, which resists attack by nitric acid. **Safety Stations:** Make emergency eyewash stations, washing facilities, and safety/quickdrench showers available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean nitric acid from shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material. Keep it off of your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Provide preplacement and annual medical exams with emphasis on skin irritation to workers who are regularly exposed to nitric acid. Workers must receive training before handling this material in the workplace; even experienced workers should undergo refresher training periodically.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store nitric acid in a cool, dry, well-ventilated area away from incompatible chemicals (see sect. 5). Consider outside, isolated, or detached storage. Protect containers from direct sunlight.
Special Handling/Storage: Build all storage facilities of nonflammable materials that are resistant to chemical attack by nitric acid. Protect containers from physical damage. Preplan for routine use and emergency response.
Engineering Controls: Proper ventilation is essential in bulk storage areas; consider installing an automatic monitoring system to detect hazardous levels of nitrogen oxides that can develop from this material.
Comments: Separate nitric acid from hydrazine, diethylenetriamine, fluorides, and all other corrosives except sulfuric acid and sulfur trioxide when shipping or transferring it.
Transportation Data (49 CFR 172.101-2)
DOT Shipping Name: (I) Nitric Acid, Fuming or (II) Nitric Acid, Over 40% or (III) Nitric Acid, 40% or Less
DOT Label: (I) Oxidizer and Poison or (II) Oxidizer and Corrosive or (III) Corrosive
DOT Hazard Class: (I) and (II) Oxidizer or (III) Corrosive Material
DOT ID Nos. (I) UN2032; (II) UN2031; (III) NA1760
IMO Class: 8 (All Types of Nitric Acid)
IMO Label: (I) Corrosive, Oxidizer, Poison; or (II) and (III) Corrosive
References: 1, 2, 26, 38, 84-94, 100, 112, 113, 114.

Prepared by PJ Igoe, BS

Industrial Hygiene Review: DJ Wilson, CIH

Medical Review: MJ Hardies, MD

Material Safety Data Sheet

from Genium's Reference Collection

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GENIUM PUBLISHING CORP.

No. 683

POLYCHLORINATED BIPHENYLS
(PCBs)

Issued: November 1988

SECTION 1. MATERIAL IDENTIFICATION

Material Name: POLYCHLORINATED BIPHENYLS (PCBs)

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Genium

Description (Origin/Uses): Commercial PCBs are mixtures that were once widely manufactured by combining chlorine gas, iron filings, and biphenyls. Their high stability contributes to their intended commercial applications and their accidental, long-term adverse environmental and health effects. PCBs are useful as insulators in electrical equipment because they are electrically nonconductive. Their distribution has been limited since 1976. The Aroclor PCB codes identify PCBs by type. The first two digits of a code indicate whether the PCB contains chlorinated biphenyls (12), chlorinated terphenyls, (54), or both (25, 44); the last two digits indicate the approximate percentage of chlorine. Found in insulating liquid, synthetic rubber, plasticizers, flame retardants, floor tile, printer's ink, paper and fabric coatings, brake linings, paints, automobile body sealants, asphalt, adhesives, electrical capacitors, electrical transformers, vacuum pumps, gas-transmission turbines, heat-transfer fluids, hydraulic fluids, lubricating and cutting oil, copying paper, carbonless copying paper, and fluorescent light ballasts.

Synonym: Chlorodiphenyls

Other Designations (Producer, Trade Name, Nation): Monsanto, Aroclor® (USA, Great Britain); Bayer, Clophen® (German Democratic Republic); Prodelec, Phenoclor®, Pyralene® (France); Kanegafuchi, Kanechlor®; Mitsubishi, Santotherm® (Japan); Caffaro, Fenclor® (Italy).

Trade Name	CAS No.	*RTECS* No.	Trade Name	CAS No.	*RTECS* No.
Aroclors	01336-36-3	TQ1350000	Aroclor 1242	53469-21-9	TQ1356000
Aroclor 1016	12674-11-2	TQ1351000	Aroclor 1248	12672-29-6	TQ1358000
Aroclor 1221	11104-28-2	TQ1352000	Aroclor 1254	11097-69-1	TQ1360000
Aroclor 1232	11141-16-5	TQ1354000	Aroclor 1260	11096-82-5	TQ1362000

HMIS			
H	1	R	1
F	1	I	3
R	0	S	1
PPG*		K	1

SECTION 2. INGREDIENTS AND HAZARDS/EXPOSURE LIMITS

PCB-42% Chlorine/Aroclor 1242
CAS No. 53469-21-9
OSHA PEL (Skin*)
8-Hr TWA: 1 mg/m³
ACGIH TLV (Skin*), 1988-89
TLV-TWA: 1 mg/m³

PCB-54% Chlorine/Aroclor 1254
CAS No. 11097-69-1
OSHA PEL (Skin*)
8-Hr TWA: 0.5 mg/m³
ACGIH TLV (Skin*), 1988-89
TLV-TWA: 0.5 mg/m³

All PCBs/Aroclors
CAS No. 1336-36-3
NIOSH REL 1977
10-Hour TWA: 0.001mg/m³
Toxicity Data**
Mouse, Oral, LD_{50}: 1900 mg/kg

*This material can be absorbed through intact skin, which contributes to overall exposure.
**See NIOSH, *RTECS* (Genium ref. 90), at the locations specified in section 1 for additional data with references to tumorigenic, reproductive, mutagenic, and irritative effects.

SECTION 3. PHYSICAL DATA

Boiling Point: Ranges from 527°F (275°C) to 725°F (385°C)
Solubility in Water (%): Insoluble
Pour Point: Ranges from -31°F (-35°C) to 87.8°F (31°C)

% Volatile by Volume: Ranges from 1.2 to 1.6
Molecular Weight (Average): Aroclor 1242: 258 Grams/Mole
Aroclor 1254: 326 Grams/Mole

Appearance and Odor: Clear to light yellow mobile oil to a sticky resin; a sweet "aromatic" odor. As the percentage of chlorine increases, the PCB becomes thicker and heavier; e.g., Aroclor 1254 is more viscous than Aroclor 1242.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point*	**Autoignition Temperature:** Not Found	**LEL:** Not Found	**UEL:** Not Found

Extinguishing Media: Use water spray/fog, carbon dioxide (CO_2), dry chemical, or "alcohol" foam to extinguish fires that involve polychlorinated biphenyls. Although it is very difficult to ignite PCBs, they are often mixed with more flammable materials (oils, solvents, etc.) **Unusual Fire or Explosion Hazards:** If a transformer containing PCBs is involved in a fire, its owner may be required to report the incident to appropriate authorities. Consult and follow all pertinent Federal, state, and local regulations. **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode; fire fighters must also wear a complete set of protective clothing. **Comments:** The hazards of PCB fires are associated with the possibility of their being released into the environment where they and their products of degeneration can pose serious long-term health risks. These potential problems are heightened by the PCBs' resistance to biological and chemical degradation and by the possibility that they will contaminate underground water systems (see sect. 5)

*Ranges from 284°F (140°C) to 392°F (200°C).

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Polychlorinated biphenyls are very stable materials. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** PCBs can react dangerously with sodium or potassium. These reactions are part of an industrial process used to destroy PCBs; however, people have been killed by explosions at PCB treatment, storage, and disposal sites. **Conditions to Avoid:** Limit human exposure to PCBs to the lowest possible level; especially avoid contact with skin. **Hazardous Products of Decomposition:** Thermal-oxidative degradation of PCBs can produce toxic gases such as carbon monoxide, chlorine, chlorinated aromatic fragments, phenolics, aldehydes, and hydrogen chloride. Incomplete combustion of PCBs produces toxic compounds such as polychlorinated dibenzofuran (PCDF, the major product of combustion), and polychlorinated dibenzo-*p*-dioxin (PCDD or dioxin).

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity: The EPA lists PCBs as carcinogens, and the IARC classifies them as probable human carcinogens (group 2B). **Summary of Risks:** Effects of accidental exposure to PCBs include acneform eruptions; eye discharge; swelling of the upper eyelids and hyperemia of the conjunctiva; hyperpigmentation of skin, nails, and mucous membrane; chloroacne; distinctive hair follicles; fever; hearing ifficulties; limb spasms; headache; vomiting; and diarrhea. PCBs are potent liver toxins that can be absorbed through unbroken skin in azardous amounts without immediately discernible pain or discomfort. Severe health effects can develop later. In experimental animals, prolonged or repeated exposure to PCBs by any route results in liver damage at levels that are less than those reported to have caused cancer in rodents. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** Skin, eyes, eyelids, blood, liver. **Primary Entry:** Inhalation, skin contact/absorption. **Acute Effects:** Skin and eye irritation, acneform dermatitis, nausea, vomiting, abdominal pain, jaundice, liver damage. **Chronic Effects:** Possible cancer (evidence of this is inconclusive); reproductive effects (jaundice, excessive secretion of tears, dermal chromopexy); and hepatitis. **FIRST AID:** **Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for 15 minutes. **Skin.** Rinse exposed skin with flooding amounts of water; wash with soap and water. **Inhalation.** Remove the exposed person to fresh air; restore and/or support breathing as needed. Have qualified medical personnel administer oxygen as required. **Ingestion.** Induce vomiting by sticking your finger to the back of the exposed person's throat. Have him or her drink 1 to 2 glasses of milk or water. **Get medical help (in plant, paramedic, community) for all exposures.** Seek prompt medical assistance for further treatment, observation, and support after first aid. **Note to Physician:** PCBs are poorly metabolized, soluble in lipids, and they accumulate in tissues or organs rich in lipids. Liver function tests can help to determine the extent of body damage in exposed persons. If electrical equipment containing PCBs arcs over, the PCBs or other hydrocarbon dielectric fluids may decompose and give off hydrochloric acid (HCl), a potent respiratory irritant.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: *Treat any accidental release of PCBs as an emergency. An SPCCP (spill-prevention control and countermeasure plan) must be formulated before spills or leaks occur.* PCBs are resistant to biodegradation, soluble in lipids, and chemically stable; as such they have become significant contaminants of global ecosystems. Releases of PCBs require immediate, competent, professional response from trained personnel. *Each release situation is unique and requires a specifically designed cleanup response.* General recommendations include adhering to Federal regulations (40 CFR Part 761). Notify safety personnel, evacuate nonessential personnel, ventilate the spill area, and contain the PCBs. All wastes, residues, and contaminated cleanup equipment from the incident are subject to EPA requirements (40 CFR 761). Consult your attorney or appropriate regulatory officials for information about reporting requirements and disposal procedures. **Waste Disposal:** Contact your hazardous waste disposal firm or a licensed contractor for detailed recommendations, especially when PCBs are unexpectedly discovered. Follow Federal, state, and local regulations. PCBs are biomagnified in the food chain; i.e., their concentration increases at each link. The disposal of PCBs or of PCB-contaminated materials is strictly regulated; violations of applicable laws can result in fines, lawsuits, and negative publicity. **Warning:** Accidental spills of PCBs that may affect water supplies must be reported to Coast Guard personnel at the National Response Center, telephone (202) 426-2675.

OSHA Designations

isted as an Air Contaminant (29 CFR 1910.1000 Subpart Z).

PA Designations (40 CFR 302.4)

CERCLA Hazardous Substance, Reportable Quantity: 10 lbs (4.54 kg), per the Clean Water Act (CWA), §§ 311 (b) (4) and 307 (a).

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing of PCBs is possible, wear a full face shield. Follow OSHA eye- and face-protections regulations (29 CFR 1910.133). **Respirator:** Wear a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (leaks or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, and gauntlets, etc., to prevent any contact of PCBs with your skin. **Ventilation:** Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of this material below the OSHA PEL standards cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contamination into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do not wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from your shoes and equipment. Heavily soiled clothing must be properly discarded in a manner consistent with applicable regulations. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in work areas.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage Segregation: Store PCBs in closed containers in a cool, dry, well-ventilated area. Protect containers from physical damage. **Special Handling/Storage:** All storage facilities must have adequate containment systems (dikes; elevated, nonporous holding platforms; retaining walls) to prevent any major release of PCBs into the environment. Carefully design and implement these extra precautions now; do not wait until you have to respond to an accidental release of this material.

Transportation Data (49 CFR 172.101-2; PCBs were the first materials to be directly regulated by Congress by way of TSCA in 1976.)

DOT Shipping Name: Polychlorinated Biphenyls
DOT Hazard Class: ORM-E
No. UN 23115
T Packaging Requirements: 49 CFR 173.510

IMO Shipping Name: Polychlorinated Biphenyls
IMO Hazard Class: 9
IMDG Packaging Group: II

References: 1, 6, 26, 38, 84-94, 100, 101, 116, 117, 120, 122.

Prepared by PJ Igoe, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: W Silverman, MD

Technical Review: Northeast Analytical, Inc. (PCB and VOC Specialists), Schenectady, New York, Telephone: (518) 346-4592

MATERIAL SAFETY DATA SHEET: SIMPLE GREEN®

I. PRODUCT & COMPANY INFORMATION

PRODUCT NAME: **SIMPLE GREEN® CLEANER / DEGREASER / DEODORIZER** Page 1 of 4

COMPANY NAME: **SUNSHINE MAKERS, INC.** Version No. 1008
15922 Pacific Coast Highway Issue Date: January, 2003
Huntington Harbour, CA 92649 USA
Telephone: 800-228-0709 • 562-795-6000
Fax: 562-592-3034
Website: www.simplegreen.com

For 24-hour emergency, call Chem-Tel, Inc.: 800-255-3924

USE OF PRODUCT: An all purpose cleaner and degreaser used undiluted or diluted in water for direct, spray, and dip tank procedures.

II. INGREDIENT INFORMATION

The only ingredient of Simple Green® with established exposure limits is undiluted 2-butoxyethanol (<6%) (Butyl Cellosolve; CAS No. 111-76-2): the OSHA PEL and ACGIH TLV is 25 ppm (skin). Note, however, that Butyl Cellosolve is only one of the raw material ingredients that undergo processing and dilution during the manufacture of Simple Green®. Upon completion of the manufacturing process, Simple Green® does not possess the occupational health risks associated with exposure to undiluted Butyl Cellosolve. Verification of this is contained in the independent test results detailed under "Toxicological Information" on Page 3 of this MSDS.

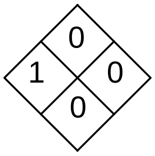
The Butyl Cellosolve in Simple Green® is part of a chemical category (glycol ethers) regulated by the Emergency Planning and Community Right-to-Know Act (SARA, Title III, section 313); therefore, a reporting requirement exists. Based upon chemical analysis, Simple Green® contains no known EPA priority pollutants, heavy metals, or chemicals listed under RCRA, CERCLA, or CWA. Analysis by TCLP (Toxicity Characteristic Leaching Procedure) according to RCRA revealed no toxic organic or inorganic constituents.

All components of Simple Green® are listed on the TSCA Chemical Substance Inventory.

III. HAZARDS IDENTIFICATION

UN Number:	Not required
Dangerous Goods Class:	Nonhazardous

Hazard Rating (NFPA/HMIS)
Health = 1* Reactivity = 0
Fire = 0 Special = 0



Rating Scale
0 = minimal 1 = slight
2 = moderate 3 = serious
4 = severe

*Mild eye irritant, non-mutagenic and non-carcinogenic. **None of the ingredients in Simple Green® are regulated or listed as potential cancer agents by Federal OSHA, NTP, or IARC.**

IV. FIRST AID MEASURES

SYMPTOMS OF OVEREXPOSURE AND FIRST AID TREATMENT

Eye contact:	Reddening may develop. Immediately rinse the eye with large quantities of cool water; continue 10-15 minutes or until the material has been removed; be sure to remove contact lenses, if present, and to lift upper and lower lids during rinsing. Get medical attention if irritation persists.
Skin contact:	Minimal effects, if any; rinse skin with water, rinse shoes and launder clothing before reuse. Reversible reddening may occur in some dermal-sensitive users; thoroughly rinse area and get medical attention if reaction persists.
Swallowing:	Essentially non-toxic. Give several glasses of water to dilute; do not induce vomiting. If stomach upset occurs, consult physician.
Inhalation:	Non-toxic. Exposures to concentrate-mist may cause mild irritation of nasal passages or throat; remove to fresh air. Get medical attention if irritation persists.

V. FIRE FIGHTING MEASURES

Simple Green® is stable, not flammable, and will not burn.

Flash Point/Auto-Ignition:	Not flammable.
Flammability Limits:	Not flammable.
Extinguishing Media:	Not flammable/nonexplosive. No special procedures required.
Special Fire Fighting Procedures:	None required.

VI. ACCIDENTAL RELEASE MEASURES

Recover usable material by convenient method; residual may be removed by wipe or wet mop. If necessary, unrecoverable material may be washed to drain with large quantities of water.

VII. HANDLING, STORAGE & TRANSPORT INFORMATION

No special precautions are required. **This product is non-hazardous for storage and transport according to the U.S. Department of Transportation Regulations.** Simple Green® requires no special labeling or placarding to meet U.S. Department of Transportation requirements.

UN Number: Not required Dangerous Goods Class: Non-hazardous

VIII. EXPOSURE CONTROLS

Exposure Limits: The Simple Green® formulation presents no health hazards to the user when used according to label directions for its intended purposes. Mild skin and eye irritation is possible (please see Eye contact and Skin contact in Section IV.).

Ventilation: No special ventilation is required during use.

Human Health Effects or Risks from Exposure: Adverse effects on human health are not expected from Simple Green®, based upon twenty years of use without reported adverse health incidence in diverse population groups, including extensive use by inmates of U.S. Federal prisons in cleaning operations.

Simple Green® is a mild eye irritant; mucous membranes may become irritated by concentrate-mist.

Simple Green® is not likely to irritate the skin in the majority of users. Repeated daily application to the skin without rinsing, or continuous contact of Simple Green® on the skin may lead to temporary, but reversible, irritation.

Medical Conditions Aggravated by Exposure: No aggravation of existing medical conditions is expected; dermal sensitive users may react to dermal contact by Simple Green®.

IX. PERSONAL PROTECTION

Precautionary Measures:	No special requirements under normal use conditions.
Eye Protection:	**Caution, including reasonable eye protection, should always be used to avoid eye contact where splashing may occur.**
Skin Protection:	No special precautions required; rinse completely from skin after contact.
Respiratory Protection:	No special precautions required.
Work and Hygienic Practices:	No special requirements. Wash or rinse hands before touching eyes or contact lenses.

X. PHYSICAL AND CHEMICAL PROPERTIES

Appearance/odor:	Translucent green liquid with characteristic sassafras odor.		
Specific Gravity:	1.0257	**Vapor Pressure:**	17 mm Hg @ 20 °C; 22 mm Hg @ 25 °C
pH of concentrate:	9.5	**Vapor Density:**	1.3 (air = 1)
Evaporation:	>1 (butyl acetate = 1)	**Density:**	8.5 lbs./gallon
Boiling Point:	110 °C (231 °F)		
Freezing Point:	-9 °C (16 °F) If product freezes, it will reconstitute without loss of efficacy when brought back to room temperature and agitated.		

VOC Composite Partial Pressure: 0.006 mm Hg @ 20 °C

Volatile Organic Compounds (VOCs): 7.96 g/L per ASTM Method 3960-90. Per California AQMD's VOC test method, product must be diluted at least 4 parts of water to 1 part Simple Green® in order to meet SCAQMD Rule 1171 & Rule 1122 and BAAQMD Regulation 8-16 VOC requirements for solvent cleaning operations.

Water Solubility: Completely soluble in water. The higher salt concentrations in marine ecosystems will lead to complexes with Simple Green® that may become visible at ratios above one part Simple Green® to 99 parts seawater.

Ash Content:	At 600 °F: 1.86% by weight.
Nutrient Content:	Nitrogen: <1.0% by weight (fusion and qualitative test for ammonia). Phosphorus: 0.3% by formula. Sulfur: 0.6% by weight (barium chloride precipitation method).

Detection: Simple Green® has a characteristic sassafras odor that is not indicative of any hazardous situation.

XI. STABILITY AND REACTIVITY INFORMATION

Nonreactive. Simple Green® is stable, even under fire conditions, and will not react with water or oxidizers. Hazardous polymerization will not occur.

XII. TOXICOLOGICAL INFORMATION

Nonhuman Toxicity

Acute Mortality Studies:

Oral LD_{50} (rat): >5.0 g/kg body weight // Dermal LD_{50} (rabbit): >2.0 g/kg body weight

Dermal Irritation: Only mild, but reversible, irritation was found in a standard 72-hr test on rabbits. A value of 0.2 (non-irritating) was found on a scale of 8.

Eye Irritation: With or without rinsing with water, the irritation scores in rabbits at 24 hours did not exceed 15 (mild irritant) on a scale of 110.

Subchronic dermal effects: No adverse effects, except reversible dermal irritation, were found in rabbits exposed to Simple Green® (up to 2.0 g/kg/day for 13 weeks) applied to the skin of 25 males and 25 females. Only female body weight gain was affected. Detailed microscopic examination of all major tissues showed no adverse changes.

Fertility Assessment by Continuous Breeding: The Simple Green® formulation had no adverse effect on fertility and reproduction in CD-1 mice with continuous administration for 18 weeks, and had no adverse effect on the reproductive performance of their offspring.

XIII. BIODEGRADABILITY AND ENVIRONMENTAL TOXICITY INFORMATION

Biodegradability:

Simple Green® is readily decomposed by naturally occurring microorganisms. The biological oxygen demand (BOD), as a percentage of the chemical oxygen demand (COD), after 4, 7, and 11 days was 56%, 60%, and 70%, respectively. Per OECD Closed Bottle Test, Simple Green® meets OECD and EPA recommendations for ready biodegradability.
In a standard biodegradation test with soils from three different countries, Butyl Cellosolve reached 50% degradation in 6 to 23 days, depending upon soil type, and exceeded the rate of degradation for glucose which was used as a control for comparison.

Environmental Toxicity Information:

Simple Green® is considered practically non-toxic per EPA's aquatic toxicity scale. Simple Green® is non-lethal to any of the marine and estuarine test animals listed in the following table at concentrations below 200 mg/L (0.02%). This table shows the Simple Green® concentrations that are likely to be lethal to 50% of the exposed organisms.

	LC_{50} in mg/L (ppm)	
	48-hour	**96-hour**
Marine Fish:		
Mud minnow *(Fundulus heteroclitus)*	1690	1574
Whitebait *(Galaxias maculatus)*	210	210
Marine/Estuarine Invertebrates:		
Brine Shrimp *(Artemia salina)*	610	399
Grass Shrimp (*Palaemonetes pugio*)	270	220
Green-lipped Mussel *(Perna canaliculus)*	220	220
Mud Snail *(Potamopyrgus estuarinus)*	410	350

XIV. DISPOSAL CONSIDERATIONS

Simple Green® is fully water soluble and biodegradable and will not harm sewage-treatment microorganisms if disposal by sewer or drain is necessary. Dispose of in accordance with all applicable local, state, and federal laws.

XV. OTHER INFORMATION

Containers:	Simple Green® residues can be completely removed by rinsing with water; the container may be recycled or applied to other uses.
Electrical Wiring Compatibility:	Polyimide insulated wiring is not affected by exposure to Simple Green®. After immersion in Simple Green® for 14 days at 74°F, the 61 cm piece of polyimide insulated wire passed a one minute dielectric proof test at 2500 volts (ASTM D-149).
Contact Point:	Sunshine Makers, Inc., Research and Development Division: 562-795-6000.

*** NOTICE ***

All information appearing herein is based upon data obtained by the manufacturer and recognized technical sources. Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of this information, Sunshine Makers, Inc. or its distributors extends no warranties, makes no representations and assumes no responsibility as to the suitability of such information for application to purchaser's intended purposes or for consequences of its use.

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Material Safety Data Sheets Collection:

Sheet No. 3A
Sodium Hydroxide, 50% Liquid

Issued: 10/77 Revision: B, 11/91

Section 1. Material Identification

36

Sodium Hydroxide, 50% Liquid (NaOH), Description: Derived by electrolysis of sodium chloride brines, by reacting calcium chloride with sodium carbonate, or by electrolytic production using the diaphragm cell. Sodium hydroxide often contains minimal amounts of sodium chloride, sodium carbonate, sodium sulfate, sodium chlorate, iron, or nickel. Used in making plastics to dissolve casein; in treating cellulose in making rayon and cellophane; in explosives, dyestuffs, electrolytic extraction of zinc, reclaiming rubber, tin plating, oxide coating, etching and electroplating, laundering and bleaching, pulp and paper manufacture; in vegetable oil refining; in peeling fruits and vegetables in the food industry; to hydrolyze fats and form soaps; and in veterinary medicine as a disinfectant.

Other Designations: CAS No. 1310-73-2; Aetznatron; Collo-Grillrein; Collo-Tapette; Feurs Rohp; Lewis-Red Devil Lye; soda lye; soda, lye solution; sodium hydrate solution; sodium hydroxide solution; white caustic solution.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(™) for a suppliers list.

Cautions: Sodium hydroxide is moderately toxic by ingestion and inhalation and can be seriously corrosive to eyes, skin, and mucous membranes.

R 0
I 2
S 4
K 0

NFPA
0
3 1
W
Alkali

HMIS
H 3
F 0
R 1
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Sodium hydroxide, ca 50% water solution

1990 OSHA PEL
Ceiling: 2 mg/m³

1991-92 ACGIH TLV
Ceiling: 2 mg/m³

1990 DFG (Germany) MAK
2 mg/m³

1990 IDLH Level
250 ppm

1990 NIOSH REL
Ceiling: 2 mg/m³

1985-86 Toxicity Data*
Monkey, eye: 1% solution applied over 24 hr produced severe irritation
Rabbit, eye: 1% solution applied to the eye caused severe irritation
Grasshopper, parenteral: 20 µl produced cytogenic mutations

* See NIOSH, *RTECS* (WB4905000), for additional irritation, mutation and toxicity data.

Section 3. Physical Data

Boiling Point: 284 °F (140 °C)
Freezing Point: 53.6 °F (12 °C)
Viscosity: 50 cP at 68 °F (20 °C)
pH (0.5 % solution): 13
Molecular Weight: 40.01
Specific Gravity: 1.53 at 77 °F (25 °C)
Water Solubility: Completely soluble in water
Other Solubilities: Soluble in alcohol, methanol and glycerol; insoluble in acetone and ether

Appearance and Odor: An odorless, clear liquid.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Although noncombustible, when in contact with moisture or water sodium hydroxide, 50% liquid, can generate enough heat to ignite surrounding combustibles. If possible without risk, remove containers from area. Use extinguishing agents suitable for surrounding fire. For small fire, use dry chemical, carbon dioxide (CO_2), or regular foam. Avoid using water spray since water reacts with sodium hydroxide to generate substantial heat. If you must use water, be sure it is as cold as possible. For large fires, use fog or regular foam.

Unusual Fire or Explosion Hazards: Sodium hydroxide solution can become very hot when in contact with water.

Special Fire-fighting Procedures: Since fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Also, wear fully protective clothing. Structural firefighters' protective clothing provides limited protection. Apply cooling water to sides of fire-exposed containers until fire is well out. *Do not* splatter or splash this material. Stay away from ends of tanks. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Sodium hydroxide solution is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Violent polymerization can occur when in contact with acrolein or acrylonitrile. Since sodium hydroxide readily absorbs water and carbon dioxide from air, keep containers tightly closed.

Chemical Incompatibilities: Since it generates large amounts of heat when in contact with water, sodium hydroxide may steam and splatter. It reacts with mineral acids to form corresponding salts, and with weak-acid gases like hydrogen sulfide, sulfur dioxide and carbon dioxide. Sodium hydroxide can be very corrosive to metals such as aluminum, tin, and zinc, as well as alloys such as steel, and may cause formation of flammable hydrogen gas. An increase in temperature and pressure occurs in closed containers when sodium hydroxide is mixed with acetic anhydride, glacial acetic acid, chlorohydrin, chlorosulfonic acid, ethylene cyanohydrin, glyoxal, oleum, 36% hydrochloric acid, 48.7% hydrofluoric acid, 70% nitric acid, or 96% sulfuric acid.

Conditions to Avoid: Avoid generation of sodium hydroxide mists, and contact with water, metals, and the chemicals listed above.

Hazardous Products of Decomposition: Thermal oxidative decomposition of sodium hydroxide can produce toxic sodium oxide (Na_2O) and peroxide (Na_2O_2) fumes.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA do not list sodium hydroxide as a carcinogen (see Chronic Effects).

Summary of Risks: Sodium hydroxide solution is toxic by mist inhalation, ingestion, or direct skin or eye contact. Damage is immediate and without prompt medical attention can become permanent. This strong, corrosive alkaline solution dissolves any living tissue it contacts.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Target Organs: Eyes, digestive tract, respiratory system, and skin.

Primary Entry Routes: Ingestion, inhalation, and skin and eye contact.

Acute Effects: Ingestion causes immediate burning of mouth, esophagus, and stomach; painful swallowing; excessive salivation; edematous (excess fluid in surrounding tissue) lips, chin, tongue, and pharynx covered with exudate (fluid oozed from swollen tissue); esophageal edema (swelling from fluid buildup in esophagus walls that can prevent swallowing within hours); edematous, gelatinous, and necrotic (localized tissue

Continue on next page

Section 6. Health Hazard Data, *continued*

death) mucous membranes; vomiting (sometimes coffee grounds-like material due to digestive hemorrhage); rapid, faint pulse; and cold, clammy skin. Death commonly occurs due to shock, asphyxia (oxygen loss due to interrupted breathing), or pneumonia by the second or third day after ingestion. Mist inhalation can cause many burns, temporary hair loss (in nasal passages since sodium hydroxide breaks down keratin), and sibly pulmonary edema (fluid in lungs). Skin contact causes slippery, soapy feeling that is usually not painful for 3 min after contact—even gh skin damage begins immediately. It causes burns, keratin (hair and nails) destruction, and intracellular edema (excess fluid in skin cells), with damage progressing to severe burns, tissue corrosion, deep ulcerations, and permanent scarring if not washed off immediately. The cornea begins to corrode on contact. Disintegration and sloughing of conjunctival and corneal epithelium may progress to temporary or permanent corneal opacification (cloudiness, becoming impervious to light) or symblepharon (adhesion of lid to eyeball).

Chronic Effects: Dermatitis may result after repeated exposure to dilute solutions. Cases of squamous cell carcinoma (malignant tumors of epithelial origin) of the esophagus are reported 12 to 42 years after ingestion, although it is unclear whether the cancer resulted from scar formation caused by tissue destruction or directly from the chemical's possible carcinogenicity.

FIRST AID: Emergency personnel should protect against contamination.

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. *Do not* allow victim to keep his eyes tightly shut. *Warning!* Although splashed in only one eye, sodium hydroxide may affect the other eye's sight if prompt medical attention is not received. Consult a physician immediately.

Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of cold water for at least 15 min. *Be aware* that this substance can become very hot when in contact with water. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious and alert* person drink 1 to 2 glasses of water followed by vinegar or fruit juice to neutralize the poison. *Do not* induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Perform endoscopy in all suspected cases of sodium hydroxide ingestion. Perform blood analysis to determine if dehydration, acidosis, or other electrolyte imbalances have occurred.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate hazard area, deny entry, and stay upwind of spills. Cleanup personnel should protect against vapor inhalation and skin or eye contact. Use water spray to disperse vapors but do not spray directly on spills. Absorb small liquid spills with fly ash or cement powder. Neutralize spill with vinegar or dilute acid. Perlite and Cellosolve WP 3H (hydroxyethyl cellulose) are recommended for vapor suppression and containment of 50% sodium hydroxide solutions. Place material in suitable container (sodium hydroxide corrodes steel at temperatures above 60 °C) for later disposal. For large wet spills, dike flow using soil, sand bags, foamed polyurethane, or foamed concrete to contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120).

Environmental Transport: In solid form, sodium hydroxide is not mobile, although it very easily absorbs moisture. Once liquid, sodium hydroxide rapidly leaches into the soil, possibly contaminating water sources.

Environmental Degradation: Ecotoxicity values (as 100% NaOH): TLm, mosquito fish, 125 ppm/96 hr (fresh water); TLm, bluegill, 99 mg/48 hr (tap water).

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.22): Characteristic of corrosivity

ed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 311 (b)(4)]

Extremely Hazardous Substance (40 CFR 355): Not listed

S. A Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

Sodium hydroxide is listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Select the respirator based on its suitability to provide adequate worker protection for the given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent any skin contact.

Ventilation: Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL and IDLH values (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Avoid physical damage to containers. Store in dry, well-ventilated area away from water, acids, metals, flammable liquids and organic halogens. Keep containers tightly closed since sodium hydroxide can decompose to sodium carbonate and carbon dioxide upon exposure to air. Since corrosion occurs easily above 140 °F (60 °C), do not store or transport in aluminum or steel containers when temperatures are near this level. Store containers in rooms equipped with trapped floor drains, curbs, or gutters.

Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control hazardous airborne contaminants and to maintain concentrations at the lowest practical level.

Other Precautions: Institute preplacement and periodic medical exams of exposed workers emphasizing the eyes, skin and respiratory tract. Consider a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Educate employees to the possible hazards in using sodium hydroxide.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Sodium hydroxide, liquid *or* solution	**IMO Shipping Name:** Sodium hydroxide, solution
D Hazard Class: Corrosive material	**IMO Hazard Class:** 8
UN1824	**ID No.:** UN1824
abel: Corrosive	**IMO Label:** Corrosive
OT Packaging Exceptions: 173.244	**IMDG Packaging Group:** II
OT Packaging Requirements: 173.249	

SDS Collection **References:** 26, 38, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 143, 146, 148, 149, 153, 159, 161, 163

repared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS

Material Safety Data Sheet

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GENIUM PUBLISHING CORP.

No. 9
SULFURIC ACID, CONCENTRATED
Revision C
Issued: October 1980
Revised: February 1986

SECTION 1. MATERIAL IDENTIFICATION

19

MATERIAL NAME: SULFURIC ACID, CONCENTRATED

OTHER DESIGNATIONS: Oil of Vitriol, Hydrogen Sulfate; H_2SO_4; CAS #7664-93-9

MANUFACTURER/SUPPLIER: Available from many suppliers, including:
Allied Corporation, PO Box 2064R, Morristown, NJ 07960; Telephone: 800 631-8050

0
3 2
W

HMIS
H:3
F: 0
R: 2
PPE: *
* See Sect. 8

R 1
I 3
S 4
K 0

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Hydrogen Sulfate (H_2SO_4) Water	93-98 Balance*	8-hr TWA: 1 mg/m^3
* Material is obtained by the reaction of SO_3 and water. Can contain low impurity levels, such as 0.02% max of iron as Fe. Properties vary with H_2SO_4 content.		Human, Mist Inhalation, TCLo: 3 mg/m^3, 24 wk. (Toxic Mouth Effects)
Current OSHA standard and ACGIH (1985-86) TLV. NIOSH has a 10-hr TWA, 40-hr. work week, of 1 mg/m^3.		Rat, Oral, LD_{50}: 2140 mg/kg

SECTION 3. PHYSICAL DATA

	93.19% H_2SO_4	98.33% H_2SO_4	100% H_2SO_4
Boiling Point, 1 atm, deg C	ca 281	ca 338	ca 330 (dc)
Specific Gravity (60/60°F)	1.8354	1.84	1.84
Volatiles, % @ 340°C	ca 100	ca 100	ca 100
Melting Point, deg C	ca -34	ca 3	10.4

Water Solubility ... Complete Miscible
Vapor Pressure, mm Hg @ 100°F ... <1 (93.19% H_2SO_4); Deg. Baume ... 66 (93.19% H_2SO_4) - Density of H_2SO_4 is often reported in degrees Baume Be). Formula is Be=145 [145/sp gr for liquids heavier than water].

Appearance and odor: Clear, colorless, hygroscopic, oily liquid with no odor. Mists greater than 1 mg/m^3 are easily recognizable. Those at 5 mg/m^3 are distinctly objectionable.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
None - Nonflammable	NA	NA	NA	NA

Sulfuric acid is nonflammable; however, it is a strong oxidizing agent and may cause ignition by contact with combustible materials. Small fires may be smothered with suitable dry chemical. Cool exterior of storage tanks of H_2SO_4 with water to avoid rupture if exposed to fire. Do not add water or other liquid to the acid! The acid, especially when diluted with water, can react with metals to liberate flammable hydrogen gas.
Sulfuric acid mists and vapors from a fire area are corrosive (see sect. 5).
Fire fighters must wear self-contained breathing equipment and fully protective clothing.

SECTION 5. REACTIVITY DATA

Sulfuric acid is stable under normal conditions of use and storage. It does not undergo hazardous polymerization. It is a strong mineral acid reacting with bases and metals. The concentrated acid is also a dehydrating agent, picking up moisture readily from the air or other materials. Hydrogen gas may be generated within a H_2SO_4 container. Vent drums cautiously.

This material reacts exothermically with water. (Acid should always be added slowly to water. Water added to acid can cause boiling and uncontrolled splashing of the acid.) Sulfur oxides can result from decomposition and from oxidizing reactions of sulfuric acid.

SECTION 6. HEALTH HAZARD INFORMATION | TLV

Concentrated sulfuric acid is a strong mineral acid, an oxidizing agent, and a dehydrating agent that is rapidly damaging to all human tissue with which it comes in contact. Ingestion may cause severe injury or death. Eye contact produces severe or permanent injury. Inhalation of mists can damage both the upper respiratory tract and the lungs. Sulfuric acid is not listed as a carcinogen by the NTP, IARC, or OSHA.

FIRST AID: EYE CONTACT: Immediately flush eyes (including under eyelids) with plenty of running water for at least 15 minutes. Speed in diluting and rinsing out acid with water is extremely important if permanent eye damage is to be avoided. Obtain medical help as soon as possible.* SKIN CONTACT: Immediately flush affected areas with water, removing contaminated clothing while under the safety shower. Continue washing with water and get medical attention.* INHALATION: Remove to fresh air. Restore breathing. Call a physician immediately. INGESTION: Dilute acid immediately with large amounts of milk or water, then give milk of magnesia to neutralize. Never give anything by mouth to an unconscious person. Do not induce vomiting; if it occurs spontaneously, continue to administer fluid. Obtain medical attention as soon as possible.*

Maintain observation of patient for possible delayed onset of pulmonary edema.

* GET MEDICAL HELP = In plant, paramedic, community.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Handle major spills by a predetermined plan. Contact supplier for assistance in this planning, in meeting local regulations, and for disposing of large amounts. Notify safety personnel. Provide optimum ventilation; vapors are extremely irritating. Stop leak if you can do so without risk.

Cleanup personnel need protection against inhalation or contact. Keep upwind. Contain spill. Minor leaks or spills can be diluted with much water and neutralized with soda ash or lime. If water is not available, cover contaminated area with sand, ashes, or gravel and neutralize cautiously with soda ash or lime.

DISPOSAL: Follow Federal, state, and local regulations. Runoff to sewer may create hydrogen gas, which is a fire or explosion hazard. EPA (CWA) RQ 1000 lbs. (40 CFR 117).

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general ventilation to meet current TLV requirements in the workplace. Where mists are up to 50 mg/m^3, a high-efficiency particulate respirator with full facepiece is warranted; a type-C supplier-air respirator with full facepiece operated in pressure-demand mode is used to 100 mg/m^3.

Avoid eye contact by use of chemical safety goggles or face shield where splashing may occur. Acid-resistant protective clothing, such as rubber gloves, aprons, boots, and suits, is recommended to avoid body contact.

Eyewash fountain and safety showers with deluge type of heads should be readily available where this material is handled or stored.

Contact lenses pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

Comprehensive preplacement and annual medical examinations with emphasis on dental erosion, cardiopulmonary system, and mucous membrane irritation and cough are indicated.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Sulfuric acid in carboys or drums should be stored in clean, ventilated storage areas having acid-resistant floors with good drainage. Keep out of direct sunlight, do not store above 89.6°F (32°C). Storage facilities are to be separate from organic materials, metallic powders, chromates, chlorates, nitrates, carbides, oxidizables, etc. Soda ash, sand, or lime should be kept in general storage or work areas for emergency use. Protect containers against physical damage. Glass bottles need extra protection. Sulfuric acid is highly corrosive to most metals, especially below 77% H_2SO_4. Avoid breathing mist or vapors. Avoid contact with skin or eyes. Do not ingest. Do not add water to concentrated acid. Drums may contain hydrogen gas, so open cautiously. Use nonsparking tools free of oil, dirt, and grit and vapor-proof electrical fixtures

DOT Classification: Corrosive Material. ID No.: UN1830 Label: Corrosive

Data Source(s) Code: 1-12, 19, 20, 24, 26, 31, 37-39, 42, 82. CK

Approvals 6/86.

Indust. Hygiene/Safety JW 6/86

Medical Review July 86

Material Safety Data Sheet

Genium Publishing Corporation
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No. 317
TOLUENE
(Revision D)

Issued: August 1979
Revised: April 1986

SECTION 1. MATERIAL IDENTIFICATION

20

MATERIAL NAME: TOLUENE

OTHER DESIGNATIONS: Methyl Benzene, Methyl Benzol, Phenylmethane, Toluol, C_7H_8, CAS #0108-88-3

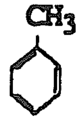
MANUFACTURER/SUPPLIER: Available from many suppliers, including:
Allied Corp., PO Box 2064R, Morristown, NJ 07960; Telephone: (201) 455-4400
Ashland Chemical Co., Industrial Chemicals & Solvents Div., PO Box 2219, Columbus, OH; Telephone: (614) 889-3844

HMIS
H: 2
F: 3
R: 0
PPE*
*See sect. 8

R 1
I 3
S 2
K 4

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Toluene	ca 100	8-hr TLV: 100 ppm, or 375 mg/m^3* (Skin)** Man, Inhalation, TCLo: 100 ppm: Psychotropic*** Rat, Oral, LD_{50}: 5000 mg/kg Rat, Inhalation, LCLo: 4000 ppm/4 hrs. Rabbit, Skin, LD_{50}: 14 gm/kg Human, Eye: 300 ppm



* Current (1985-86) ACGIH TLV. The OSHA PEL is 200 ppm with an acceptable ceiling concentration of 300 ppm and an acceptable maximum peak of 500 ppm/10 minutes.

** Skin designation indicates that toluene can be absorbed through intact skin and contribute to overall exposure.

*** Affects the mind.

SECTION 3. PHYSICAL DATA

Boiling Point ... 231°F (111°C)
Vapor Pressure @ 20°C, mm Hg ... 22
Water Solubility @ 20°C, wt. % ... 0.05
Vapor Density (Air = 1) ... 3.14

Evaporation Rate (BuAc = 1) ... 2.24
Specific Gravity (H_2O = 1) ... 0.866
Melting Point ... -139°F (-95°C)
Percent Volatile by Volume ... ca 100
Molecular Weight ... 92.15

Appearance and odor: Clear, colorless liquid with a characteristic aromatic odor. The odor is detectable to most individuals in the range of 10 to 15 ppm. Because olfactory fatigue occurs rapidly upon exposure to toluene, odor is not a good warning property.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
40°F (4°C) CC	896°F (480°C)	% by Volume	1.27	7.1

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical, alcohol foam. Do not use a solid stream of water because the stream will scatter and spread the fire. Use water spray to cool tanks/containers that are exposed to fire and to disperse vapors.

UNUSUAL FIRE/EXPLOSION HAZARDS: This OSHA class IB flammable liquid is a dangerous fire hazard. It is a moderate fire hazard when exposed to oxidizers, heat, sparks, or open flame. Vapors are heavier than air and may travel a considerable distance to an ignition source and flash back.

SPECIAL FIRE-FIGHTING PROCEDURES: Fire fighters should wear self-contained breathing apparatus with full facepiece operated in a positive-pressure mode when fighting fires involving toluene.

SECTION 5. REACTIVITY DATA

CHEMICAL INCOMPATIBILITIES: Toluene is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization. This material is incompatible with strong oxidizing agents, dinitrogen tetraoxide, silver perchlorate, tetranitromethane, and uranium hexafluoride. Contact with these materials may cause fire or explosion. Nitric acid and toluene, especially in the presence of sulfuric acid, will produce nitrated compounds that are dangerously explosive.

CONDITIONS TO AVOID: Avoid exposure to sparks, open flame, hot surfaces, and all sources of heat and ignition. Toluene will attack some forms of plastics, rubber, and coatings. Thermal decomposition or burning produces carbon dioxide and/or carbon monoxide.

SECTION 6. HEALTH HAZARD INFORMATION | TLV

Toluene is not considered a carcinogen by the NTP, IARC, or OSHA. SUMMARY OF RISKS: Vapors of toluene may cause irritation of the eyes, nose, upper respiratory tract, and skin. Exposure to 200 ppm for 8 hours causes mild fatigue, weakness, confusion, lacrimation (tearing) and paresthesia (a sensation of prickling, tingling, or creeping on the skin that s no objective cause). Exposure to higher concentrations may cause headache, nausea, dizziness, dilated pupils, and horia, and, in severe cases, may cause unconsciousness and death. The liquid is irritating to the eyes and skin. Contact with the eyes may cause transient corneal damage, conjunctival irritation, and burns if not promptly removed. Repeated and/or prolonged contact with the skin may cause drying and cracking. It may be absorbed through the skin in toxic amounts. Ingestion causes irritation of the gastrointestinal tract and may cause effects resembling those from inhalation of the vapor. Chronic overexposure to toluene may cause reversible kidney and liver injury. FIRST AID: EYE CONTACT: Immediately flush eyes, including under eyelids, with running water for at least 15 minutes. Get medical attention if irritation persists.* SKIN CONTACT: Immediately flush skin (for at least 15 minutes) while removing contaminated shoes and clothing. Wash exposed area with soap and water. Get medical attention if irritation persists or if a large area has been exposed.* INHALATION: Remove victim to fresh air. Restore and/or support breathing as required. Keep victim warm and quiet. Get medical help.* INGESTION: Give victim 1 to 2 glasses of water or milk. Contact a poison control center. Do not induce vomiting unless directed to do so. Transport victim to a medical facility. Never give anything by mouth to a person who is unconscious or convulsing. * GET MEDICAL ASSISTANCE = In plant, paramedic, community. Get medical help for further treatment, observation, and support after first aid, if indicated.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Notify safety personnel of large spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Limit access to spill area to necessary personnel only. Remove leaking containers to safe place if feasible. Cleanup personnel need protection against contact with liquid and inhalation of vapor (see sect. 8). WASTE DISPOSAL: Absorb small spills with paper towel or vermiculite. Contain large spills and collect if feasible, or absorb with vermiculite or sand. Place waste solvent or absorbent into closed containers for disposal using nonsparking tools. Liquid can be flushed with water to an open holding area for handling. Do not flush to sewer, watershed, or waterway. COMMENTS: Place in suitable container for disposal by a licensed contractor or burn in an approved incinerator. Consider reclaiming by distillation. Contaminated absorbent can be buried in a sanitary landfill. Follow all Federal, state, and local regulations. TLm 96: 100-10 ppm. Toluene is designated as a hazardous waste by the EPA. The EPA (RCRA) HW No. is U220 (40 CFR 261). The reportable quantity (RQ) is 1000 lbs/454 kg (40 CFR 117).

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements. Ventilation fans and other electrical service must be sparking and have an explosion-proof design. Exhaust hoods should have a face velocity of at least 100 lfm (linear feet inute) and be designed to capture heavy vapor. For emergency or nonroutine exposures where the TLV may be exceeded, u an organic chemical cartridge respirator if concentration is less than 200 ppm and an approved canister gas mask or self-contained breathing apparatus with full facepiece if concentration is greater than 200 ppm.
Safety glasses or splash goggles should be worn in all work areas. Neoprene gloves, apron, face shield, boots, and other appropriate protective clothing and equipment should be available and worn as necessary to prevent skin and eye contact.
Remove contaminated clothing immediately and do not wear it until it has been properly laundered.

Eyewash stations and safety showers should be readily available in use and handling areas.

Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION: Store in a cool, dry, well-ventilated area away from oxidizing agents, heat, sparks, or open flame. Storage areas must meet OSHA requirements for class IB flammable liquids. Use metal safety cans for handling small amounts. Protect containers from physical damage. Use only with adequate ventilation. Avoid contact with eyes, skin, or clothing. Do not inhale or ingest. Use caution when handling this compound because it can be absorbed through intact skin in toxic amounts. SPECIAL HANDLING/STORAGE: Ground and bond metal containers and equipment to prevent static sparks when making transfers. Do not smoke in use or storage areas. Use nonsparking tools. ENGINEERING CONTROLS: Preplacement and periodic medical exams emphasizing the liver, kidneys, nervous system, lungs, heart, and blood should be provided. Workers exposed to concentrations greater than the action level (50 ppm) should be examined at least once a year. Use of alcohol can aggravate the toxic effects of toluene.
COMMENTS: Emptied containers contain product residues. Handle accordingly!
Toluene is designated as a hazardous substance by the EPA (40 CFR 116). DOT Classification: Flammable liquid. UN1294.
Data Source(s) Code: 1-9, 12, 16, 20, 21, 24, 26, 34, 81, 82. CR

Approvals	J.O. Recrocco, 11/86.
Indust. Hygiene/Safety	DJW 10-86
Medical Review	Oct 86

Material Safety Data Sheet

From Genium's Reference Collection

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GENIUM PUBLISHING CORP.

No. 318

XYLENE (Mixed Isomers)
(Revision D)
Issued: November 1980
Revised: August 1988

SECTION 1. MATERIAL IDENTIFICATION

26

Material Name: XYLENE (Mixed Isomers)

Description (Origin/Uses): Used as a raw material for the production of benzoic acid, phthalic anhydride, isophthalic and terephthalic acids and their dimethyl esters in the manufacture of polyester fibers; in sterilizing catgut; with Canadian balsam as oil-immersion in microscopy; and as a cleaning agent in microscopic techniques.

Other Designations: Dimethylbenzene; Xylol; C_8H_{10}; CAS No. 1330-20-7

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

Comments: Although there are three different isomers of xylene (*ortho*, *meta*, and *para*), the health and physical hazards of all three isomers are very similar. This MSDS is written for a xylene mixture of all three isomers, which is usually commercial xylene.

3
2 0
-

NFPA

HMIS
H 2
F 3
R 0
PPG*
*See sect. 8

R 1
I 3
S 2
K 3

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Xylene (Mixed Isomers), CAS No. 1330-20-7*	**	IDLH*** Level: 1000 ppm

*o-Xylene, CAS No. 0095-47-6
m-Xylene, CAS No. 0108-38-3
p-Xylene, CAS No. 0106-42-3

**Check with your supplier to determine if there are additions, contaminants, or impurities (such as benzene) that are present in reportable quantities per 29 CFR 1910.

***Immediately dangerous to life and health.

**** See NIOSH, *RTECS* (No. ZE2100000), for additional data with references to reproductive, irritative, and mutagenic effects.

OSHA PEL
8-Hr TWA: 100 ppm, 435 mg/m^3

ACGIH TLVs, 1987-88
TLV-TWA: 100 ppm, 435 mg/m^3
TLV-STEL: 150 ppm, 655 mg/m^3

Toxicity Data****
Human, Inhalation, TC_{Lo}: 200 ppm
Man, Inhalation, LC_{Lo}: 10000 ppm/6 Hrs
Rat, Oral, LD_{50}: 4300 mg/kg

SECTION 3. PHYSICAL DATA

Boiling Point: 275°F to 293°F (135°C to 145°C)*
Melting Point: -13°F (-25°C)
Evaporation Rate: 0.6 Relative to BuAc = 1
Specific Gravity (H_2O = 1): 0.86

Water Solubility (%): Insoluble
Molecular Weight: 106 Grams/Mole
% Volatile by Volume: Ca 100
Vapor Pressure: 7 to 9 Torrs at 68°F (20°C)
Vapor Density (Air = 1): 3.7

Appearance and Odor: A clear liquid; aromatic hydrocarbon odor.

*Materials with wider and narrower boiling ranges are commercially available.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
81°F to 90°F (27°C to 32°C)	867°F (464°C)		1%	7%

Extinguishing Media: Use foam, dry chemical, or carbon dioxide. Use water sprays to reduce the rate of burning and to cool containers.

Unusual Fire or Explosion Hazards: Xylene vapor is heavier than air and may travel a considerable distance to a low-lying source of ignition and flash back.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Xylene is stable in closed containers during routine operations. It does not undergo hazardous polymerization.

Chemical Incompatibilities: This material may react dangerously with strong oxidizers.

Conditions to Avoid: Avoid any exposure to sources of ignition and to strong oxidizers.

azardous Products of Decomposition: Carbon monoxide (CO) may be evolved during xylene fires.

SECTION 6. HEALTH HAZARD INFORMATION

Xylene is not listed as a carcinogen by the IARC, NTP, or OSHA.
Summary of Risks: Liquid xylene is a skin irritant and causes erythema, dryness, and defatting; prolonged contact may cause blistering. Inhaling xylene can depress the central nervous system (CNS), and ingesting it can result in gastrointestinal disturbance; and possibly hematemesis (vomiting blood). Effects on the eyes, kidneys, liver, lungs, and the CNS are also reported. **Medical Conditions Aggravated by Long-Term Exposure:** Problems with eyes, skin, central nervous system, kidneys, and liver may be worsened by sure to xylene. **Target Organs:** CNS, eyes, gastrointestinal tract, blood, liver, kidneys, skin. **Primary Entry:** Inhalation, contact/absorption. **Acute Effects:** Dizziness; excitement; drowsiness; incoordination; staggering gait; irritation of eyes, nose, and throat; corneal vacuolization; anorexia; nausea; vomiting; abdominal pain; and dermatitis. **Chronic Effects:** Reversible eye damage, headache, loss of appetite, nervousness, pale skin, and skin rash.
FIRST AID: Eyes. Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. **Skin.** Immediately wash the affected area with soap and water. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have a trained person administer oxygen. **Ingestion.** Never give anything by mouth to someone who is unconscious or convulsing. Vomiting may occur spontaneously, but do not induce it. If vomiting should occur, keep exposed person's head below his or her hips to prevent aspiration (breathing the liquid xylene into the lungs). Severe hemorrhagic pneumonitis with grave, possibly fatal, pulmonary injury can occur from aspiring very small quantities of xylene.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. If exposure is severe, hospitilization for at least 72 hours with careful monitoring for delayed onset of pulmonary edema is recommended.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, provide ventilation, and eliminate all sources of ignition immediately. Cleanup personnel need protection against contact with and inhalation of xylene vapor (see sect. 8). Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways.
Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.
OSHA Designations
Air Contaminant (29 CFR 1910.1000 Subpart Z)
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste, No. U239
CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg), per the Clean Water Act (CWA), section 311 (b) (9)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield as a supplementary protective measure. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Use a NIOSH- ved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits n section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine use (leaks or cleaning reactor vessels and storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, gauntlets, etc., as required by the specifics of the work operation to prevent prolonged or repeated skin contact with xylene. **Ventilation:** Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of xylene below the OSHA PEL standard cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of xylene into general work areas by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations.
Safety Stations: Make eyewash stations, safety/quick-drench showers, and washing facilities available in areas of use and handling.
Contaminated Equipment: Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean xylene from shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material. Keep it off of your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale xylene vapor.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store xylene in a cool, dry, well-ventilated area away from sources of ignition and strong oxidizers. Protect containers from physical damage.

Special Handling/Storage: Make sure all engineering systems (production, transportation) are of maximum explosion-proof design. Ground and bond all containers, pipelines, etc., used in shipping, transferring, reacting, producing, and sampling operations.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Xylene	**DOT Label:** Flammable Liquid	**IMO Label:** Flammable Liquid
DOT ID No. UN1307	**DOT Hazard Class:** Flammable Liquid	**IMO Class:** 3.2 or 3.3

References: 1, 2, 12, 73, 84-94, 100, 103.

Prepared by PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: MJ Hardies, MD

APPENDIX C

HEAT STRESS/COLD STRESS GUIDELINES

Cold Stress Guidelines

	Symptoms	What to do
Mild Hypothermia	• Body Temp 98-90°F • Shivering • Lack of coordination, stumbling, fumbling hands • Slurred speech • Memory loss • Pale, cold skin	• Move to warm area • Stay active • Remove we clothes and replace with dry clothes of blankets • Cover the head • Drink warm (not hot) sugary drink
Moderate Hypothermia	• Body temp 90-86°F • Shivering stops • Unable to walk of stand • Confused irrational	• All of the above, plus: • Call 911 • Cover all extremities complexly • Place very warm objects, such as hot packs on the victim's head, neck, chest and groin
Severe Hypothermia	• Body temp 86-78°F • Severe muscle stiffness • Very sleepy or unconscious • Ice cold skin • Death	• Call 911 • Treat victim very gently • Do not attempt to re-warm
Frostbite	• Cold, tingling, stinging or aching feeling in the frostbitten area, followed by numbness • Skin color turns red, then purple, then white or very pale skin • Cold to the touch • Blisters in severe cases	• Call 911 • Don not rub the area • Wrap in soft cloth • If help is delayed, immerse in warm, not hot, water
Trench Foot	• Tingling, itching or burning sensation • Blisters	• Soak feet in warm water, then wrap with dry cloth bandages • Drink a warm sugary drink

HEAT STRESS GUIDELINES

Form	Signs & Symptoms	Care	Prevention[3]
Heat Rash	Tiny red vesicles in affected skin area. If the area is extensive, sweating can be impaired.	Apply mild lotions and cleanse the affected area.	Cool resting and sleeping areas to permit skin to dry between heat exposures
Heat Cramps	Spasm, muscular pain (cramps) in stomach area and extremities (arms and legs).	Provide replacement fluids with minerals (salt) such as Gatorade.	Adequate salt intake with meals[1] ACCLIMATIZATION[2]
Heat Exhaustion	Profuse sweating, cool (clammy) moist skin, dizziness, confusion, pale skin color, faint, rapid shallow breathing, headache, weakness, muscle cramps.	Remove from heat, sit or lie down, rest, replace lost water with electrolyte replacement fluids (water, Gatorade) take frequent sips of liquids in amounts greater than required to satisfy thirst.	ACCLIMATIZATION[2] Adequate salt intake with meals [1] only during early part of heat season. Ample water intake, frequently during the day
Heat Stroke	HOT Dry Skin. Sweating has stopped. Mental confusion, dizziness, nausea, severe headache, collapse, delirium, coma.	HEAT STROKE IS A MEDICAL EMERGENCY - Remove from heat. - COOL THE BODY AS RAPIDLY AS POSSIBLE by immersing in cold (or cool) water, or splash with water and fan. Call for Emergency Assistance. Observe for signs of shock.	ACCLIMATIZATION[2] Initially moderate workload in heat (8 to 14 days). Monitor worker's activities.

Footnotes:

1.) American diets are normally high in salt, sufficient to aid acclimatization. However, during the early part of the heat season, (May, June), one extra shake of salt during one to two meals per day may help, so long as this is permitted by your physician. Check with your personal physician.

2.) ACCLIMATIZATION - The process of adapting to heat is indicated by worker's ability to perform hot jobs less fluid loss, lower concentrations of salt loss in sweat, and a reduced core (body) temperature and heart rate.

3.) Method to Achieve Acclimatization - Moderate work or exercise in hot temperatures during early part of heat season. Adequate salt (mineral) and water intake. Gradually increasing work time in hot temperatures. Avoid alcohol. Normally takes 8 to 14 days to achieve acclimatization. Lost rapidly, if removed from strenuous work (or exercise) in hot temperature for more than approximately five days.

APPENDIX D

INCIDENT REPORTING

GEI Accident Investigation Report

Basic Rules for Accident Investigation

- Find the cause to prevent future accidents - Use an unbiased approach during investigation
- Interview witnesses & injured employees at the scene - conduct a walkthrough of the accident
- Conduct interviews in private - Interview one witness at a time.
- Get signed statements from all involved.
- Take photos or make a sketch of the accident scene.
- What hazards are present - what unsafe acts contributed to accident
- Ensure hazardous conditions are corrected immediately.

Date & Time		**Location**	
Tasks performed		**Witnesses**	
Resulted in	**__ Injury __ Fatality** **__Property Damage**	**Property Damage (list):**	
Injured			
Describe Accident Facts & Events			

Root Cause Analysis	*Check ALL that apply to this accident*		
Unsafe Acts		**Unsafe Conditions**	
Improper work technique		Poor Workstation design	
Safety rule violation		Unsafe Operation Method	
Improper PPE or PPE not used		Improper Maintenance	
Operating without authority		Lack of direct supervision	
Failure to warn or secure		Insufficient Training	
Operating at improper speeds		Lack of experience	
By-passing safety devices		Insufficient knowledge of job	
Protective equipment not in use		Slippery conditions	
Improper loading or placement		Excessive noise	
Improper lifting		Inadequate guarding of hazards	

Servicing machinery in motion		Defective tools/equipment	
Horseplay		Poor housekeeping	
Drug or alcohol use		Insufficient lighting	
Causes (primary & contributing):			
Corrective Actions:			
Employee Signature		**Investigator Signature**	
Date		**Date**	

Accident Report Review

Supervisor _______________________________________ Date _______________

Regional HSO ____________________________________ Date _______________

Corporate HSO ____________________________________ Date _______________

ACCIDENT REPORT FORM

Report No. ________

Site: ____ Project No. ____________________

Location: ____

Date of Report: ______________________________ Preparer's Name:___________________________________

Name and Address of Injured: ____

Date of Birth _________________ Date of Hire: _____________ Title/Classification: ______________________

Division/Department ______________________________ Date of Accident __________ Time: _____________

Accident Category: ___ Motor Vehicle ___ Property Damage ___ Fire

___ Chemical Exposure ___ Near Miss ___ Other

Severity of Injury or Illness: ____ Non-disabling ___ Disabling

____ Medical Treatment ___ Fatality

Amount of Damage: $___________________________ Property Damaged: ______________________________

Estimated Number of Days Away from Job: ____

Nature of Injury or Illness: ____

CLASSIFICATION OF INJURY:

____ Fractures
____ Dislocations
____ Sprains
____ Abrasions
____ Lacerations
____ Punctures
____ Bites
____ Toxic Ingestions

____ Heat Burns
____ Chemical Burns
____ Radiation Burns
____ Bruises
____ Blisters
____ Toxic Respiratory Exposure
____ Toxic Ingestions
____ Dermal Allergy

____ Cold Exposure
____ Frostbite
____ Heat Stroke
____ Heat Exhaustion
____ Concussion
____ Faint/Dizziness
____ Toxic Respiratory

GEI Consultants

ACCIDENT REPORT FORM
(continued)

Part of Body Affected: ____

Degree of Disability: ____

Date Medical Care Was Received: ____

Where Medical Care Was Received: ____

Address (if off site): ____

ACCIDENT LOCATION:

Causative agent most directly related to accident (object substance, material, machinery, equipment conditions):

____

____

Was weather a factor? ____

Unsafe mechanical/physical/environmental condition at time of accident (be specific):

____

____

Unsafe act by injured and/or others contributing to the accident (be specific, must be answered):

____

Personal factors (improper attitude, lack of knowledge or skill, slow reaction, fatigue):

____

____

ACCIDENT REPORT FORM
(continued)

Level of personal protection equipment required in Site Safety Plan: ____

____

Modifications: ____

Was injured using required equipment? ____

If not, how did actual equipment use differ from plan? ____

____

What can be done to prevent a recurrence of this type of accident (modification of machine; mechanical guards; correct environment training):

____

____

Detailed narrative description (how did accident occur, why; objects, equipment, tools used, circumstance assigned duties) (be specific):

____

____

(Use separate sheet as required)

Witnesses to accident ____

Signature of Preparer ____

Signature of Site Leader ____

APPENDIX E

UTILITY CLEARANCE

Utility Clearance Documentation

Project: ____________________

Site: ____________________

Drilling Location ID: ____________________

Driller: ____________________

GEI PM: ____________________

GEI Field Team Leader: ____________________

Utility Drawings Reviewed: ____________________

Provided By: ____________________

Reviewed By: ____________________

One Call Utility Clearance Call Date: ____________________

Utility Clearance Received back from (list utilities): ____________________

Completed By (Company): ____________________ Date: __________

GEI Staff Responsible for Oversight: ____________________

Metal Detector Survey (yes/no): ____________________

Drilling Location Cleared by: ____________________

Contractor: ____________________ Date: __________

GEI Staff Responsible for Oversight: ____________________

Physical Test Pit Clearance Required (yes/no): ____________________

Contractor: ____________________ Date: __________

GEI Staff Responsible for Oversight: ____________________

Handclearing Performed: ____________________ Date: __________

Contractor: ____________________

GEI Staff Responsible for Oversight: ____________________

Notes: ____________________

____

Based upon the best available information, appropriate utility clearance proceedures were performed for the invasive work specified. If client ordered/site specific deviations from existing GEI utility clearance procedures exist, they are approved by the client signature below.

Client Signature (Optional): ____________________ Date: __________

GEI, Inc. Representative: ____________________ Date: __________

Appendix C

Standard Operating Procedures

GEI CONSULTANTS, INC.
455 Winding Brook Drive, Suite 201
Glastonbury, Connecticut

SOP No. PM-001
Revision No. 1
Effective Date: June 2008

STANDARD OPERATING PROCEDURE

PM-001 Public Utility Markout

---

1. Objective

The objective of this SOP is to standardize the utility markout procedures prior to and during excavation. City/state government may have additional requirements for utility markout procedures. Some municipalities/states require that the excavator/consultant perform all markout procedures. All markout procedures should be performed in accordance with local and state regulations.

2. Execution

- The excavator/consultant visits the site and marks out every place he may be excavating with white paint, flags, or stakes.
- All sample locations should be marked out with sample identification number and type of sample (e.g. boring, testpit, or monitoring well).
- The excavator/consultant fills out all the information about the excavation on a request form specified by the state utility markout program and then calls in the request. Sample location maps can be faxed to the utility markout program to clarify sampling locations.
- The customer service representative takes the information and gives the excavator/consultant a markout ticket number and a list of utilities notified. The excavator/consultant records these on the markout request information sheet for later reference.
- Utilities will only markout, or clear, facilities under their responsibility. Generally, this means that they will only markout up to the property boundary. Property owners are then responsible to provide information for private utility locations.
- It is important the excavator/consultant provides an accurate field contact phone number because that is the phone number the facility operators will use should they need to contact the excavator/consultant regarding the markout request.
- The excavator/consultant then notifies any non-member facility operators if known (such as apartment complexes, commercial complexes, railroads with communication cables, etc.).
- Each utility notified either marks out their facilities at the work site, or determines that the site is clear.
- Each utility either completes the markout, or notifies the excavator/consultant they are clear, or that they need additional information.
- American Public Works Association (APWA) Uniform Color Code For Marking Underground Utility Lines:

1. **White** – Proposed Excavation
2. **Pink** – Temporary Survey Markings
3. **Red** – Electric Power Lines, Cables, Conduit & Lighting Cables
4. **Yellow** – Gas, Oil, Steam, Petroleum & Gaseous Material
5. **Orange** – Communications, Alarm, Signal Lines, Cables or Conduit
6. **Blue** – Water
7. **Purple** – Radioactive Materials
8. **Green** – Sewers & Drain Lines

- The excavator/consultant then checks off each facility operator on his markout request information sheet.
- The excavator/consultant begins work on the scheduled work date and time (if all the facility operators have responded) taking care to find and preserve any markings that have been made.
- When digging near a buried facility, the excavator/consultant observes the approximate location around that facility.
- If exposing a facility, the excavator/consultant provides proper support and protection for it so that the facility will not be damaged.
- When the excavation is complete, the excavator/consultant provides proper backfill for any facilities that have been exposed, and removes all utility markings.

3. Limitations

- Markout notification time usually does not include holidays. Make sure holidays are considered and markout time is scheduled accordingly. Under no circumstances are markouts allowed to be performed prior to the required markout time.
- Do not use white paint if precipitation is eminent. Consider using stakes if snow is predicted.
- If the excavator/consultant needs to dig within the approximate location of a combustible, hazardous fluid, or gas line (natural gas, propane or gasoline), the excavator/consultant must hand dig only! The approximate location is defined as 24” on either side of the designated center line of the facility if the diameter is not provided or 24” from each outside edge if the diameter is provided.
- When excavating close to an underground facility, it is good practice to have a spotter assist and guide the machine operator.
- Take care not to damage the conduit or protective coating of a facility. If the excavator/consultant damages this, leave the damaged facility exposed and immediately call the utility owner.
- If contact occurs involving gas, the excavator must notify police, fire, and emergency personnel, and evacuate employees and general

public. No attempt should be made to tamper with or correct the damaged facility.

- If the excavation work requires significant spans of the facility to be exposed, it is the excavator's responsibility to support them (to prevent sagging or collapse) as needed. Contact the utility operator for support, guidance, or assistance.

4. References

Connecticut

Name: Call-Before-You-Dig (CBYD)

Telephone: 1-800-922-4455

Website: www.cbyd.com

Wait time after notification: 2 business days (excluding holidays)

Expiration of markout: 30 days

New York State

Name: Dig Safely New York

Telephone: 1-800-962-7962

Website: www.digsafelynewyork.com

Wait time after notification: 2 business days (excluding holidays)

Expiration of markout: 30 days

New York City/Long Island

Name: New York City One Call Center

Telephone: 1-800-272-4480

Website: www.nycli1calldsi.com

Wait time after notification: 2 to 10 days (excluding holidays)

Expiration of markout: 30 days

New Jersey

Name: New Jersey One Call

Telephone: 1-800-272-1000

Website: www.nj1-call.org

Wait time after notification: 2 business days

Expiration of markout: 45 days

5. Attachment

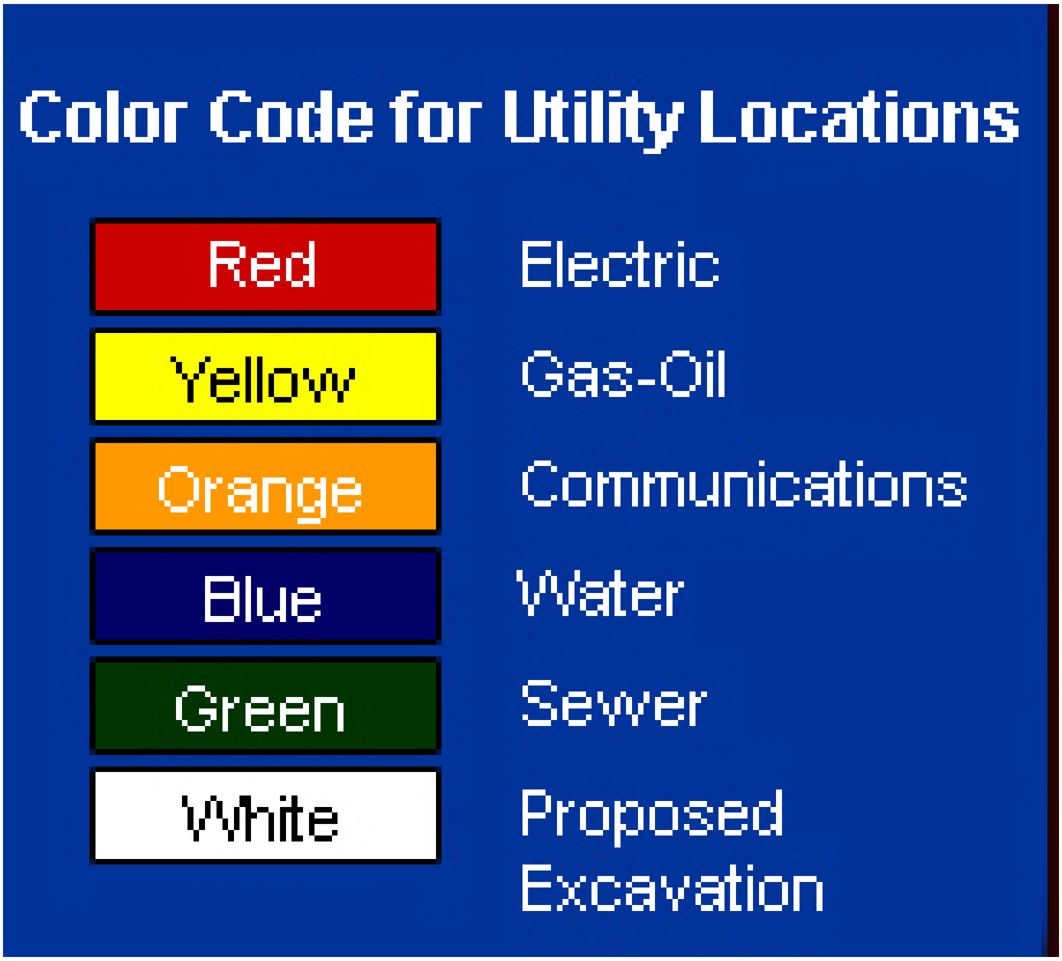
Attachment A – Standard Utility Color Codes

6. Contact

Brian Conte

SOP PM-001

Attachment A – Standard Utility Color Codes



Color Code for Utility Locations

Red	Electric
Yellow	Gas-Oil
Orange	Communications
Blue	Water
Green	Sewer
White	Proposed Excavation

STANDARD OPERATING PROCEDURE

RE-001 Site Reconnaissance

---

1. Objective

A site reconnaissance is conducted to evaluate the likelihood of contamination at a site that may be attributed to past or present spills, releases, or waste handling/disposal practices. A site reconnaissance should be conducted after available background information is compiled and reviewed. Site reconnaissances are used to confirm, supplement, or modify the existing information about the site.

2. Execution

- Record observations in a bound field notebook (See SOP FD-001 Field Notebook) or on the Site Reconnaissance Checklist (Attachment A).
- Make arrangements with the property owner or occupant for access to the site and site buildings. Be clear that access will need to be provided to all site features.
- Obtain a preliminary base map of the site and a road map with a 500-foot, 1,000-foot, and/or 0.5 mile radius drawn from the boundaries of the site. At the time of the site reconnaissance, determine the street names and numbers at each chosen radii. In rural areas where street numbers are not available, maintain a radius of approximately 1,000 feet.
- If available, review surficial and bedrock geology and United States Geological Survey (USGS) maps prior to the site reconnaissance.
- Interview personnel familiar with past and present site conditions during the site reconnaissance. The following information should be recorded: the interviewed person's name, address, telephone number, position in firm or agency, relation to the study site, and years of experience at the site.
- Document the site reconnaissance with photographs. Maintain a photograph log that includes the photograph number, date, location where the photograph was taken, orientation of view, and subject manner.
- Walk entire site property boundaries and make traverses across the site.
- Each of the items on the attached form must be addressed and are described below. If something does not apply to the site, indicate N/A. Do not leave blank.
    i. Provide general information concerning site identification (street address, size).
    ii. Document site weather conditions, amount of snow, temperature, flooding, etc., in field notebook.

iii. Topography - Describe general site topography and estimate surface drainage direction.
iv. Vegetation - Describe general surface vegetation at site. Look for evidence of stressed, dead, or dying vegetation. Changes in the size or age of similar vegetation can indicate areas of clearing, past site disturbance, or former access roads.
v. Hydrogeology - Locate surface water bodies and wetlands and, where possible, determine surface flow directions. Identify the following.
    1. Geology and surface features - Identify landforms, soil exposures, and rock outcrops. Describe the presence and character of artificial fill.
    2. Monitoring wells - Identify the location of monitoring wells on base maps and measure distances of monitoring wells from buildings or other permanent structures. If possible, obtain information concerning the type of well and construction details from the client.
    3. Trace storm drain system, in general, to off-site discharge.
vi. Land Uses - Describe current and former land uses and a history of previous spills or releases. Obtain dates whenever possible. Information may be obtained through interviews with current or former owners, occupants, or employees.
vii. USTs and ASTs - Describe condition of ASTs and USTs present on site. Look for indications of spills around fill/vent pipes. Look for the presence of fill and vent pipes adjacent to buildings. Inquire about the presence or replacement of former UST and AST locations, size, and contents. Obtain copies of UST monitoring and test records, if available. Identify the number of vent pipes and compare to the number of identified or documented USTs/ASTs. Make note of pavement fracture patterns which may indicate pump islands or UST removal areas. Identify current and former heating sources.
viii. Waste Information - Describe current operations likely to involve the use, treatment, storage, disposal, or generation of oil and/or hazardous materials (OHMs). Describe the presence and condition of drums, barrels, other storage containers, and disposal areas. Is the area bermed? Are there floor drains present? Record indicators of spills, staining, soil discoloration, leachate breakout, fill materials, or odors. Locate and describe the condition of wastewater systems, pits, lagoons, and disposal areas. If available, obtain copies of Material Safety and Data Sheets for later review. Identify present and past locations where waste is or has been handled or disposed.

ix. Site Utilities - Describe overhead and underground utilities. Identify whether site is on municipal water or if water is supplied through private wells on site. Identify whether site is on municipal sewer or on an on-site septic system, and include the location of the disposal area (leach field, pit, or trench). Inquire whether the site has had a former septic system or wastewater disposal area. Floors should be observed to identify existing or previously abandoned floor drains. Roof drains and grease traps, if any, should be identified. Discharge locations of floor drains, grease traps, roof drains, and catch basins should be identified. Check labels on transformers for polychlorinated biphenyls (PCBs). Note the absence of labels.
x. Buildings - Obtain as much information as possible about past and present use activities within the building(s). Describe the condition of floors in the basement or first floor, including cracks and evidence of spills. Describe building construction, (for example, a slab on grade or basement, steel or wood frame), and note exterior wall construction. Observe building for additions or historical add-ons.
xi. Site Access - Describe fences, roads, topography, vegetation, subsurface or overhead utilities, wet areas, and other factors that may affect site access for a subsurface exploration program.
xii. Site Abutters - Describe types of general land use activities on abutting properties, including abutters across streets from the site. If possible look for indicators of disturbed land areas and vegetation. Describe general topography and drainage. Look for evidence of USTs. Record names of businesses for regulatory review. Do not trespass on abutting properties.
xiii. Site Vicinity - Identify street addresses at major cross streets up to 0.5-mile radius surrounding the site. Identify sensitive receptors such as schools, nurseries, day care centers, parks, playgrounds, etc., within a 500-foot radius of the site.
xiv. Site Escort - Identify the person who is conducting the site walkover with you.
xv. Prepare a site sketch or mark the locations of observed conditions on a preliminary base map.

3. Limitations

- If observations are recorded in a field notebook, use the Site Reconnaissance Form (provided below) as a checklist.
- Note any area of the site which could not be observed directly during the site reconnaissance because of restricted access, miscellaneous debris, snow cover, and other adverse conditions.

4. References

ASTM Revised Standards on Environmental Site Assessments (2005), E 1527-05

Code of Federal Regulations All-Appropriate Inquiries Standards and Practices for All Appropriate Inquiries (40 CFR Part 312)

Guidance to Environmental Site Assessment (September 1992), National Ground Water Association

Standard References for Monitoring Wells (January 1991), The Massachusetts Department of Environmental Protection, DEP Publication #WSC-310-91

The Massachusetts Contingency Plan (July 30, 1993), The Massachusetts Department of Environmental Protection, 310 CMR 40.0483

5. Attachments

Attachment A - Site Reconnaissance Checklist

6. Contact

Mr. Gary Iadarola

RE-001 Attachment A: Site Reconnaissance Checklist

GEI Job No.:

Date:

Site Reconnaissance performed by:

GEI Project Manager:

Part 1: General Information

Client

Property Name

Address

Size of Site

Easements

Paved parking lot areas (patched areas)

USGS Quadrangle

GIS Maps

Available bedrock or surficial geology maps

Weather at time of visit (include snow cover, flooding, etc.)

Part II: Topography (level-rolling-hilly-etc.)

Describe

Degree of slopes, approx.

Drainage (estimated surface water flow direction)

Part III: Surface Vegetation (wooded-brush-grass-landscaped)

Describe

Stressed or stained vegetation

Describe

Part IV: Hydrogeology (surface water bodies and wetlands)

Describe

a. Geology (bedrock outcrops, fill areas, soil exposures, trenches, etc.)

Describe

b. Surface features (drumlins-valley floor-flood plain)

Describe

c. Monitoring wells (number, size, roadbox, stand-up pipe, location, distance from buildings)

Describe

Part V: Land Use (current, former)

Describe

Part VI: USTs and/or ASTs

Vent and fill pipes (number and locations)

Tank ID	UST/ AST	Capacity (Gallons)	Date Installed	Date Removed	Date of Last Tightness Test

Part VII: Waste Information (drums, barrels, storage containers, wastewater systems/discharges, pits, lagoons, odors)

Describe

Dumpsters/Trash Collection (past & present)

Waste Materials

Dumped Material or Miscellaneous Debris

Areas of Fill

Part VIII: Utilities

Water Electric Gas Oil Cable/Phone
Sewer Septic Leachfield Catch Basins
Manholes Drywells Transformers

Describe

Part IX: Buildings (exterior)

Number of Buildings/Additions

Locations

Size of Buildings

Number of Stories

Age

Describe

Part X: Buildings (interior) (Fill out this section for each building interior.)

Inside Building Descriptions and Uses (offices, commercial, industrial, manufacturing, and other)

Chemical Storage

Basement and/or 1st Floor (type of construction)

Floor Drains, Sumps (number and location)

Floor Condition (cracks, spills)

Part XI: Site Access (fencing, gates, roads, etc.)

Describe

Part XII: Site Abutters (addresses and land uses)

North

East

South

West

Part XIII: Site Vicinity

Names of Cross Streets

Direction in which Street Addresses Increase or Decrease (within 1,000-foot radius of site)

Schools, nurseries/day care centers (within 500-foot radius of site)

Part XIV: Site Escort

Affiliation Employed at facility

Part XIV: Additional Comments:

GEI CONSULTANTS, INC.
455 Winding Brook Drive, Suite 201
Glastonbury, Connecticut

SOP No. FD-001
Revision No. 1
Effective Date: June 2008

STANDARD OPERATING PROCEDURE

FD-001 Field Notebook

---

1. Objective

Proper documentation of all site activities is a crucial part of the field investigation process. Documentation, relative to sampling procedures, includes sample labels, sample seals, field logbooks, chain of custody records, sample analysis request forms, and laboratory sample logs. The field notebook serves as a record of significant field activities performed or observed during the project. The field notebook provides a factual basis for preparing field observation reports, if required, and reports to clients and regulatory agencies. Example field notes are provided in Appendix A.

2. Execution

- Use a separate all-weather bound notebook for each site/location/project number.
- Write neatly using black or blue waterproof pen (or note if field conditions [i.e., cold or wet weather] require use of pencil).
- Write the project name, project number, book number (i.e., 1 of 3), and date on the front cover. On the inside cover, identify the project name, project number, and “Return Book To:” the office address of the project manager.
- Number all of the pages of the field book starting with the first entry.
- Record activities as they occur.
- Neatly cross out mistakes using a single line and initial them. Erasures are not permitted. If an error is made on an accountable document assigned to one individual, that individual will make all corrections. The person who made the entry will correct any subsequent error discovered on an accountable document. All subsequent corrections will be initialed and dated.
- Sign or initial and date the bottom of every page with an entry. outplace a diagonal line through unused portions of a page.
- Record the following information upon each arrival at the site:
    1. Date/time/weather/project number
    2. GEI personnel
    3. Purpose of visit/daily objectives
    4. Record conversations with: [Recommendation - If possible, record telephone numbers of individual contacts for the site in the field notebook.]
    5. Contractors
    6. Clients
    7. Visitors (include complete names, titles, and affiliations whenever possible).

    8. GEI office staff
    9. Landowners (site or abutters)
    10. Note time of arrival and departure of individuals visiting the site
- Additional observations to record:
    1. Type and quantity of monitoring well construction materials used
    2. Use of field data sheets or electronic logging equipment (e.g. boring logs, monitoring well sampling logs, etc.)
    3. Ambient air monitoring data
    4. Locations and descriptions of sampling points
    5. Sample media (soil, sediment, groundwater, etc.)
    6. Sample collection method
    7. Number and volume of sample(s) collected and sample bottle preservatives used
    8. Sample identification number (s) and date and time of sample collection
    9. Approximate volume of groundwater removed before sampling
    10. Field observations
    11. Any field observations made such as pH, temperature, turbidity, conductivity, water level, etc.
    12. References for all maps and photographs of the sampling site(s)
    13. Information pertaining to sample documentation: bottle lot numbers/ dates, method of sample shipments, chain-of custody record numbers, and overnight shipping numbers.
    14. Surveying data (including sketches with north arrows)
    15. Changes in weather
    16. Rationale for critical field decisions
    17. Recommendations made to the client representative and GEI Project Manager
    18. Include a site sketch or representative site photograph of conditions at the end of the day, if required
    19. Time
    20. Summarize work completed/work remaining
- Place a diagonal line though and sign portions of pages not used or skipped
- Bottom of each page signed and dated

3. Limitations

- Only record facts.

- Allow time at the end of the day to write your journal, and make it a priority, even at the expense of observing time.
- Record all observations regardless of relevancy.
- Identify conditions or events that could affect/impede your ability to observe conditions.
- Do not use spiral notebooks because pages can be easily removed.

4. References

New Jersey DEP Field Sampling Procedures Manual, August 2005.

Yerington Mine Site SOP-03 Standard Operating Procedure Field Notes and Documentation, Revision 0 Revision Date: June 6, 2006.

ASFE Model Daily Field Report (1991), ASFE, Inc.

5. Attachments

Attachment A - Example Field Notes

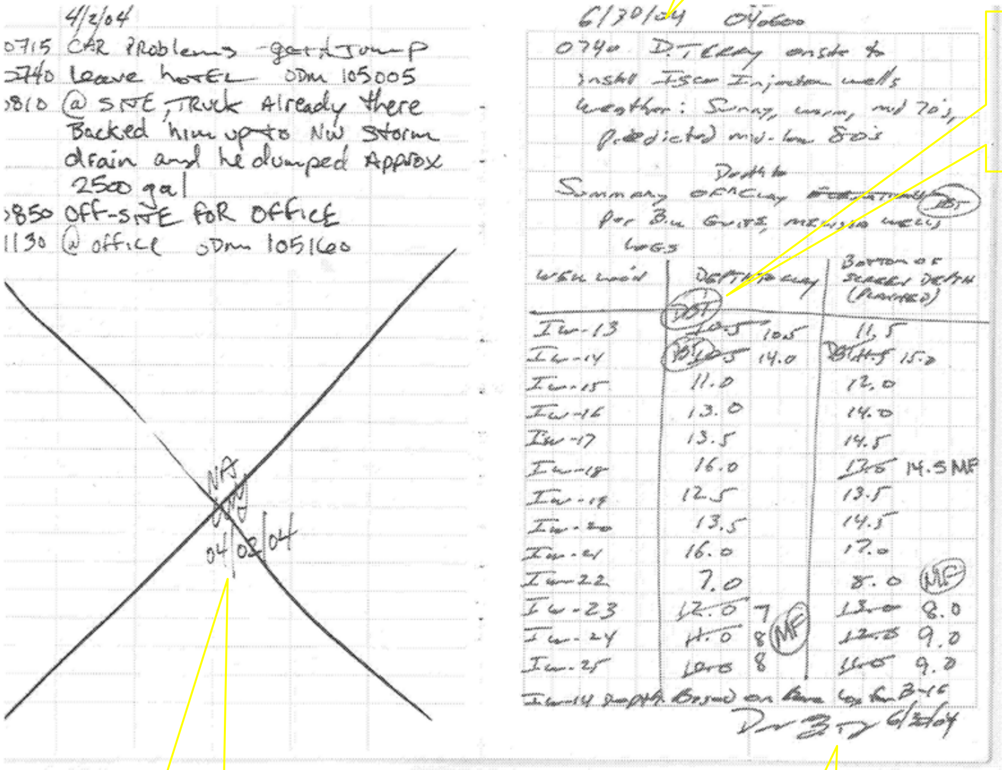
6. Contact

Melissa Felter

SOP FD-001

Attachment A – Example Field Notes

Start of each day includes:
- **Date**
- **Project Number**
- **People on site**
- **Purpose of Work**
- **Weather Conditions**



4/2/04
0715 CAR Problems - get Jump
740 leave hotEL ODM 105005
810 @ SITE, TRuck Already there
Backed him up to NW Storm
drain and he dumped Approx
2500 gal
850 Off-SITE FoR OfficE
1130 @ office ODM 105160

04/02/04

6/30/04 040600
0740 D. Terry onsite to
install ISCO Injection wells
Weather: Sunny, warm, mid 70's,
predicted mid-low 80's

Summary of Depth to Clay ~~[illegible]~~ DBT
for B.W. Guite, [illegible] well
Logs

Well Install	Depth to Clay	Bottom of Screen Depth (Planned)
IW-13	DBT ~~10.5~~ 10.5	11.5
IW-14	DBT ~~10.5~~ 14.0	~~[illegible]~~ 15.0
IW-15	11.0	12.0
IW-16	13.0	14.0
IW-17	13.5	14.5
IW-18	16.0	~~17.5~~ 14.5 MF
IW-19	12.5	13.5
IW-20	13.5	14.5
IW-21	16.0	17.0
IW-22	7.0	8.0 MF
IW-23	~~12.0~~ 7 MF	~~13.0~~ 8.0
IW-24	~~11.0~~ 8	~~12.5~~ 9.0
IW-25	~~10.5~~ 8	~~11.5~~ 9.0

IW-14 depth Based on boring log for B-16

6/30/04

Errors are single line crossed out and initialed

Blank Space crossed out and initialed

Bottom of each page signed and dated

STANDARD OPERATING PROCEDURE

FD-002 Field Observation Report

---

1. Objective

A Field Observation Report is required to accurately summarize the activities, observations, and decisions made during the day's field work. The daily field observation report may serve as a permanent record of the day's activity for the Project Manager (PM), In-House Consultant (IHC), and client.

2. Execution

- If required, at the close of the day's field work, a Field Observation Report must be prepared by the individual responsible for the field notebook. This report must be completed before leaving work for the day. Contents of the report should include, at a minimum, the following information.
    1. A record of person(s) present at the site, time of arrival, departure times (e.g., GEI, contractor(s), client, etc.).
    2. A record of the daily objective(s) and the activities performed (e.g., drilled five borings in the overburden).
    3. A summary of deviation(s) from the field plan or objectives.
    4. A summary of field decision(s) made, who made it/them, and the basis for such decision(s).
    5. A diagram, sketch, and/or map showing the location and extent of the work or other significant observation(s) made during the day.
    6. Any recommendations that may result from field observations and any actions that resulted from those recommendations.
    7. A summary listing and field sketch showing location(s) of field activity.
- Submit a draft report to the PM/IHC for review and editing related to the clarity and conciseness of the report. Complete any editorial changes, sign, date, and submit the report to PM/IHC for approval/signature. Field Observation Reports should be written neatly. They are not required to be typed unless specifically requested by the PM.

3. Limitations

- Not all projects require daily field observation reports.
- The Field Observation Report should be based solely upon factual information, not opinions. Any speculation should be clearly noted in the report as such.

- The Field Observation Report should never be released to anyone other than the PM/IHC prior to review and sign-off unless explicitly authorized by the PM/IHC.

4. References

New Jersey DEP Field Sampling Procedures Manual, August 2005

Yerington Mine Site SOP-03 Standard Operating Procedure Field Notes and Documentation, Revision 0 Revision Date: June 6, 2006

ASFE Model Daily Field Report (1991), ASFE, Inc.

5. Attachments

Attachment A - Example Field Observation Form

6. Contact

Mrs. Melissa Felter

Attachment A: FIELD OBSERVATION REPORT

	Date:
Project :	**Report No.**
Client :	**Page:**
Contractor:	**GEI Proj. No.**

Time of Arrival: **Departure:** . **Weather:**

<u>Persons Contacted,Company</u> **<u>GEI Representatives</u>**

Purpose of Site Visit:

Observations

1.

By:	**Reviewed By:**

GEI CONSULTANTS, INC.
455 Winding Brook Drive, Suite 201
Glastonbury, Connecticut

SOP No. FD-003
Revision No. 2
Effective Date: December 2008

STANDARD OPERATING PROCEDURE

FD-003 Sample Management and Chain of Custody

---

1. Objective

To properly collect, label, document, preserve, package, transport environmental samples, and to provide a record of the custody of any environmental field sample from time of collection to delivery to the laboratory. The Chain-of-Custody (COC) can be used as a legal document to guarantee that samples were not mishandled and that they were delivered to the laboratory within the timeframe necessary to start analysis. A sample is under custody if:

a) it is in GEI’s possession; or
b) it is in GEI’s view after being in GEI's possession; or
c) it was in GEI’s possession and then it was locked up to prevent tampering; or
d) it is in a designated secure area. GEI facilities are designated secure areas.

2. Execution

- Review the work plan prior to sampling to determine the following:
    i. The analysis required by the period and sample volumes required by the laboratory to perform those analysis. (Be explicit when requesting analysis on the COC (e.g. rather than “VOCs” (Volatile Organic Compounds) write “VOCs 8260”.)
    ii. The turnaround time required by the project.
    iii. If the data will be sent directly from the laboratory to the data validator or Data Group.
    iv. Holding time restrictions for sampling media and analytical methods.
- Label the jar or bottle not on the cap.
- Following sample collection, the sample container is labeled using a waterproof marker with the sample ID, the date and time (military time) of sample collection, project number, sample preservatives, and the sampler’s initials. Sample custody begins at this time.
- Record the above information in the field notebook.
- Individually wrap sample jars with packing material. Place samples in a chilled (4°C) cooler immediately after collection.
- Complete a chain of custody (COC) for the samples as described below, and sign off on the COC each time a new person takes possession of the samples. A COC form must accompany each shipment/delivery of samples to the laboratory. GEI or Laboratory COC forms may be used as long as the laboratory form contains the same required information as described below.

- An example COC is provided in Attachment A.
- Place a custody seal on the cooler if shipping.
- Transport samples to the laboratory as soon as possible. It is preferable the samples are sent from the field rather than brought back to the office for submission at a later date.

2.1. Chain-of-Custody (COC) Completion

- Record the project name and number, the sampler's name(s) and the state where the samples were collected.
- For each sample, enter the sample identification number, date and time (military time) collected, whether the sample is a grab or composite sample and the number of sample containers. Record the type of analysis (including laboratory method; e.g. EPA-SW846 Method XX) requested and the preservative (if appropriate) in the vertical boxes.
- When samples are ready to be relinquished, complete the bottom of the form with date and time (military time) and signatures of relinquisher and receiver of samples as indicated. The sample collector is always the first signature while the analytical laboratory is the final signature. Theoretically, all individuals handling the samples between collection and laboratory should sign the form; however, if a common carrier (i.e., Federal Express, UPS) is used for shipping, GEI must identify the carrier in the 'Received by' box on the COC. If the sampler hand delivers the samples to the laboratory, the received box must be signed by the laboratory.
- The forms are in triplicate (white, yellow, and pink copies). The pink copy should be retained by the sampling personnel and provided to the Data Group for proper filing. The white and yellow copies should accompany the samples to the laboratory.
- Prior to sample shipment, the COC must be placed inside the cooler (in a ziplock bag or other watertight package taped inside the lid of the cooler), and the cooler must be sealed with a signed COC seal.
- If a common carrier such as FedEx is used to transport the samples to the laboratory, include the carrier tracking number and identify the carrier in the "Received by" box on the COC.
- Any unused sampling containers/media that is sent back to the lab should be included on the COC. Return samples to the laboratory in a timely manner.
- Field duplicates should be anonymous to the laboratory, but must be recorded for use by the Data Group. To keep track of this information, link the field duplicate with the proper sample in the field copy of the COC and also the field book.

- After the samples are sent to the laboratory, the field copy must be sent to the Data Group. You can send the field copy with duplicate information in the mail to the Data Group.

3. Limitations

- The field notebook must document all GEI personnel who had custody of any samples prior to shipping the samples to the laboratory, the samples must be relinquished to the shipper and the COC signed and dated by the sampler and the shipper, even if both people are GEI personnel.
- Keep the number of people involved in collecting and handling samples and data to a minimum.
- Only allow people associated with the project to handle samples and data.
- Always document the transfer of samples and data from one person to another on chain-of-custody forms.
- Always accompany samples and data with their chain-of-custody forms.
- Give samples and data positive identification at all times that is legible and written with permanent ink.
- When sending samples via a common carrier, use one COC per package.
- Do not send samples from more than one site with separate COCs in a single package.

4. References

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

Connecticut Department of Environmental Protection, Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory

Determination of Volatile Organic Compounds, Version 2.0 February 28, 2006.

5. Attachments

Attachment A – Example Chain of Custody

6. Contact

Brian Skelly

Chain of Custody Record

STL Connecticut
128 Long Hill Cross Road
Shelton, CT 06484
Tel: 203-929-8140

Example.
COC

SEVERN TRENT STL
Severn Trent Laboratories, Inc.

STL-4124 (0901)

Client GEI	Project Manager Dave Terry	Date 12-31-07	Chain of Custody Number 00452
Address 455 Winding Brook Dr	Telephone Number (Area Code)/Fax Number 860 368 5300 / 860 368 5307	Lab Number	Page 1 of 1
City Glastonbury State CT Zip Code 06033	Site Contact M. Felter Lab Contact Paul Hobart		
Project Name and Location (State) CarrollGardens NY	Carrier/Waybill Number FedEx 9383 7603 0879		
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil		Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH	Analysis (Attach list if more space is needed): VOC 8260B	SVOC 8270C	TO-15 + NAPHTHALENE	Special Instructions/ Conditions of Receipt
CGSB-01 (0-2)	12-31-07	1130				X		X						X	X		
CGSB-02 (3-4)	12-31-07	1250				X		X						X	X		
CGSB-02 (3-4) MS	12-31-07	1250				X		X						X	X		
CGSB-02 (3-4) MSD	12-31-07	1250				X		X						X	X		
CGSB-XX (5-6)	12-31-07	0800				X		X						X	X		
CGTB-123107	12-31-07	1400					TB				X			X			
CGGW-01	12-31-07	1430		X				X			X			X	X		
CGSG-01	12-31-07	0700-1500	X													X	CANISTER# 2613 REGULATOR# 779

NEW JERSEY : "CLP data package deliverables"

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Unknown

Sample Disposal
☐ Return To Client ☒ Disposal By Lab ☐ Archive For ______ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☒ Other See Contract

QC Requirements (Specify) NYS Cat B ASP deliverable send to Lorie Mackinnon Send EDD to datagroup@geiconsultants.com

1. Relinquished By Melissa J Felter	Date 12-31-07	Time 1600	1. Received By FedEx	Date 12-31-07	Time
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments
USED FLOW CONTROLLER FOR AIR SAMPLE INCLUDED

RIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

STANDARD OPERATING PROCEDURE

FD-004 Photodocumentation

---

1. Objective

To properly document and retain photographic records. Keeping a record of photographs taken is crucial to their validity as a representation of an existing situation.

2. Execution

- Photographs of a site, individual samples, or other observations should be taken using a digital camera.
- All photographic records should be recorded in the Field Notebook (SOP FD 001) and the following information should be recorded in the field notebook.
    i. Number of photograph in sequence
    ii. Compass direction describing the direction the photograph was taken (e.g. looking southeast)
    iii. Brief description of what the photograph is intended to show
- The field notebook should also note who took the photographs, and the date and time each photograph was taken.
- The photographs should be electronically backed up on a computer or other data storage device.
- Photographs should be placed on a photograph record template and the relevant information describing the photograph should be inserted into the caption section for each photograph.

3. References

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

4. Attachments

Attachment A – Example of Photodocumentation Template

5. Contact

Mrs. Melissa Felter

Attachment A – Example of Photographic Record

GEI Consultants, Inc.

Project: Project Name

Location: Project Location

Photographer: K. Barber

Date: 10/25/07

Photo No.: 1

Direction: N

Comments:
Entrance of site with tree mulching operations.

Photographer: K.Barber

Date: 10/25/07

Photo No.: 2

Direction: W

Comments:
On-site building built in 1936.

GEI CONSULTANTS, INC.
455 Winding Brook Drive, Suite 201
Glastonbury, Connecticut

SOP No. DM-002
Revision No. 1
Effective Date: June 2008

STANDARD OPERATING PROCEDURE

DM-002 Hollow-Stem Auger

---

1. Objective

To standardize the drilling of overburden soil borings for environmental investigations. This standard operating procedure (SOP) addresses the use of hollow-stem augers to drill the soil boring.

2. Execution

- Contact the owner to determine the locations of underground utilities/obstructions. Verify with the contractor that the utility clearance service of the particular state you're working in has been contacted. Ask the subcontractor to provide you with the utility clearance authorization number and the time of clearance to proceed, and record the number in the field notebook (See SOP PM-001).
- Inspect the drilling rig to make sure it is clean and that the down-hole equipment has been steam-cleaned. Check that the steam-cleaner is working properly (i.e., that steam is being produced). Measure and record lengths of all down-hole drilling equipment, including the drilling heads and miscellaneous rods and attachments. Record all observations and measurements in the field notebook.
- If a surface-soil sample is desired, collect this sample with a split-spoon sampler prior to setting the first flight of augers up over the borehole. For all soil samples, use a 140-lb hammer to drive the sampler, unless conditions necessitate using a 300-lb hammer (see SOPs SM-001, *Split-Spoon Sampling* and SM-0003, *Soil Classification,* for details). Count and record the number of blow counts per 6-inch increments, confirming, blow counts with driller if necessary).
- Decontaminate the split-spoon sampler after each use (see *Equipment Decontamination,* SOP QA-001) or use another decontaminated split-spoon sampler.
- Direct the drillers to drill the borehole to the top of the next sampling interval. Remove the auger cutting bit/plug and insert the split-spoon sampler into the interior of the augers (the drillers are responsible for this activity). Measure the stick-up of the rods attached to the sampler to ensure that the nose of the spoon is in virgin soil below the augers.
- Watch for signs of a soil strata change at depth during drilling (i.e., change in blow counts, change in soil color, soil wetness, soil contamination, bouncing of the drill rig, etc.). If important to the investigation, stop drilling and collect a soil sample.
- Repeat until the borehole has been drilled to the desired depth.

- If a monitoring well is not installed in the soil boring, fill the boring with either cement/bentonite grout or properly-tamped and hydrated bentonite. Do not backfill the boring with drill cuttings unless explicitly allowed under state-specific regulations.
- Complete boring log and, if necessary, well installation logs (SOP SM-003, *Soil Classification*).
- Record boring locations on a site map and in a field notebook sketch. Measure each location from on-site reference points in the field notebook so that enough information can be obtained to recreate the location.

3. Limitations

- At all times, follow safety procedures as defined in the site-specific Health and Safety Plan.
- In areas of significant soil contamination, hollow-stem augers may cross-contaminate upper soil layers as contaminated cuttings move up the auger flights. The potential also exists for contaminated augers to carry contamination to deeper soil strata.
- If *in situ* borehole permeability tests are to be performed prior to installation of the monitoring well, the hollow-stem auger method is not appropriate due to water loss at the auger junctions.
- If significant unanticipated contamination is encountered during drilling, stop drilling to confer with the project manager and evaluate health and safety conditions. If the borehole is to be advanced below the contaminated strata, use telescoping techniques (see SOP DM-008 *Monitoring Well Telescoping Techniques*) to avoid cross-contaminating underlying geologic strata.
- When drilling below the groundwater table in fine to medium sands, the potential exists for the phenomenon of “running sands” or “blow in” to occur. Frequent measurements inside the hollow-stem augers after the drill bit/plug is removed will indicate if running sands are present. If sands start to flow into the auger, pour clean water into the augers and keep the augers filled during sampling.
- If necessary, arrange for the storage of contaminated soil cuttings and water in drums or other appropriate containers in a secure place at the site. Containers should be labeled.
- Plan the drilling program to drill borings from the least- to most-contaminated areas. Be prepared in advance and know where alternative drilling locations are in the event that problems are encountered at each planned soil boring location. Alternative locations will need to have utility clearance.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90

Nielsen, D.M. (1993), “Correct Well Design Improves Monitoring,” Environmental Protection, July, pp. 38-49

Standard References for Monitoring Wells (April 1991), Commonwealth of Massachusetts Department of Environmental Protection, WSC-310-91

5. Attachments

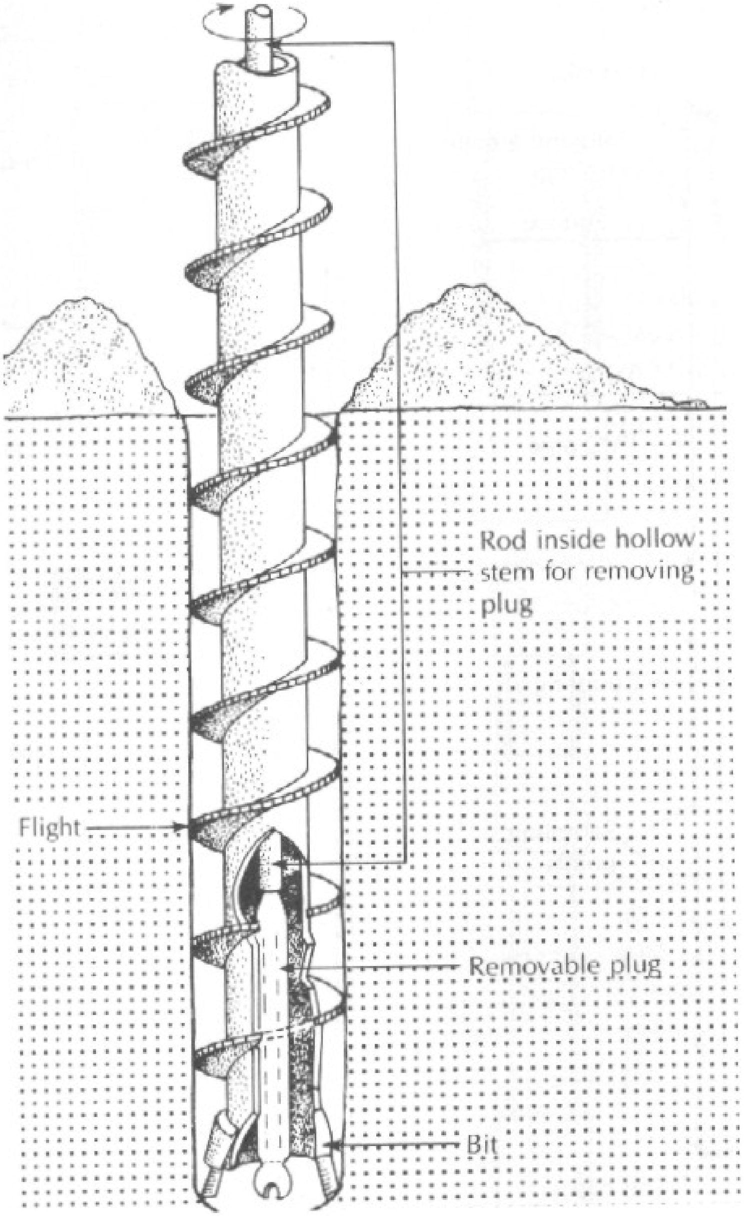
Attachment A – Hollow-Stem Auger

6. Contact

Gary Fuerstenberg

SOP DM-002

Attachment A – Hollow Stem Auger



STANDARD OPERATING PROCEDURE

DM-006 GeoProbe ® Direct Push Boring

---

1. Objective

The purpose of this standard operating procedure (SOP) is to standardize soil sample collection using GeoProbe® and MacroCore® technologies. A Geoprobe relies on a relatively small amount of static (vehicle) weight combined with percussion as the energy for advancement of a tool string. Using a Geoprobe, you can drive a Macrocore® to obtain continuous soil cores or discrete soil samples.

2. Execution

- Contact the owner to determine the locations of underground utilities/obstructions. Verify, with the contractor, that the utility clearance service of the particular state has been contacted. Ask the subcontractor to provide an utility clearance authorization number and the time of clearance to proceed, and record the number in the field notebook (See Public Utility Markout SOP PM-001).
- Inspect the drilling rig to make sure it is clean and that the down-hole equipment has been steam-cleaned. Check that the steam-cleaner is working properly (i.e., that steam is being produced). Measure and record lengths of all down-hole drilling equipment, including the drilling heads and miscellaneous rods and attachments. Record all observations and measurements in the field notebook.
- Insert a Macrocore (MC) ® liner, (i.e polyvinyl chloride (PVC)) into the sample tube, and connect an MC drive head to the top of the sample tube. A diagram of the MC assembly is provided as Attachment A.
- The drive head is then tightened into the sample tube, and a drive cap is attached to the drive head.
- Place the sampler in the driving position, and drive the sampler until the drive head reaches the ground surface.
- Remove the drive cap, attach a pull cap to the sampler drive head, and pull the sampler out of the ground.
- Remove the cutting shoe and filled liner.
- When the sampler is brought to the ground surface, it should be opened immediately, and the length of recovery should be measured and recorded.
- Decontaminate the sampler if necessary (SOP QA-001 Equipment Decontamination) and reassemble the parts with a new liner, and insert the sampler down the same hole to take the next soil core.
- In non-cohesive soils, slough material may enter the sampler as the next core is collected (see limitations below).

- Careful logging of soil stratigraphy is necessary to document whether soil sloughing has occurred within the borehole (see limitations).
- Remove the sample with a clean laboratory spoon and transfer it directly to a suitable sample container.
- Label, preserve, and store the sample in accordance with SOP SC-002 Sample Handling.

3. Limitations

- The GEI oversight person shall ensure that the borehole created by the MC sampling tube does not collapse between collection of each sample. If the borehole collapses and representative samples cannot be obtained using the standard macro-core sampler, then one of two options may be used.
  i. The MC sampler can be fitted with a piston rod assembly, or a 1.5-inch outer diameter (O.D.), large bore sampler equipped with a piston rod assembly may be used to collect the samples. The sample tube (MC)is advanced through the caved-in borehole material to the top of the desired sampling interval. The sample tube remains closed by a piston tip as it is advanced. Upon reaching the target sample depth, the piston tip will be released and the discrete sampler device is then advanced to collect the representative sample.
  ii. The piston rod assembly is driven up to the top of the sample tube as the sample enters the tube.
- Because the MC sampling tube uses a dedicated, disposable liner made of clear plastic, the only part of the sampler that contacts the soil sample is the cutting shoe. Each sample liner will be disposed of after use and a new liner will be placed in the macro-core tube prior to collection of subsequent samples. Cutting shoes and sample collection spoons used to transfer samples to the laboratory jars will be decontaminated between use.

4. References

ASTM D6001-05 Guide for Direct Push Water Sampling for Geoenvironmental Investigations, April 2005

GeoProbe Systems, "GeoProbe MacroCore MC-5 1.25-inch Light Weight Center Rod Soil Sample System SOP", Technical Bulletin No. MK 3139, November 2006

5. Attachments

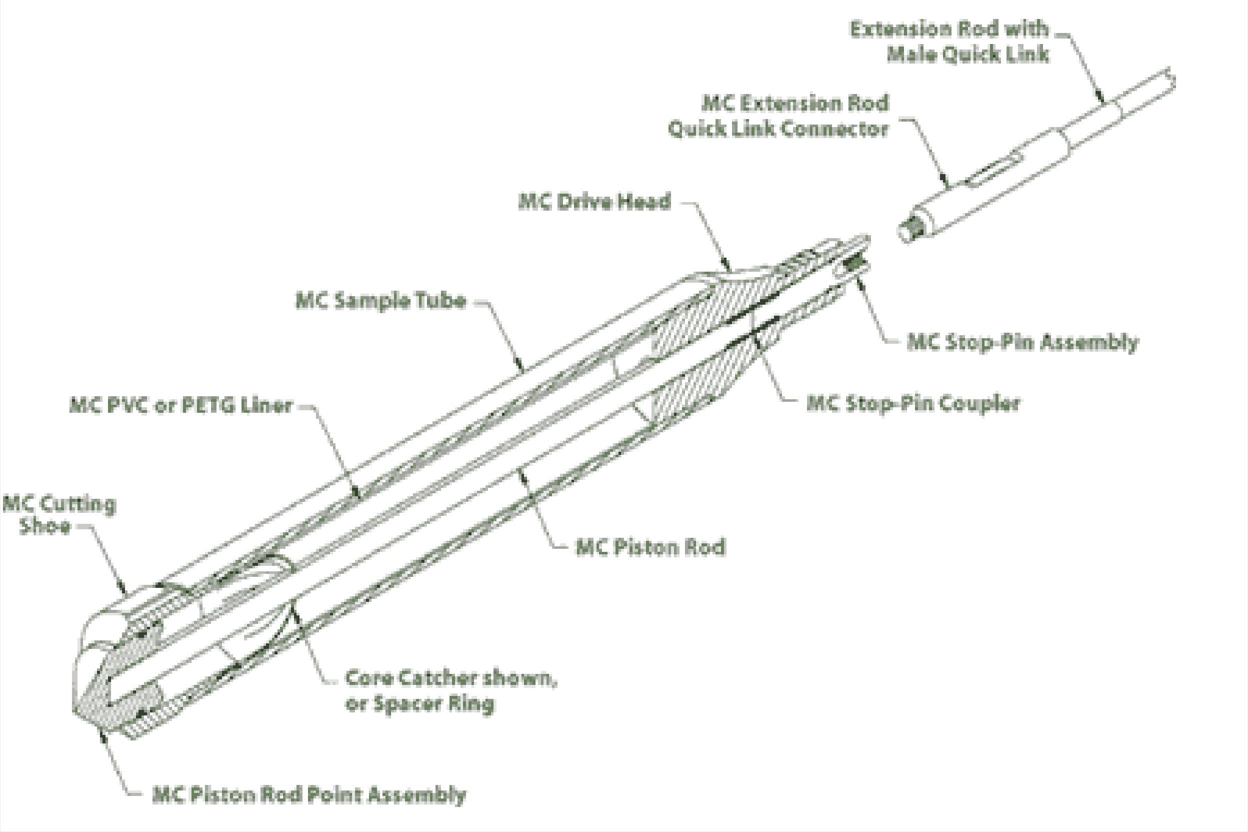
Attachment A – GeoProbe® with Macrocore® Sampler Assembly

6. Contact

Melissa Felter

SOP DM-006

Attachment A – GeoProbe® with Macrocore® Sampler Assembly



Above: Diagram of a Macrocore® sampler

Right: A track-mounted GeoProbe ® Rig

GEI Consultants

GEI CONSULTANTS, INC.
455 Winding Brook Drive, Suite 201
Glastonbury, Connecticut

SOP No. DM-007
Revision No. 1
Effective Date: June 2008

STANDARD OPERATING PROCEDURE

DM-007 Monitoring Well Construction and Installation

---

1. Objective

The objective of this standard operating procedure (SOP) is to standardize the installation of shallow overburden monitoring wells for environmental investigations. This SOP addresses the installation of monitoring wells screened across the groundwater table and assumes the monitoring wells will be constructed of flush-joint PVC pipe; the screened section will have factory-slotted openings. Well dimensions (well diameter, screen length, and screen slot-diameters) will be specified in the Work Plan.

2. Execution

- Attachment A provides a diagram of typical Shallow, intermediate, and deep groundwater monitoring well construction detail.
- Using a weighted tape, measure and record the depth of the completed soil boring before beginning the well installation.
- Measure the depth to groundwater in the borehole over a 10 to 15 minute period to ensure that the groundwater elevation has approximately stabilized. Compare the saturated soil depth estimated from split-spoon samples to the measured water level in the borehole. If drilling water has been used during boring advancement, pump the water out of the borehole to the static water depth, based on examination of the soil samples, and monitor the recovery of groundwater until the level has stabilized.
- Choose the monitoring well screen and riser lengths so that the slotted section of the screen intersects the groundwater table. If the borehole is deeper than the desired well depth, then fill the base of the borehole with bentonite.
- A minimum of a one-inch sump should extend to the bottom of the well.
- Monitoring well should be constructed of either 2 or 4 inch inner diameter (ID) Schedule 40 threaded flush-jointed PVC.
- Install and secure a bottom well cap. The bottom cap should be secured with either a threaded coupling and/or stainless steel screws.
- Place at least 12 inches of clean uniformly graded medium quartz filter sand pack into the base of the borehole. Measure and record the depth of the boring. Temporarily cover the top of the riser pipe and lower the complete well plus riser into the borehole, with the base resting on the sand pack.
- Add adequate sand to surround the area around the slotted section. The filter sand should extend at least 2 feet above the top of the slotted section.

- Remove the drilling casing/augers from the borehole slowly, at a maximum of 2-foot intervals. As the drillers pour or use tamping rods to place the filter sand in the borehole, take frequent measurements of the depth-to-sand. Do not let the sand "bridge" in the annular space. Continue to observe the water level in the borehole.
- Place at least 1 foot of bentonite seal above the filter pack. If the seal is above the water table, use at least 5 gallons of potable water to hydrate the bentonite.
- If necessary, pump bentonite-cement grout using a tremie pipe into the bottom of the annular space to the ground surface. Grout should be mixed in approximately the following proportions: 7.5 gallons water to one 94-lb. bag of cement to 2-4 lbs of pulverized bentonite. The grout must be mixed using the pump on the rig to ensure proper mixing. The protective casing should be set in the grout before it sets.
- The protective surface casing will be either a flush-mounted roadbox or a steel “stick up” pipe. The base of either type of casing must extend at least 1 foot into the grout below the ground surface (below the frost line) whenever possible.
- Cut the monitoring well riser flat and place a mark or "V"-notch or an arrow on the casing with an indelible marker at one point for surveying and groundwater measurements. Cut the well riser so that the top of the well is 3 to 6 inches below the top of the protective casing.
- Set bentonite-cement grout in the annular space between the protective casing and the borehole up to the ground surface. Slope the concrete radially away from the protective casing at the ground surface to promote surface water runoff. In areas of high traffic or areas of parking lots and/or roadways where plowing occurs, set the roadbox FLUSH with the ground surface to avoid damage to the well.
- If the well is installed in a high-traffic area with a guardpipe, additional protection such as steel pole bumpers around the guardpipe may be necessary.
- Place a locking cap on the well pipe.
- All well locations should be photodocumented in accordance with SOP FD-004 Photodocumentation.
- Label the protective well casing with a paint pen and tape out the location to nearby landmarks so that the well may be located in the future. Make sure to enter this information in the field notebook). If possible, place a brightly colored stake or other identifier adjacent to the well.
- Develop the well (see SOP DM-009, *Monitoring Well Development*).

3. Limitations

- At all times, follow safety procedures as defined in the site-specific Health and & Safety Plan.

- Site-specific conditions must be evaluated to determine appropriate materials.
- The water table will fluctuate seasonally and from year-to-year. Try and estimate the maximum high and low elevations of the water table from the current water table elevation and the season. Place the 10-foot screen so that at least 2 feet of the screen will extend above the top of the screen when water is at its highest. If very substantial fluctuations in the groundwater table are expected, a 15-foot screen is acceptable.
- Do not screen across different hydrostratigraphic units if possible (for example, outwash sands and till) unless specified in the Work Plan or approved by the Project Manager.
- If the formation is composed of a material that is uniformly coarser than the filter sand, the grain size of the filter sand must be increased. Consideration should also be given to changing the slot size on the well screen. Differences in average grain size should generally not be greater than a factor of two to four times.
- Do not use borehole/auger cuttings for backfill during monitoring well installation. If the cuttings are suspected to contain contamination which was identified during drilling, cuttings are to be containerized for later characterization and not used for filter pack materials.
- Do not screen across a confining layer (e.g., silt or clay). Backfill all confining layers with hydrated bentonite or grout.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90

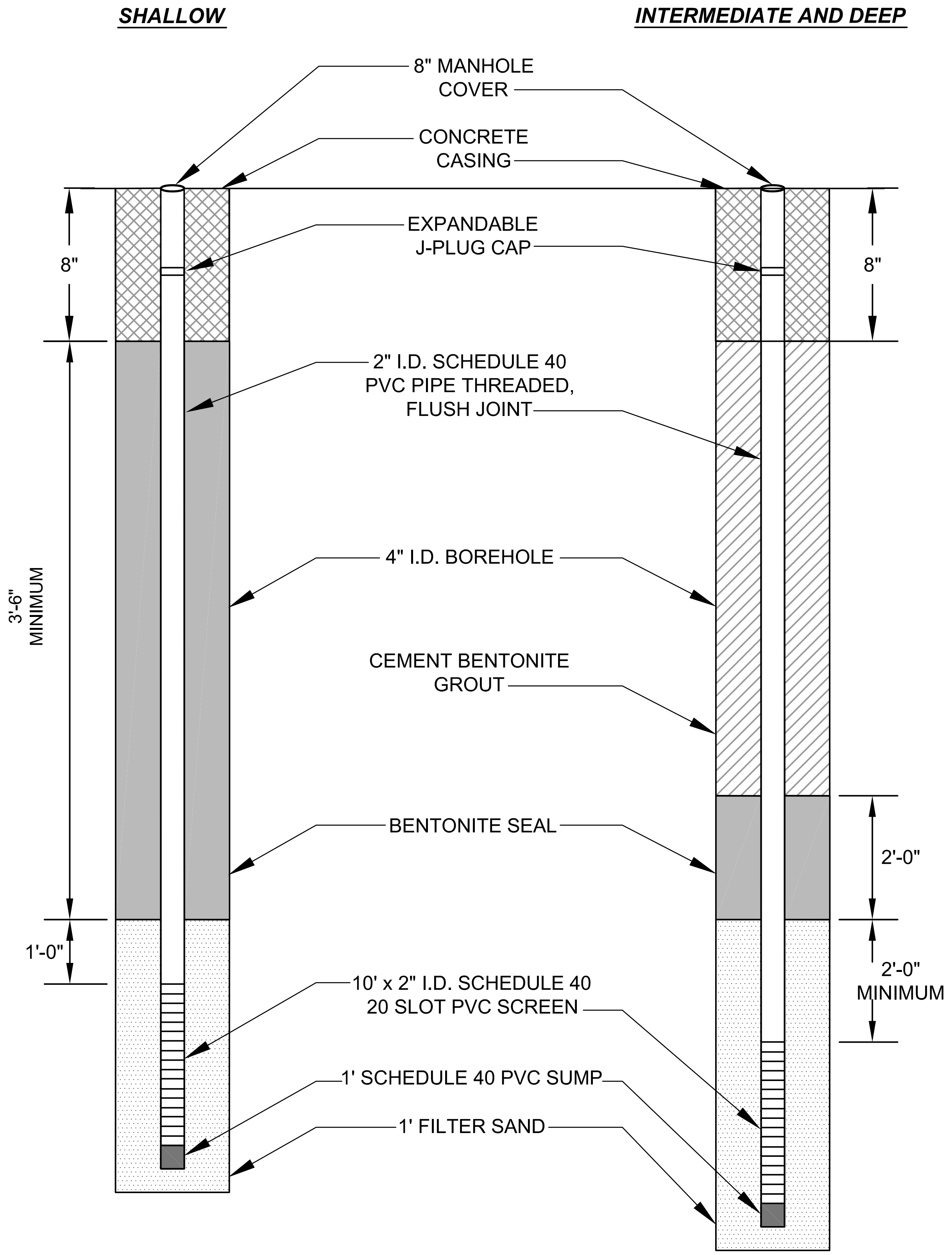
Nielsen, D.M. (1993), "Correct Well Design Improves Monitoring," Environmental Protection, July, pp. 38-49

5. Attachments

Attachment A – Typical Shallow, Intermediate, and Deep Groundwater Monitoring Well Construction Detail

6. Contact

David Terry



NOT TO SCALE

GEI Consultants

TYPICAL SHALLOW, INTERMEDIATE AND DEEP GROUNDWATER MONITORING WELL CONSTRUCTION DETAIL

June 2008

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GEI CONSULTANTS, INC.
455 Winding Brook Drive, Suite 201
Glastonbury, Connecticut

SOP No. DM-009
Revision No. 1
Effective Date: June 2008

STANDARD OPERATING PROCEDURE

DM-009 Monitoring Well Development

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1. Objective

To remove drilling fluids, to remove fines soil particles that may be trapped in the monitoring well's sand pack and screen, and to set the sand pack so that it will function properly.

2. Execution

- Decontaminate all development equipment prior to use with methanol, Alconox, and deionized-water rinses. See SOP QA-001 Equipment Decontamination.
- Calculate the volume of water in the monitoring well (one well volume).
- Record volume on Monitoring Well Sampling Record (Attachment A).
- Collect a sample of water from the monitoring well with a submersible pump, a bailer, or a Water pump. Record the color and turbidity of the sample. Remove the greater of the following amounts of groundwater:
    i. Ten well volumes.
    ii. The volume of fluid added during drilling.
- Purge groundwater until it runs clear (<50 nephelometric turbity units (NTUs)).
- Measure the purge rate (gallons per minute) and total volume purged.
- Monitor the groundwater level in the well during development to determine if the pumping rate is sufficient to create a drawdown in the well.
- Collect groundwater samples every few well volumes during the pumping and record the physical properties (color and turbidity).
- Stop pumping when the purge water is relatively clear. Place a surge block in the monitoring well. Slowly move the surge block up and down in the well. Periodically remove the surge block and purge the groundwater until it is relatively clear again. Start at a slow pace and progress to a faster surging action through time.
- Monitor the turbidity and color of the water during this procedure. The well is considered fully developed when all of the following criteria have been met:
    i. The volume of fluid added during drilling has been removed.
    ii. The water removed from the well is <u>relatively</u> free of fine-grained particles.
    iii. Record the volume of water pumped from the well and the physical properties (color, turbidity) of the water.

3. Limitations

- Always remove groundwater with fine particles from the well before surging. The fine particles may be forced into the well screen by the surging action.
- Pump contaminated groundwater into a properly labeled drum.
- Use a bailer to develop monitoring wells that are installed in soils that are composed of fine-grained silts and clays. Pumping and mechanical surging is not recommended because these more vigorous techniques can cause fine particles to clog the filter pack.
- Sampling of groundwater should not occur within two weeks after development.

4. Calculations

To calculate the volume of water in the well, the following equation is used:
Well Volume (V) = Br2 h (cf) **[Equation 1]**
where:

B = pi (3.14)
r = radius of monitoring well in feet (ft)
h = height of the water column in ft. [This may be determined by subtracting the depth to water from the total depth of the well as measured from the same reference point.]
cf = conversion factor in gallons per cubic foot (gal/ft^3) = 7.48 gal/ft^3. [In this equation, 7.48 gal/ft^3 is the necessary conversion factor.]

Monitor well diameters are typically 2-, 3-, 4-, or 6-inches. A number of standard conversion factors can be used to simplify the above equation using the diameter of the monitor well. The volume, in gallons per linear foot, for various standard monitor well diameters can be calculated as follows:
where:

V (gal/ft) = Br^2 (cf) **[Equation 1]**
B = pi (3.14)
r = radius of monitoring well (ft)
cf = conversion factor (7.48 gal/ft^3)

For example, a two inch diameter well, the volume per linear foot can be calculated as follows:

V (gal/ft) = Br^2 (cf) **[Equation 2]**
= 3.14 (1/12 ft)2 7.48 gal/ft^3
= 0.1631 gal/ft

NOTE: The diameter must be converted to the radius in feet as follows:

Well Diameter (inches) x 0.5 = Well Radius (ft) **[Equation 3]**

The volume in gallons/feet for the common size monitor wells are as follows:

Well diameter (inches)	Volume (gal/ft)
2	0.1631
3	0.3670
4	0.6524
6	1.4680

If you utilize the volumes for the common size wells above, Equation 1 is modified as follows:
where:

Well volume = (h) (f) **[Equation 4]**

h = height of water column (ft)

f = the volume in gal/ft calculated from Equation 2

5. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90.

Nielsen, D.M. (1993), "Correct Well Design Improves Monitoring," Environmental Protection, July, pp. 38-49.

"The Methods & Mechanics of Well Development, Part 2 of 5," National Drillers Buyers Guide, March 1993, p. 17.

Standard References for Monitoring Wells (April 1991), Commonwealth of Massachusetts Department of Environmental Protection, WSC-310-91.

U. S. EPA Environmental Response Team Standard Operating Procedure SOP: 2044 ," Monitor Well Development" REV: 0.1, 10/23/01

6. Attachments

Attachment A - Monitoring Well Sampling Record

7. Contact

Gary Fuerstenberg

GEI Consultants

MONITORING WELL SAMPLING RECORD

PID Reading ____________
Job Name ____________
Job Number ____________
By ____________ Date ____________
Location ____________
Measurement Datum ____________
Well Number ____________

Pre-Development Information

Time (start) ____________
Water Level ____________
Total Depth of Well ____________
One Purge Vol ____________
Three Well Volume ____________

Water Characteristics

Color ____________ Clear ____ Cloudy ____
Odor ____ None ____ Weak ____ Moderate ____ Strong
Any films or immiscible material None

Volume (gal)	Time	pH	Temp (EC)	Spec. Conductance (ΦS/cm)	Turbidity (NTU)	DO Conc. (mg/L)	ORP (mV)	TDS

Total Volume Removed (gal) ____________
pH ____________
Temperature (EC) ____________
Specific Conductance (ΦS/cm) ____________
DO Concentration (mg/L) ____________
ORP (mV) ____________
TDS ____________

Post Development Information

Time (Finished) ____________
Water Level ____________
Total Depth of Well ____________
Approximate Volume Removed (gal) ____________

Water Characteristics

Color ____________ Clear ____ Cloudy ____
Odor ____ None ____ Weak ____ Moderate ____ Strong
Any films or immiscible material None ____________

Comments:

GEI CONSULTANTS, INC.
455 Winding Brook Drive, Suite 201
Glastonbury, Connecticut

SOP No. SC-002
Revision No. 2
Effective Date: December 2008

STANDARD OPERATING PROCEDURE

SC-002 Sample Handling

---

1. Objective

Sample handling involves the collection and shipping of environmental samples to a laboratory for chemical analysis. The overall objective of sample handling is to ensure that samples are properly:

- labeled and documented;
- preserved;
- packaged; and
- transported to laboratories.

2. Execution

- Prior to mobilizing to the field, select a shipper or arrange for a courier for sample delivery to the laboratory. If using a shipper (i.e., Federal Express, or UPS) determine the time constraints for pickup requests, the location and hours of the nearest shipping office, and any size/weight restrictions.
- Label all laboratory glassware with waterproof ink prior to collecting samples. The label should have an adhesive and be placed on the jar or bottle, not on the cap.
- Record the following information on the label and in the field notebook (See Field Notebook SOP FD-001): project number, sample identification (i.e. MW201 or SS-2), date, and time (military time) of collection, sampler's initials, and preservative, if present.
- If sample jars are not pre-preserved, add preservative as appropriate.
- At each sampling location, samples must be collected in order of volatility, most volatile first. Samples collected for volatile analysis must be placed in sample containers immediately upon retrieval of the sample.
- Aqueous samples for volatile analysis must be collected without air bubbles. Soil samples for volatile analysis should be compacted to eliminate as much headspace as possible. Other laboratory glassware should also be filled when possible. Care must be taken to avoid getting soils on the threads of sample jars, which can cause a faulty seal.
- If compositing of samples is performed in the field, specify basis for composite (i.e. volume, weight, spoon recovery, etc.) and record procedure for compositing sample in the field book.
- Once samples have been collected, place samples in a cooler with ice or a blue pack and start the chain-of-custody form (SOP FD-003 Sample Handling and *Chain of Custody*).

- For shipping, individually wrap each sample bottle with bubble packing or suitable packing material and place the wrapped bottles in the cooler with sufficient packing material between samples to avoid breakage.
- Place a layer of packing material above and below the sample bottles. Place blue ice packs or ice bags on top of the packing material. Fill the remaining space in the cooler with packing material to eliminate the possibility of vertical movement of samples.
- Place the completed and signed chain-of-custody form in a plastic bag and place on top of the packing material in the cooler.
- Fill out the appropriate shipping or courier forms and attach to the top of the cooler. If necessary, place the proper shipping labels on the cooler. Have the courier sign the COC form (or write pickup by FEDEX, UPS, etc. with date and time). Place a custody seal on the cooler.
- All sample should be submitted as soon as possible. It is preferable for samples to be mailed prior to returning to the office.
- A copy of the waybills must be kept by the field supervisor to track shipments if necessary.

3. Limitations

- At all times, follow safety procedures as defined in the site-specific Health and Safety Plan.
- Field personnel must be aware of analyses which have short holding times and schedule sampling events and shipping accordingly. Shipment of samples for analyses with short holding times must be planned in advance. Refer to the project work plan, quality assurance project plan, or state/federal regulations for holding time and preservative information.
- In general, glassware for aqueous samples contains preservatives, (i.e. HNO3, HCl, etc). When collecting the sample, take care not to overfill the container, thus flushing the preservative out of the bottle.
- Never composite samples for VOCs in the field. Collect individual aliquots and direct the laboratory to perform compositing.
- Collection of aqueous samples should not be performed over the opening of a monitoring well. Preservatives from overfilling, a marker pen or other objects could fall into the well.
- If the recharge volume for a monitoring well is low, completely fill all volatile vials and then collect the minimum sample volume required for each remaining analysis.
- During subsurface soil sampling, if the recovery from the split-spoon sample is inadequate, if appropriate, resample the bottom of the borehole to obtain proper sample volume.

- Laboratories will homogenize and test the contents of the sample container, unless directed otherwise. Samples should not contain rocks, twigs, leaves, etc. unless these materials are of interest.

4. References

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

Connecticut Department of Environmental Protection, Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory

Determination of Volatile Organic Compounds, Version 2.0 February 28, 2006.

5. Attachments

Attachment 1 - General Guidelines for selecting equipment on the basis of construction material and target analyte(s)

6. Contact

Melissa Felter

Table 2. General Guidelines for selecting equipment on the basis of construction material and target analyte(s)

[✔, generally appropriate for use shown; Si, silica; Cr, chromium; Ni, nickel; Fe, iron; Mn, manganese; Mo, molybdenum; CFC, chlorofluorocarbon; B, boron]

Construction material for sampling equipment		Target analyte(s)	
Material	**Description**	**Inorganic**	**Organic**
	Plastics[1]		
Fluorocarbon ploymers[2] (other varies available for differing applications)	Chemically inert for most analytes	✔ (potential source of fluoride)	✔ (Sorption of some organics)
Polypropylene	Relatively inert for inorganic analytes	✔ (not appropriate for Hg)	**Do not use**
Polypropylene (linear)	Relatively inert for inorganic analytes	✔ (not appropriate for Hg)	**Do not use**
Polyvinyl chloride (PVC)	Relatively inert for inorganic analytes	✔ (not appropriate for Hg)	**Do not use**
Silicone	Very porous. Relatively inert for most inorganic analytes	✔ (potential source of Si)	**Do not use**
	Metals		
Stainless steel 316 (SS 316)	SS-316-metal having the greatest corrosion resistance. Comes in various grades. Used for submersible pump casing.	✔ (Potential source of Cr, Ni, Fe, and possible Mn and Mo) **Do not use** for surface water unless encasted in plastic.	✔ Do not use if corroded[3]
Stainless steel 304	Similar to SS-316, but less corrosion resistant	**Do not use**	✔ Do not use if corroded[3]
Other metals: brass, iron, copper, aluminum, galvanized and carbon steels	Refrigeration-grade copper or aluminum tubing are used routinely for collection of CFC samples	**Do not use**	✔ Routinely used for CFCs Do not use if corroded[3]
	Glass		
Glass, borosilicate (laboratory grade)	Relatively inert. Potential sorption of analytes	✔ **Do not use** for trace element analyses. Potential source of B and Si	✔

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[1] Plastic used in connection with inorganic trace-element sampling should be uncolored or white. Tubing used for trace metal sampling should be cleaned by soaking in 5-10 percent HCl solution for 8-24 hours, rinsing with reagent water (metals free) and allowed to air dry in mercury-free environment. After drying, the tubing is doubled-bagged in clear polyethylene bags, serialized with a unique number, and stored until used.

[2] Fluorocarbon polymers include materials such as Teflon™, Kynar™, and Tefzel™ that are relatively inert for sampling inorganic or organic analytes. Only fluoropolymer should be used for samples that will analyzed for mercury because mercury vapors can diffuse in or out of other materials, resulting in either contaminated or biased results.

[3] Corroded/weathered surfaces are active sorption sites for organic compounds.

STANDARD OPERATING PROCEDURE

SC-003 Investigation Derived Waste

---

1. Objective

The objective of this standard operating procedure (SOP) is to provide guidelines for the proper management of Investigational Derived Waste (IDW) resulting from site investigation activities. This SOP addresses IDW generated during field tasks typically performed for environmental site investigations. The intent of this SOP is to provide a set of guidelines for proper assessment and handling of these IDWs.

2. Execution

The procedures for identification of IDW management needs and selection of appropriate management methods are outlined below. In all cases, the selection of IDW management procedures will be governed by NYSDEC DER-10, Section 3.3(e), Management of investigation derived waste. A copy of this section of DER-10 is included with this SOP as Attachment B.

- Determine the suspected contamination type and impacted media anticipated, based on previous investigations, current analytical data, and/or site history.
- Consider the following issues when selecting IDW management option(s):
  i. anticipated volume of IDW to be generated during on-site activities
  ii. potential contaminants and their concentrations
  iii. location of the nearest populations and the likelihood and/or degree of site access
  iv. potential exposures to workers
  v. potential for environmental impacts
  vi. community concerns
  vii. potential storage areas
  viii. regulatory constraints
  ix. potential on-site treatment options
- Review IDW Management Options summarized in Attachment A for each media suspected of contamination.
- Select IDW Management Option(s) prior to the commencement of field activities that will generate waste materials.
- Include the selected IDW Management Option(s) in the Field Plan.
- In addition to the issues considered above for the selection of IDW management strategies/disposal options, more specific considerations/guidelines include:

2.1. Test Pit Excavation

- Segregate contaminated soil from uncontaminated soil using visual and/or field screening methods.
- Use appropriate barrier (two layers of 6-ml plastic sheeting) for temporary stockpiling of contaminated soil adjacent to test pit.
- Backfill test pits with uncontaminated soil.
- For situations where returning contaminated soil to the test pit is deemed protective by the project manager, backfill soil in the same order as the soil was excavated from the test pit.

2.2. Boring/Monitoring Well Installation

- For auger borings, segregate contaminated soil (determined by visual and/or field screening methods) from uncontaminated soil during drilling. Segregate residual contaminated soil from split-spoon sampling.
- Auger cuttings or sediment generated by drive and wash may be spread around the ground surface at the boring location if deemed appropriate by the project manager. IDW may be placed in an appropriate area or container pending characterization and appropriate disposal. (A useful rule of thumb is to assume generation of one 55-gallon drum of cuttings for each 20 feet drilled with 7-¼-inch-I.D. augers).
- Segregate contaminated drilling fluid from uncontaminated fluid for rotary wash borings.
- Drilling fluid management options include pouring the drilling fluid on the ground in the Area of Concern (AOC) or containerizing the fluid in drums or tanks.

2.3. Water Development/Sampling

- Contaminated groundwater removed from wells by pumping or bailing for the purpose of well development and sampling may be poured on the ground in the AOC or containerized in drums or tanks at the project manager's discretion.

2.4. Decontamination Fluids

- Decontamination fluids may only be poured on the ground in the vicinity of the well in situations deemed protective by the project manager. Alternatively, the fluids may be containerized in drums or tanks.

2.5. Disposable Personal Protective Equipment

- Disposable PPE must be managed like any other IDW. It should only be removed from the site with the project manager's approval, and may be disposed of as ordinary rubbish only if it has not come into contact with hazardous materials.

3. Limitations

- The preferred IDW management option is to return the IDW to its source.
- The IDW selected must be in accordance with state/federal regulations.
- Our clients are responsible for the disposal of IDW, should disposal be necessary.

4. References

Guide to Management of Investigation - Derived Wastes (April 1992), United States Environmental Protection Agency, Publication 9345.3-03FS.

DER-10 Technical Guidance for Site Investigation and Remediation, May 2010, New York State Department of Environmental Conservation.

5. Attachments

Attachment A: Summary of IDW Management Options
Attachment B: NYSDEC DER-10, Section 3.3(e)

6. Contact

Bruce Coulombe

Table 1: Summary of IDW Management Options

Attachment A: - SUMMARY OF IDW MANAGEMENT OPTIONS

GEI Consultants, Inc. Standard Operating Procedures

Management of Investigation - Derived Waste

Type of IDW	Generation Processes	Management Options	Remarks
Soil	Boring/monitoring well installation Test pit excavation Soil sampling	Return to source immediately after generation	OK only if deemed "protective" by project manager and regulatory agency
		Spread around boring test pit or source within the AOC	OK only if deemed "protective" by project manager and regulatory agency
		Send to on-site TDU within AOC	Need Interim or Permanent permit if on-site storage >90 days
		Send to off-site TDU within 90 days	Requires manifests, analytical characterization
		Store for future treatment and/or disposal. Storage consistent with state/federal regulations.	Storage container/pile/tank in accordance with 40 CFR Part 264 and 265 (see notes)
		Store temporarily awaiting laboratory analysis. Storage consistent with state/federal regulations.	
Sediment/Sludge	Sludge pit sampling Sediment sampling	Return to source immediately after generation	OK only if deemed "protective" by project manager and regulatory agency
		Send to on-site TDU within AOC	Need Interim or Permanent permit if on-site storage >90 days
		Send to off-site TDU within 90 days	Requires manifests, analytical characterization
		Store for future treatment and/or disposal. Storage consistent with state/federal regulations.	Storage container/pile/tank in accordance with 40CFR Part 264 and 265

Attachment A: - SUMMARY OF IDW MANAGEMENT OPTIONS

GEI Consultants, Inc. Standard Operating Procedures

Management of Investigation - Derived Waste

Type of IDW	Generation Processes	Management Options	Remarks
Aqueous liquids (groundwater, surface water, drilling fluids, other wastewater)	Well installation/development Well purging during sampling Ground water discharge - pump tests Surface water sampling	Pour onto ground close to well (nonhazardous)	Ensure that it is permissible by local, state, and Federal regulations
		Send to on-site TDU within AOC	Storage in accordance with 40 CFR Part 264 and 265, 90-day limit
		Send to off-site commercial treatment unit within 90 days	Requires manifests, analytical characterization
		Send to POTW	Obtain appropriate discharge permit(s)
		Store for future treatment and/or disposal. Storage consistent with state/federal regulations.	Consistent w/ final remedial action
		Discharge to surface water	OK only if deemed "protective," complies w/ CWA, USCG regulations. Obtain appropriate discharge permit(s).

Decontamination fluids	Decon of PPE and equipment	Send to on-site TDU within AOC	Storage in accordance with 40 CFR Part 264 and 265, 90-day limit
		Send to off-site TDU within 90 days	Requires manifests, analytical characterization
		Store for future treatment and/or disposal. Storage consistent with state/federal regulations.	Consistent with final remedial action
Disposable PPE	Sampling, drilling, and test pit excavation observation, other on-site activities	Send to on-site TDU within AOC	Dispose of appropriately after characterization
		Place in on-site industrial dumpster	Project-specific determination required
		Send to off-site TDU within 90 days	Project-specific determination required
		Store for future treatment and disposal. Storage consistent with state/federal regulations.	Project-specific determination required

Notes:

1) AOC - area of contamination
2) TDU - temporary disposal unit
3) PPE - personal protective equipment
4) POTW - publicly owned treatment works
5) Generation processes listed here are provided as examples.
IDW may also be generated as a result of other site activities.
6) RCs - Reportable Concentrations
7) RCRA Container/Waste Pile/Tank requirements:
Containers; 40 CFR 264 Subpart I and 265 Subpart I
Waste Piles; 40 CFR 264 Subpart L and 265 Subpart L
Tanks; 40 CFR 264 Subpart J and 265 Subpart J

Attachment B - NYSDEC DER-10, Section 3.3(e)

(e) Management of investigation derived waste (IDW). An investigation work plan is also to identify provisions for management of IDW. This subdivision sets forth guidance for the handling and disposal of contaminated soil and water generated during an investigation, in a manner that does not pose a threat to public health and the environment and is compliant with applicable rules and regulations. Absent a regulatory exemption, the transport, storage and disposal of IDW is generally subject to one or more solid or hazardous waste regulations (e.g., 6 NYCRR Parts 360, 364 and the 370 series). Unless specifically noted herein, no guidance provided in this subdivision is intended to impose more stringent requirements than the applicable regulations regarding the handling, transport, storage or disposal of IDW.

1. Drill cutting and spoil disposal from on-site locations. Drill cuttings and other soil generated on-site during an investigation from the installation of soil borings, monitoring wells or geoprobes are presumed to be contaminated. Such cuttings and spoil:

i. must be stored on protective sheeting and covered with protective sheeting if cuttings remain on ground at the end of the day;

ii. may be disposed at the site within the borehole that generated them to within 12 inches of the surface or if the site is a residential site backfilling may be to within 24 inches of the surface, unless:

(1) free product, NAPL or grossly contaminated soil, are present in the cuttings;

(2) the borehole will be used for the installation of a monitoring well (cuttings may only be used to backfill boreholes installed for soil sampling);

(3) the borehole has:

(A) penetrated an aquitard, aquiclude or other confining layer; or

(B) extended into bedrock;

(4) backfilling the borehole with cuttings will create a significant path for vertical movement of contaminants. Soil additives (bentonite) may be added to the cuttings to reduce permeability;

(5) the soil cannot fit into the borehole as set forth in paragraph i. above.

iii. cuttings meeting any of the conditions set forth in subparagraph i above, which cannot be disposed in the borehole must be containerized and handled as set forth in paragraph 3 below; and

iv. the borehole area must be restored, after backfill:

(1) in unpaved areas, by placing 12 inches of cohesive, compacted soil meeting the requirements for fill of subdivision 5.5(e) and Appendix 5 over the area of the borehole, unless the site is a residential site in such case 24 inches are required; or

(2) for paved areas, by placing clean cohesive, compacted soil in the borehole to sufficient depth to allow restoration of the paved surface; and

v. if the site includes streets, sidewalks or other publicly accessible areas, the off-site provisions in paragraph 2 should be applied to samples collected in those areas.

2. Drill cutting and spoil disposal from off-site locations not know to be contaminated. Cuttings and spoils generated from off-site locations during an investigation are to be managed as follows:

i. cuttings, may initially be placed on plastic as generated,, but should be containerized as drilling progresses. Overnight storage outside of a container is not allowed. The cuttings may be transported from the point of generation to a temporary on-site storage area without a 6 NYCRR Part 364 permit;

ii. cuttings from off-site boring locations are considered non contaminated until testing indicates otherwise, unless field screening results of the soil are positive for the presence of contamination; and

iii. the borehole will be filled with soil or a soil bentonite mixture and restored as set forth in clauses 1.iv (1) or (2) above.

3. Drill cutting and soil disposal from known contaminated locations. Representative samples of drill cuttings or other IDW from known contaminated locations at a site or from off-site locations, identified in accordance with paragraphs 1 and 2 above, must be characterized for disposal. Such samples must be analyzed to ensure proper classification, treatment and disposal and where determined to be:

i. hazardous waste or a solid waste, must be properly managed and disposed at a properly permitted treatment, storage or disposal facility. Such waste will:

(1) be transported by a hauler permitted in accordance with 6 NYCRR Part 364;

(2) if such cuttings and soil are determined to be a hazardous waste, the waste shipment shall be accompanied by a manifest in accordance with 6 NYCRR Part 372; and

(3) any IDW soil identified as either a solid or hazardous waste, may be stored on the site in a secure area awaiting disposal, in accordance with applicable DEC waste management regulations or other provisions approved by DER; and

ii. soil not characterized as a solid or hazardous waste may be placed at the site, or returned to the off site location where it originated, in a manner set forth in the DER-approved work plan.

4. Test pits. When excavating test pits to delineate the extent of contamination, the soil removed from the excavation is to be managed as follows:

i. any drums or other containers encountered, as well as NAPL or other free product, will be over packed or otherwise containerized for appropriate off-site disposal, as discussed in subparagraph 2ii above;

ii. where subparagraph i above does not apply, material removed may be placed back in the excavation in the same general strata from which it was removed; and

iii. the excavation shall be managed so as not to contaminate the surface of the site, all soil removed will be placed on plastic.

5. Investigation generated water/fluid handling and disposal. All water/fluid resulting from well development and/or well purging before sampling must be collected, handled and discharged/disposed of pursuant to applicable guidance and regulations. Water/fluid generated during an investigation:

i. is to be containerized upon production and is to subject to the following handling/disposal guidelines:

(1) 6 NYCRR Part 364 will not apply to the transport of the containers from the point of generation to a temporary on-site storage area, or treatment facility;

(2) the containers must be securely staged, pending appropriate disposal as set forth in subparagraph ii below;

(3) NAPL shall never be released to the ground;

(4) where containers include water mixed with NAPL, the water can be decanted from the NAPL (or vice versa) as long as a measurable layer of water remains with the NAPL, and the decanted water is NAPL- and/or sheen-free;

(5) groundwater from several monitoring wells may be combined provided they are associated with the same disposal site and aquifer; and

(6) NAPL may be collected from several containers and combined provided it all comes from monitoring wells associated with the same disposal site;

ii. it may be stored on-site in labeled containers in an area with secondary containment awaiting treatment and/or disposal, in accordance with applicable DEC waste management regulations (e.g., 6 NYCRR Parts 360, 364 and the 370 series) or other provisions approved by DER. The contents of the containers will be

(1) properly treated or disposed of, when any of the following are observed:
(A) visual evidence of contamination, consisting of discoloration, sheens, free product or NAPL;
(B) olfactory evidence of contamination; or
(C) concentrations of contaminants above groundwater standards at levels of concern are known to be present in the monitoring wells, based on previous sampling of the groundwater; or
(2) if none of the conditions described in clause ii(1) apply, the containerized water may be:
(A) recharged to unpaved ground into the same groundwater unit, within or directly adjacent to a source area in a manner which does not result in surface water runoff, with DER approval; or
(B) if a remedial treatment system designed to treat water is operational at the site the water may be added to the influent of the treatment system; and

(3) treatment or disposal of contaminated water/fluids will be at:
(A) a permitted off-site facility;
(B) an existing on-site permitted facility or a remedial treatment facility capable of treating the water/fluids, if one exists; or
(C) an on-site treatment unit brought to the site, properly designed to handle the water/fluids, where a permit waiver pursuant to section 1.10 has been granted by DER; and

iii. sediment that settles out of the IDW, provided there is no NAPL or free product present, must be handled and disposed in accordance with paragraphs 1 to 3 above, as appropriate for the location of the well.

6. Short-term surface water or groundwater discharges. Water resulting from pump tests or pilot studies conducted at a site pursuant to a DER approved work plan may be discharged to surface or groundwater providing the water meets, or is treated to meet, certain generic criteria. The generic discharge criteria for short term discharges can be found on the DEC website or may be obtained from the DER project manager.

GEI CONSULTANTS, INC.
455 Winding Brook Drive, Suite 201
Glastonbury, Connecticut

SOP No. SC-004
Revision No. 1
Effective Date: June 2008

STANDARD OPERATING PROCEDURE

SC-004 Head Space VOC Screening

---

1. Objective

To obtain a site-specific measurement of the volatile organic compounds (VOC) concentrations present in soil. This information can be used: 1) to segregate soil based on degree of contamination, 2) to identify samples for quantitative analysis of VOCs, or 3) as a qualitative method to evaluate the presence or absence of VOCs in soil.

2. Execution

- A photoionization detector (PID) or flame ionization detector (FID) instrument is used to measure VOCs in jar head space (JHS) screening. Select the appropriate instrument, lamp, and calibration gas for the site-specific contaminants. Calibrate the instrument in accordance with the manufacturer's instructions before JHS screening begins. Record the type of calibration gas, detector, and lamp in the field notebook.
- Note the highest VOC concentration that the instrument measures in air in the work area before performing JHS screening. Record this as the initial background concentration.
- Half-fill a clean, glass jar with the soil. Use a clean trowel or soil spatula. Quickly cover the open top with one or two sheets of clean, aluminum foil and screw on the cap to tightly seal the jar. Label the sample location and depth from which the sample was collected on the jar.
- Allow headspace development for at least 10 minutes at an ambient temperature of 50°F or greater. Vigorously shake the jar for 15 seconds at the beginning and end of the headspace development period. When ambient temperatures are below 50°F, place the jar in a heated van or building during the headspace development period.
- After headspace development, remove the screw cap to expose the foil seal. Quickly puncture the foil seal with the instrument's sampling probe and insert it to a point at about one-half of the headspace depth.
- Record the highest VOC concentration that the instrument displays as the JHS concentration. The highest concentration should occur between 2 and 5 seconds after probe insertion.

3. Limitations

- The instruments may work poorly in the rain and in freezing temperatures. Under such conditions, operate the instrument in a heated vehicle or building.

- Prevent water and soil particles from entering the tip of the instrument probe. Use a filter on the instrument's probe.
- Measure background VOC conditions and perform JHS screening away from non-site-related VOC sources, such as vehicle and heavy equipment exhaust.
- The VOC concentration on the instrument's display may vary when the air contains high VOC concentrations or high moisture.
- JHS screening is a guide that helps the screener to segregate soils into broadly defined categories. JHS screening results may differ by orders of magnitude from laboratory testing results.
- Note that states may have specific procedures for field monitoring. In Massachusetts, the Massachusetts Department of Environmental Protection (DEP) requires that screening of gasoline-contaminated soil be performed in accordance with Attachment II of the DEP's policy #WSC-94-400 Interim Remediation Waste Management Policy for Petroleum Contaminated Soils. Consult this procedure or any relevant guidance documents for assistance.

4. References

Interim Remediation Waste Management Policy for Petroleum Contaminated Soils. (April 1994), Massachusetts Department of Environmental Protection, Policy #WSC-94-400.

5. Attachments

None

6. Contact

Lynn Willey

STANDARD OPERATING PROCEDURE

SM-001 Soil Sampling Techniques Including Split-Spoon

---

1. Objective

This Standard Operating Procedure (SOP) is used primarily to collect surface and shallow subsurface soil samples. Surface soils are generally classified as soils between the ground surface and 6 to 12 inches below ground surface. The shallow subsurface interval may be considered to extend from approximately 12 inches below ground surface to a site-specific depth at which sample collection using manual methods becomes impractical. Refer to state-specific regulations as to the exact definition of what constitutes a surface soil.

2. Execution

2.1. Surface Soil Sampling

Collection of samples from near-surface soil can be accomplished with tools such as spades, shovels, trowels, and scoops. Surface material is removed to the required depth and a stainless steel or plastic scoop is then used to collect the sample. This method can be used in most soil types but is limited to sampling at or near the ground surface. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member. A flat, pointed mason trowel to cut a block of the desired soil is helpful when undisturbed profiles are required.

- Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.
- Using a pre-cleaned, stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.
- If volatile organic analysis is to be performed, transfer the sample directly into an appropriate labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly.
- Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval.
- Either place the sample into appropriate labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval or location into the homogenization container and mix thoroughly.
- When compositing is complete, place the sample into appropriate labeled containers and secure the caps tightly.

2.2. Sampling at Depth with Augers and Thin Wall Tube Samplers

This system consists of an auger, or a thin-wall tube sampler, a series of extensions, and a "T" handle. Attachment A provides a diagram of these items. The auger is used to bore a hole to a desired sampling depth, and is then withdrawn. The sample may be collected directly from the auger. If a core sample is to be collected, the auger tip is then replaced with a thin wall tube sampler. The system is then lowered down the borehole, and driven into the soil to the completion depth. The system is withdrawn and the core is collected from the thin wall tube sampler. Several types of augers are available; these include: bucket type, continuous flight (screw), and post-hole augers. Bucket type augers are better for direct sample recovery because they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from the flights. The continuous flight augers are satisfactory when a composite of the complete soil column is desired. Post-hole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy soil and cannot be used below a depth of approximately three feet.

The following procedure is used for collecting soil samples at depth with the auger:

- Attach the pre-decontaminated auger bit to a drill rod extension, and attach the "T" handle to the drill rod.
- Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first three to six inches of surface soil for an area approximately six inches in radius around the drilling location.
- Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.
- After reaching the desired depth, slowly and carefully remove the auger from the hole. When sampling directly from the auger, collect the sample after the auger is removed from the hole.

2.3. Thin- Walled Core Sample

- Remove auger tip from the extension rods and replace with a pre-cleaned thin wall tube sampler. Install the proper cutting tip.
- Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Do not scrape the borehole sides. Avoid hammering the rods as the vibrations may cause the boring walls to collapse.

- Remove the tube sampler, and unscrew the drill rods.
- Remove the cutting tip and the core from the device.
- Discard the top of the core (approximately 1 inch), as this possibly represents material collected before penetration of the layer of concern. Place the remaining core into the appropriate labeled sample container. Sample homogenization is not required.
- If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly.
- When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.
- If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, and follow previous steps, making sure to decontaminate the auger and tube sampler between samples.
- Abandon the hole according to applicable state regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

2.4. Sampling at Depth with a Split-Spoon (Barrel) Sampler

Split-spoon sampling is generally used to collect undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split-spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split-spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted. A diagram of the split-spoon sampler assembly is provided as Attachment A.

When split spoon sampling is performed to gain geologic information, all work should be performed in accordance with ASTM D1585-98, "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils". The following procedures are used for collecting soil samples with a split-spoon:

- Select the size (length and diameter) of split-spoon sampler based on the amount of soil that is needed for characterization. The ASTM standard for N-values is 1 3/8 - inch I.D. Specify spoon size and basket type to driller prior to mobilization to the site.

- Select a soft or stiff basket for the spoon (a softer basket works better for loose or soft material).
- Prior to hammering the split spoon to collect the sample, verify that the split-spoon is no more than 6 inches above the top of the desired sample depth. If the split spoon is more than 6 inches above the top of the desired sample depth, clean out the hole prior to sampling. Record all depth measurements relative to ground surface.
- Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top. See diagram in Attachment A.
- Place the sampler in a perpendicular position on the sample material.
- For all soil samples, use a 140-lb hammer to drive the sampler, unless conditions necessitate using a 300-lb hammer.
- Record in the site logbook or on field data sheets the length of the tube used to penetrate the material being sampled, and the number of blows required to obtain this depth.
- Count and record the number of blow counts per 6-inch increments (confirming blow counts with driller if necessary).
- Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. The amount of recovery and soil type should be recorded on the boring log. If a split sample is desired, a cleaned, stainless steel knife should be used to divide the tube contents in half, longitudinally. This sampler is typically available in 2 and 3 1/2 inch diameters. A larger barrel may be necessary to obtain the required sample volume.
- Without disturbing the core, transfer it to appropriate labeled sample container(s) and seal tightly.
- Note any material in the nose (shoe) of the spoon.
- Immediately collect a sample for VOCs (if required by the site-specific field sampling plan) by collecting soil from the entire length of the split spoon, unless otherwise specified. When the most impacted interval (based on field instrument screening) is sampled for laboratory analysis, screen the spoon with the field instrument first, then collect the soil sample for VOC analysis from the appropriate interval.
- Screen the soil sample for VOCs or other constituents as indicated in the site-specific field sampling plan.

3. Limitations

- At all times, follow safety procedures as defined in the Site-Specific Health and Safety Plan.
- Weather conditions (e.g. frozen ground) may prevent the collection of samples and should be considered prior to sample collection.
- Tools plated with chrome or other materials should not be used.

3.1. Split Spoon Sampling

- Be aware of the length of the drill string, the sample depth, and the required stickup of the drill string to ensure accurate sample interval measurement.
- If drilling with hollow-stem augers, the removal of the drill string from the hole, prior to attaching the split-spoon sampler, may cause soils to be sucked up into the augers (blow-in running sands). Upon recovery, determine what is blow-in. In general, blow-in is more unconsolidated than the rest of the sample and lacks stratification (do not include blow-in for recovery of sample collection).
- If soils are loose sands or soft clay, the drill string and sampler may advance slightly under its own weight, giving a false depth for soil collection.
- Never sample more than two spoons consecutively unless material is tight. Do not let the split spoon penetrate more than it can hold.
- In many instances groundwater will fill the auger and the split-spoon.

4. References

ASTM D1585-98, "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils". 1998.

United States Environmental Protection Agency, SOP 2012 “Soil Sampling”, Revision 0.0, February 18, 2000.

5. Attachments

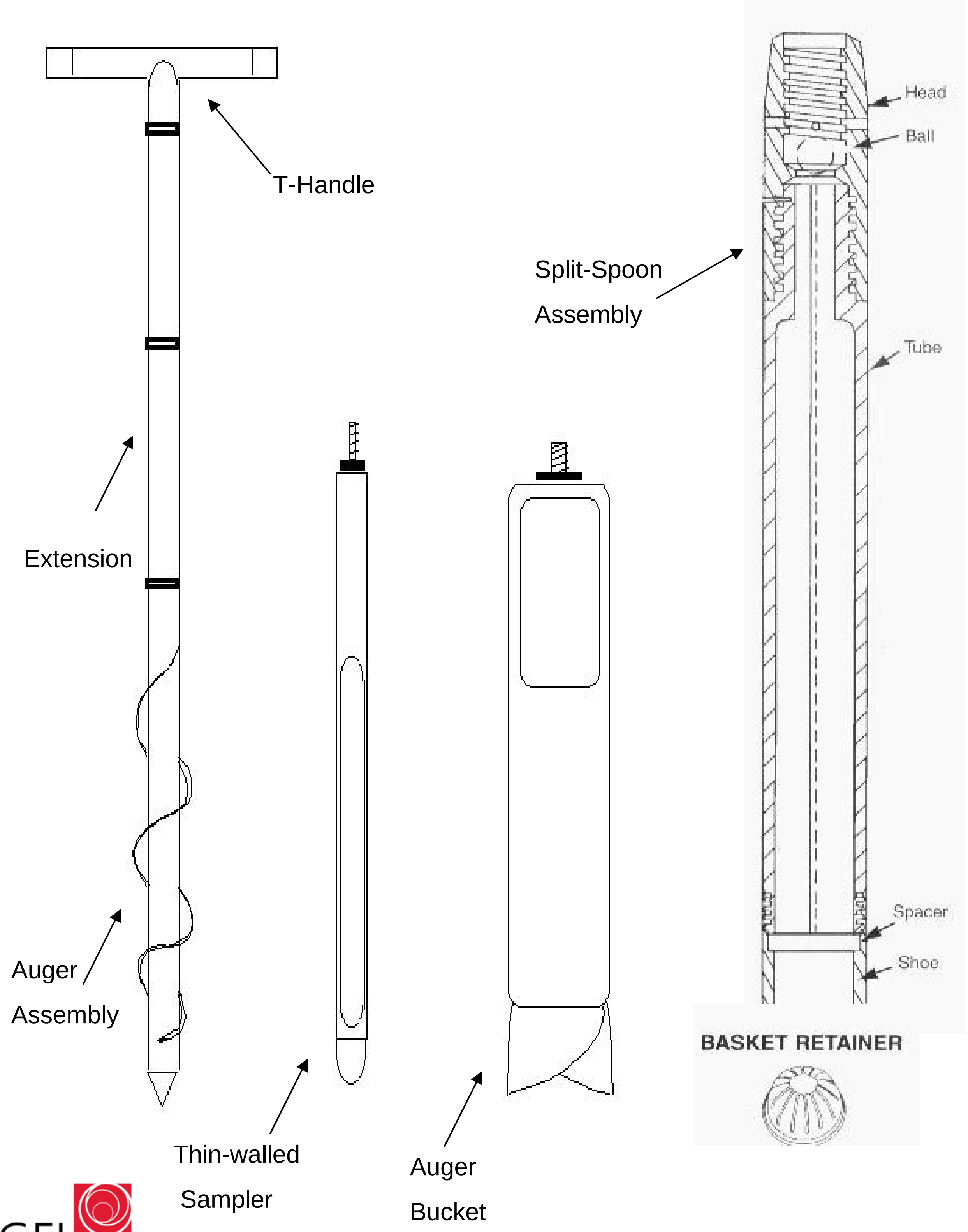
Attachment A - Sampler Design Assembly

6. Contact

Gary Fuerstenberg

SM-001

Attachment A – Sampler Design Assembly



GEI CONSULTANTS, INC.
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SOP No. SM-003
Revision No. 1
Effective Date: June 2008

STANDARD OPERATING PROCEDURE

SM-003 Soil Classification

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1. Objective

To describe and classify soil samples collected in the field in a consistent and useful manner. GEI has adopted the Unified Soil Classification System (USCS).

2. Execution

- Describe soil samples according to the ASTM Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) D2488 (see Attachment A – Visual Manual Descriptions).
- Identify and record the soil in terms of the major and minor constituents (i.e., sand gravel, silt, clay), Unified Soil Classification Symbol, sample structure, plasticity and dilantancy for fine-grained soils, color, local or geologic name if known (e.g., Boston Blue Clay or glacial till), odor, presence of iron or other staining, and presence of organic matter, shells, debris, or other unusual characteristics of the same.
- If a soil split-spoon sample contains more than one soil type (for example, the upper portion is silty sand and the lower portion is clay) describe each type separately, and obtain separate jars of each type.
- Record sampler type, blow counts, soil description, etc. on the boring log (see Attachment A Visual Manual Descriptions).
- One modification to the ASTM standard: Use "widely graded" and "narrowly graded" instead of "well-graded" and "poorly graded."
- Attachment B provides a Percentage Diagram for Estimating Composition by Volume. Based on the percent volume, the following descriptions should be used:
    1. “and” = 35-50%
    2. “some” = 20-35%
    3. “little” = 10-20%
    4. “trace” = 1-10%

3. Limitations

- Certain projects or clients will require the use of other classification systems. Other classification systems should not be used unless specifically required by the client.

- Some soil characteristics, such as plasticity and dilatancy, are difficult to identify in the field during extremely cold or wet weather. The field classification should be verified in the office after the samples have returned to room temperature if samples were collected during extreme weather conditions.

- The ASTM Standard Test Method for Classification Soils for Engineering Purposes, D2487 may be used in conjunction with the Visual-Manual Method to confirm the soil classification.

4. References

Annual Book of ASTM Standards (1993), Section 4, v. 4.08 Soil and Rock; Building Stones; Geosynthetics, D2488-90, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), American Society of Testing Materials (ASTM).

5. Attachments

Attachment A – Visual Manual Descriptions with example boring log
Attachment B – Percentage Diagram for Estimating Composition By Volume

6. Contact

Lynn Willey

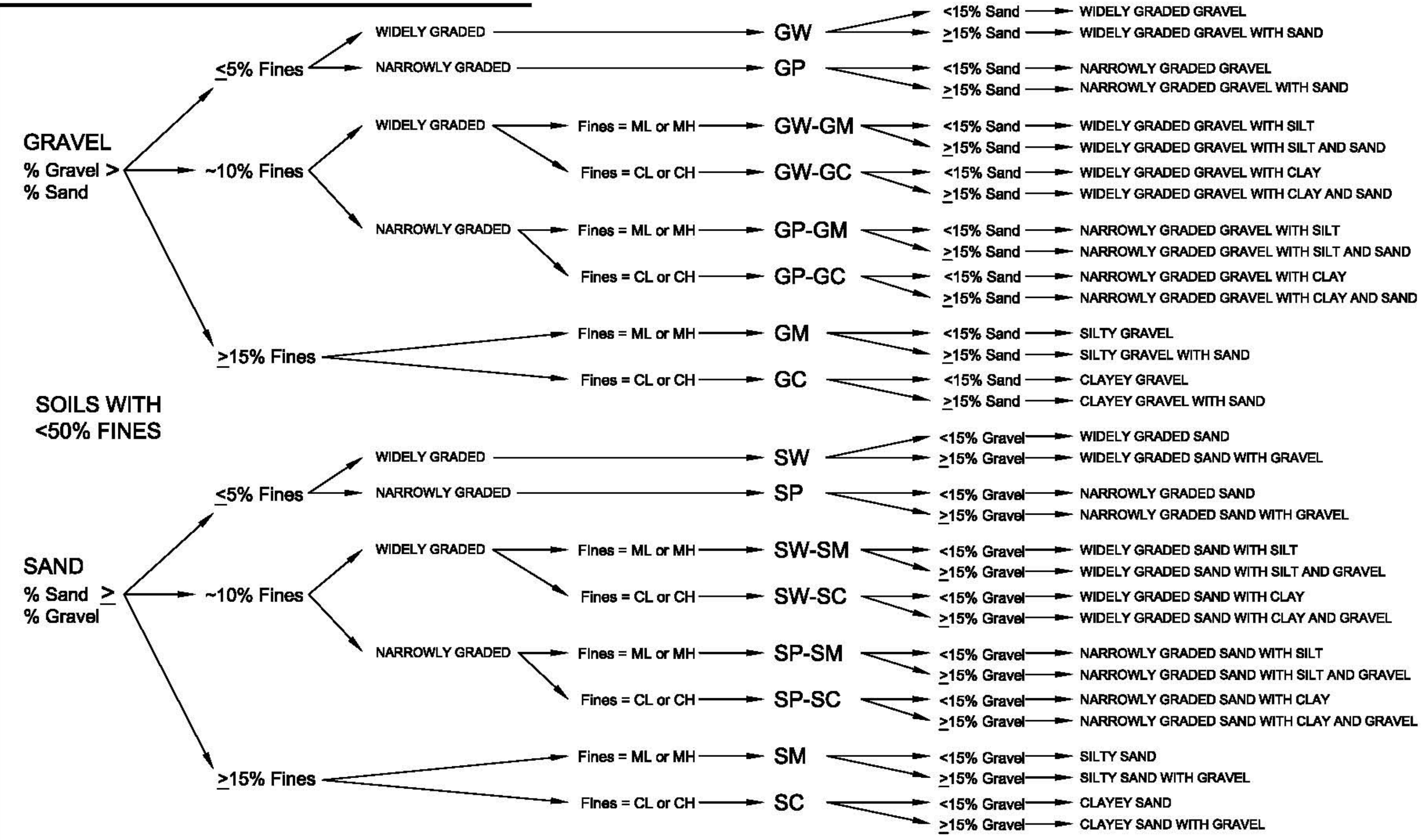
GEI Consultants

COARSE-GRAINED SOILS

VISUAL-MANUAL DESCRIPTIONS

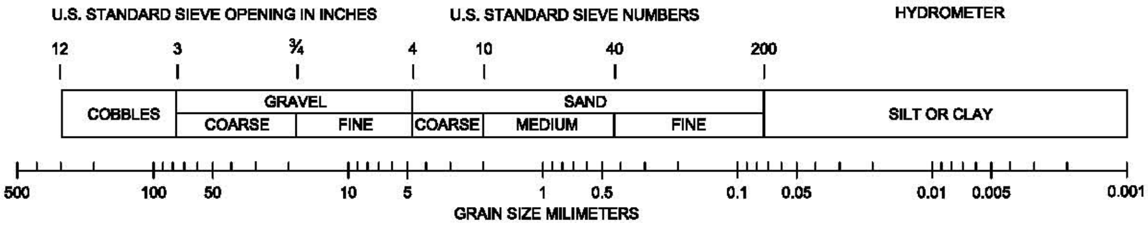
TYPICAL SOIL COLORS

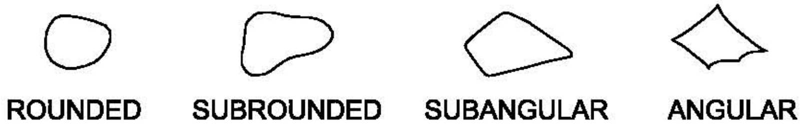
- YELLOW
- OLIVE
- LIGHT BROWN
- BROWN
- REDDISH BROWN
- RED
- GRAY
- BLACK



SOILS WITH <50% FINES

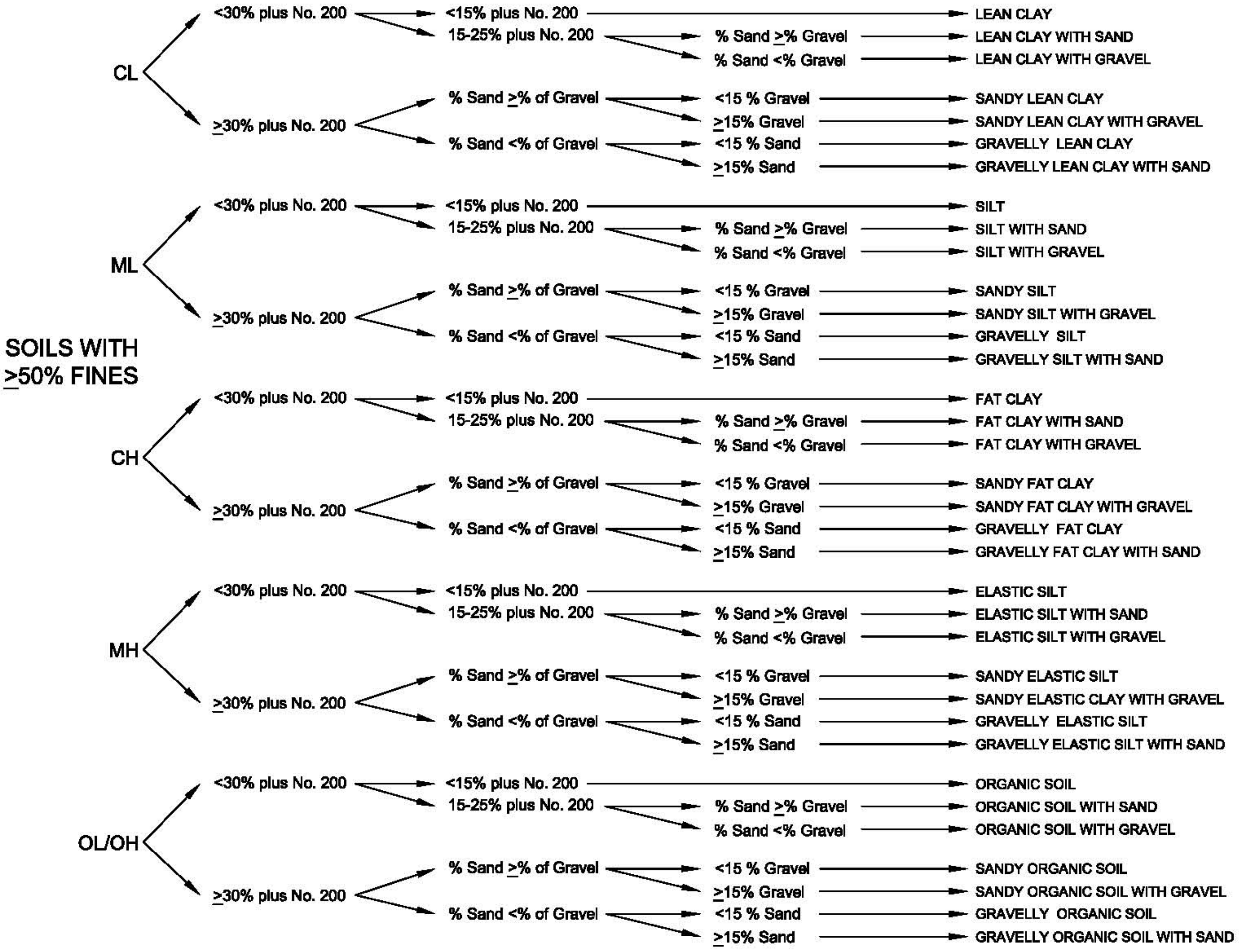
				GROUP SYMBOL		GROUP NAME
GRAVEL % Gravel > % Sand	≤5% Fines	WIDELY GRADED		GW	<15% Sand	WIDELY GRADED GRAVEL
					≥15% Sand	WIDELY GRADED GRAVEL WITH SAND
		NARROWLY GRADED		GP	<15% Sand	NARROWLY GRADED GRAVEL
					≥15% Sand	NARROWLY GRADED GRAVEL WITH SAND
	~10% Fines	WIDELY GRADED	Fines = ML or MH	GW-GM	<15% Sand	WIDELY GRADED GRAVEL WITH SILT
					≥15% Sand	WIDELY GRADED GRAVEL WITH SILT AND SAND
			Fines = CL or CH	GW-GC	<15% Sand	WIDELY GRADED GRAVEL WITH CLAY
					≥15% Sand	WIDELY GRADED GRAVEL WITH CLAY AND SAND
		NARROWLY GRADED	Fines = ML or MH	GP-GM	<15% Sand	NARROWLY GRADED GRAVEL WITH SILT
					≥15% Sand	NARROWLY GRADED GRAVEL WITH SILT AND SAND
			Fines = CL or CH	GP-GC	<15% Sand	NARROWLY GRADED GRAVEL WITH CLAY
					≥15% Sand	NARROWLY GRADED GRAVEL WITH CLAY AND SAND
	≥15% Fines		Fines = ML or MH	GM	<15% Sand	SILTY GRAVEL
					≥15% Sand	SILTY GRAVEL WITH SAND
			Fines = CL or CH	GC	<15% Sand	CLAYEY GRAVEL
					≥15% Sand	CLAYEY GRAVEL WITH SAND
SAND % Sand ≥ % Gravel	≤5% Fines	WIDELY GRADED		SW	<15% Gravel	WIDELY GRADED SAND
					≥15% Gravel	WIDELY GRADED SAND WITH GRAVEL
		NARROWLY GRADED		SP	<15% Gravel	NARROWLY GRADED SAND
					≥15% Gravel	NARROWLY GRADED SAND WITH GRAVEL
	~10% Fines	WIDELY GRADED	Fines = ML or MH	SW-SM	<15% Gravel	WIDELY GRADED SAND WITH SILT
					≥15% Gravel	WIDELY GRADED SAND WITH SILT AND GRAVEL
			Fines = CL or CH	SW-SC	<15% Gravel	WIDELY GRADED SAND WITH CLAY
					≥15% Gravel	WIDELY GRADED SAND WITH CLAY AND GRAVEL
		NARROWLY GRADED	Fines = ML or MH	SP-SM	<15% Gravel	NARROWLY GRADED SAND WITH SILT
					≥15% Gravel	NARROWLY GRADED SAND WITH SILT AND GRAVEL
			Fines = CL or CH	SP-SC	<15% Gravel	NARROWLY GRADED SAND WITH CLAY
					≥15% Gravel	NARROWLY GRADED SAND WITH CLAY AND GRAVEL
	≥15% Fines		Fines = ML or MH	SM	<15% Gravel	SILTY SAND
					≥15% Gravel	SILTY SAND WITH GRAVEL
			Fines = CL or CH	SC	<15% Gravel	CLAYEY SAND
					≥15% Gravel	CLAYEY SAND WITH GRAVEL





1. GROUP NAME and (SYMBOL)
2. Structure , if any. (stratified layer thicknesses, lenses, varves, gradational changes)
3. Describe sand, gravel and fines components, with percentages, in order of predominance. Include max gravel size. For test pits give percent cobbles and boulders, by volume, and include max size.
4. Color
5. Sheen, odor, roots, ash, brick, cementation, reaction with HCL, etc.
6. "Fill," local name or geologic name, if known

FINE-GRAINED SOILS
VISUAL-MANUAL DESCRIPTIONS



ID OF INORGANIC FINE SOILS FROM MANUAL TESTS

Symbol	Name	Dry Strength	Dilatancy	Toughness*
ML	Silt	None to low	Slow to rapid	Low or thread cannot be formed
CL	Lean Clay	Medium to high	None to slow	Medium
MH	Elastic Silt	Low to medium	None to slow	Low to medium
CH	Fat Clay	High to very high	None	High

1. GROUP NAME and (SYMBOL)
2. Describe fines, sand, and gravel components, in order of predominance. Include plasticity of fines. Include percentages of sand and gravel.
3. Color
4. Sheen, odor, roots, ash, brick, cementation, torvane and penetrometer results, etc.
5. "Fill," local name or geologic name, if known

PEAT

Peat refers to a sample composed primarily of vegetable matter in varying stages of decomposition. The description should begin: PEAT (PT) and need not include percentages of sand, gravel or fines.

CRITERIA FOR DESCRIBING PLASTICITY

Description	Criteria
Nonplastic ML	A 1/8-in. (3 -mm) thread cannot be rolled at any water content
Low Plasticity ML, MH	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit *
Medium Plasticity MH, CL	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High Plasticity CH	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

* Toughness refers to the strength of the thread near plastic limit. The lump refers to a lump of soil drier than the plastic, similar to dry strength.

BORING LOCATION Maple Ave Sidewalk
GROUND ELEVATION (NGVD)
GROUNDWATER EL. DATE
DATE START/FINISH 2/14/07 - 2/15/07
DRILLED BY Geologic: M. Costigan
LOGGED BY T. Kahl/M. Yako TOTAL DEPTH (FT) 25

B101

PG. 1 OF 1

EL. FT.	DEPTH FT.	SAMPLE TYPE and NO.	SAMPLE BLOWS PER 6 IN.	SAMPLE PEN IN.	SAMPLE REC IN.	PID JAR HS / REMARKS	GRAPHIC LOG	SOIL AND ROCK DESCRIPTIONS
								4" pavement
	2.5	S1	13-9 17-14	24	0	0.5 ppm	FILL	S1: Redrove 0.5 to 3.5 ft. Recovery 11": WIDELY GRADED SAND (SW) ~85% sand, ~10% gravel to 1", <5% nonplastic fines, brown. Contains brick fragments and ash. Fill.
	5					hard drilling 3 to 4 ft, possible boulder		
		S2	7-7 11-13	24	8	2.0 ppm		S2: NARROWLY GRADED SAND WITH SILT AND GRAVEL (SP-SM) ~65% mostly fine sand, ~25% gravel to 3/4 inch ~10% non-plastic fines, brown. Fill.
	7.5	S3	9-10 2-1	24	16	0.0 ppm		S3 (0-10"): Similar to S2.
	10						ORGANICS	S3 (10"-16"): ORGANIC SILT (OL) ~100% slightly plastic fines, dark gray, organic odor, contains white shell fragments.
	12.5	S4	WOH 1-2 1	24	15	0.0 ppm		
	15					hard drilling at 15.5 ft		S4: Similar to S3, bot 6".
	17.5	S5	20-35 50/3"	15	8	Top of rock ~19 ft. Roller bit to 20 ft.	TILL	S5: SILTY SAND WITH GRAVEL (SM) ~60% mostly fine sand, ~25% slightly plastic fines, ~15% gravel to 1/2 inch, olive. Glacial Till.
	20 22.5	C1	RQD 70%	60	54	lost ~10 gallons drill fluid from 23 to 25 ft	ROCK	C1: SCHIST, hard, slight weathering at joint surfaces, joints at ~30 degrees from horizontal and generally parallel to foliation, gray. Marlborough Formation.
	25 27.5 30							Bottom of Boring 25 ft Truck-mounted drill rig. 4-inch casing to 19 ft. Safety-hammer with rope and cathead for SPT. Backfilled with drill cuttings.

BLOWS PER 6 IN.–140 LB. HAMMER FALLING 30 IN. TO DRIVE A 2.0 IN. OD SPLIT SPOON SAMPLER
PEN–PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC–RECOVERY LENGTH OF SAMPLE
RQD–LENGTH OF SOUND CORES > 4 IN./ LENGTH CORED, %
S–SPLIT SPOON SAMPLE
U–UNDISTURBED SAMPLES, UF–FIXED PISTON
UO–OSTERBERG
$\underline{\nabla}$ GROUNDWATER

NOTES:
1: Groundwater at 10 ft depth at start of day 2/15/07.

PROJECT 07999-0
DATE

GEI Consultants

EXAMPLE SOIL DESCRIPTIONS

SANDY SILT (ML) ~60% slightly plastic fines, ~40% mostly fine sand, 1" thick layer of fine to medium sand with <20% fines, gray.

LEAN CLAY (CL) ~90% moderately plastic fines, ~10% fine sand, olive. Boston Blue Clay. Sv = 0.5, 0.5, 0.8 tsf, Qp = 1.0, 1.5, 1.6 tsf

Stratified CLAYEY SAND (SC) and WIDELY GRADED SAND (SW) SC layers 1 to 2 inches thick consist of fine sand with ~30% moderately plastic fines, gray. SW layers 1 to 4 inches thick consist of fine to coarse sand, ~10% gravel to 1/2 inch, <5% fines, brown. Hydraulic Fill.

EXAMPLE ROCK DESCRIPTIONS

(0-9"): GRANITE, hard, one piece, joint surface slightly weathered, pink.
(6-60"): PHYLLITE, joints ~ 45° generally parallel to foliation, 9" to 44" moderate to severe jointing and joint weathering. 44" to 60" single piece, green-gray.

ARGILLITE, medium hard, moderately weathered joints, gray. Cambridge Argillite.

GEOPROBE AND ROTOSONIC

When SPTs are not performed, note sample density (sands) or stiffness (clays) in description.

CRITERIA FOR DESCRIBING DILATANCY OF FINE-GRAINED SOILS

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

SPT: Standard Penetration Test

30-inch drop with 140-lb hammer
1 3/4 to 2 1/4 turns around cathead
2-inch O.D. split spoon sampler

ENV'L TERMINOLOGY FOR SOIL DESCRIPTIONS

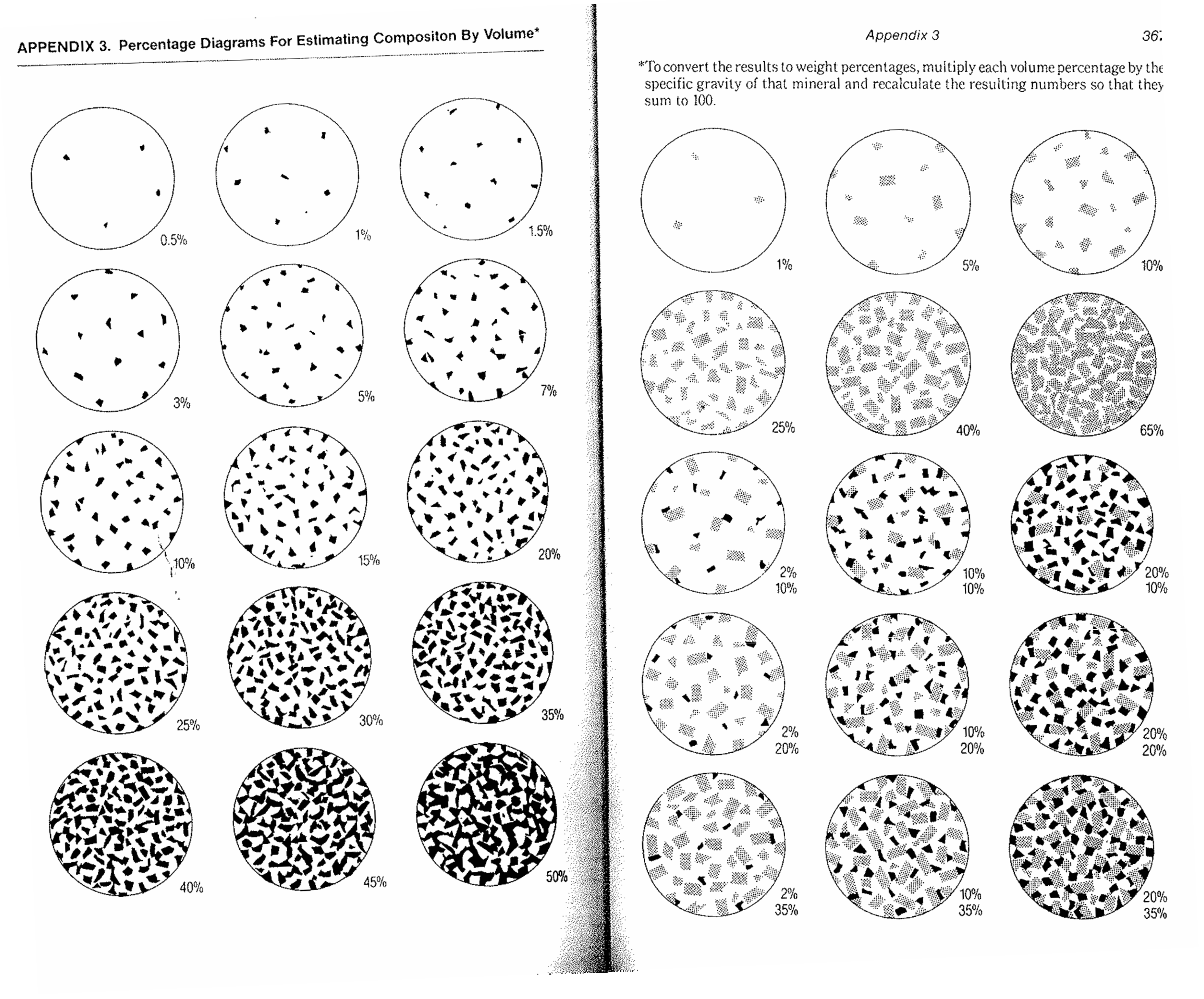
- **Ash** - Typically silt-size to medium sand-size.
- Do not use the term "cinders." This is not a technical term. Instead, use "ash," "burnt wood," "burnt material," or a similar term.
- **Coal-like material** - If it looks like coal but you aren't sure.
- **Clinker** - Vitrified (glass-like) or heat-fused material. Often burned impurities in coal. Often looks like pumice, but heavier.
- **Slag** - Similar to clinker, but normally refers to residue from metal ore processing.

- **Sheen** - Iridescent petroleum-like sheen. Not to be used for a "bacterial sheen," which can be distinguished by its tendency to break up on the water surface at angles. Petroleum sheen will be continuous and will not break up.
- **Stained** - Use with a color ("brown-stained") to indicate that the soil is stained a color other than its natural (unimpacted) color.
- **Coated** - Soil grains are coated with NAPL (oil, tar, etc.). There is not enough NAPL to saturate the pore spaces. ("Split spoon sampler coated with brown oil." "Soil grains coated with gray substance with slight gasoline-like odor.")
- **Saturated** - The entire sample pore space is saturated with NAPL. If you use this term, be sure it is not water saturating the pore spaces. Depending on viscosity, the NAPL may drain from a soil sample. ("Sample saturated with green, sticky substance.")
- **Blebs** - Discrete sphericals of NAPL in a soil matrix that was not visibly coated or saturated. ("Occasional blebs of reddish-brown tar.")
- **Oil** - Exhibits a petroleum odor, different from MGP odors.
- **Tar** - Exhibits an MGP odor (e.g. naphthalene-like odor).

- **Odors** - Use terms such as "naphthalene-like odor" or "petroleum-like odor." Use modifiers (strong, moderate, slight) to indicate odor intensity.

SM-003

Attachment B – Percentage Diagram for Estimating Composition By Volume



APPENDIX 3. Percentage Diagrams For Estimating Compositon By Volume*

*To convert the results to weight percentages, multiply each volume percentage by the specific gravity of that mineral and recalculate the resulting numbers so that they sum to 100.

Source: Geology in the Field, Robert F. Compton, Page 361-362, 2001

STANDARD OPERATING PROCEDURE

SM-004 Test Pit Excavation

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1. Objective

The test pit is used to characterize geologic strata and collect representative soil samples from these strata.

2. Execution

- Have contractors steam clean equipment before beginning field activities.
- Contact the owner to determine the location of underground utilities. Verify, with the contractor, that local/regional utility clearance service has been contacted. Ask subcontractor to provide local/regional utility clearance service authorization number and record this in the field notebook. Mark out/stake out the approximate excavation extent. Clearance may require marking of subsurface explorations prior to contacting utility clearance service.
- Excavate the designated area using a backhoe to the dimensions indicated in the Field Plan. Place excavated material that has suspected and/or visible contamination on a plastic liner away from the excavation.
- During excavation, monitor ambient air for Volatile Organic Compounds (VOCs) or other contaminants of concern. Record readings in field notebook (see SOP FD-001 Field Notebook).
- Describe sidewall strata, test pit dimensions, and soil classifications on test pit log (see SOP SM-003 Soil Classification). Record the presence and size of existing obstructions and any existing foundations. Take photographs of excavation sidewalls.
- Label sample bottles (see SOP SC-002 Sample Handling).
- Collect soil samples from the test pit sidewalls and bottom at designated depths, at strata changes, or based upon field screening using equipment (backhoe bucket, stainless steel remote sampler, etc.) designated in the field plan. Do not enter a test pit unless side slopes satisfy Occupational Safety and Health Administration (OSHA) regulations and other health and safety concerns have been addressed.
- Transfer sample to the appropriate glassware with a decontaminated stainless steel trowel or spatula (see *Equipment Decontamination* SOP).
- Store samples on ice in a cooler (see SOP SC-002 Sample Handling and SOP FD-003 Chain-of-Custody).
- Screen soil samples for VOCs or other contaminants of concern and record results in the field notebook.

- Backfill excavation as soon as possible with material designated in field plan. Segregate contaminated soil as necessary (see SOP SC-003 IDW). Properly identify segregated material and secure as designated in the field plan.
- Measure dimensions of excavation and record in the field notebook.
- Sketch dimension and location of the test pit relative to a site reference point and record in the field notebook. Note the sample locations by number on a cross section sketch and plan view sketch.

3. Limitations

- At all times, follow safety procedures as defined in the site-specific Health & Safety Plan.
- NEVER CLIMB INTO THE EXCAVATION TO COLLECT A SOIL SAMPLE unless the excavation is shored or the sidewalls are sloped in accordance with OSHA regulations and all proper personal protective safety precautions have been considered and implemented.
- Terminate excavation if the flow of ground water into the excavation adversely affects the stability of the excavation (i.e., slumping). Make sure to note in the field notebook the depth to ground water.
- Terminate excavation if drums, tanks, or other potential sources of contamination are observed. Record visible drum markings, labels, and any other pertinent information on the test pit log and in the field notebook. Photograph drums and materials.
- Do not leave an open excavation unattended without isolating it from passerby and vehicular traffic.

4. References

Earth Manual (1968), United States Department of the Interior, Bureau of Reclamation, United States Government Printing Office, Washington, D.C., pp. 134-139.

OSHA Standards for Excavations, Department of Labor, Federal Register, 29 CFR Part 1926, Aug. 9, 1994.

5. Attachments

None

6. Contact

Douglas Bonoff

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SOP No. GW-001
Revision No. 1
Effective Date: June 2008

STANDARD OPERATING PROCEDURE

GW-001 Water Level Measurement

---

1. Objective

The purpose of this Standard Operating Procedure (SOP) is to set guidelines for the determination of the depth to water in an open borehole, cased borehole, monitoring well, or piezometer.

2. Execution

- Prior to collecting water level measurements all wells should be opened to the atmosphere and allowed to equilibrate prior to collecting groundwater elevation measurements.
- All groundwater level measurements need to be performed in the shortest possible timeframe (no more than four hours).
- Groundwater levels are measured using an electronic ground water-level indicator which has a cable divided into incremental measurements of 0.01 feet and two conductors forming a probe. When ground water is encountered, the circuit is completed and a light, meter, or audible buzzer is activated. The depth to ground water is then measured from this point to the reference mark on the inner casing of the monitor well.
- All ground water-level measurements should be made from the same marked reference point at the top of the inner well casing. A licensed surveyor must mark the reference point.
- If no discernable survey mark is observed on the inner casing, the ground water-level measurement should be read from the highest point of the inner casing.
- If no survey mark is observed on the inner casing, it should be noted with the ground water-level data and the highest point of the casing must be marked for future reference.
- Measurements should be made three to four times to confirm the measurement. Each time a measurement is made it should be determined to the nearest one-hundredth of a foot (0.01).
- Certain situations may necessitate that all water level measurements at a given site should be collected within a shorter than 24-hour period. These situations may include:
    1. The magnitude of the observed changes between wells appears too large.
    2. Changes in atmospheric pressure.
    3. Aquifers which are tidally influenced.
    4. Aquifers affected by river stage, impoundments, and/or unlined ditches.

5. Aquifers stressed by intermittent pumping of production wells.
6. Aquifers being actively recharged due to precipitation events.
7. Occurrence of pumping.

- All well measurements should be performed the same day, prior to the evacuation of any wells which may influence groundwater elevations in the area of the investigation.
- Measurements should be collected from the same survey point, and to avoid any procedural differences, preferably by the same person and measuring tape.
- The following items should be recorded on field data sheets while collecting groundwater level measurements:
    1. Diameter of protective outer casing
    2. Security and integrity of the well
    3. The number of the well
    4. Inner diameter and construction material of the inner well casing
    5. Total depth of the well from the top of the inner casing or surveyor’s mark, if present (measured to 0.01 foot)
    6. Depth from the top of the inner casing to ground water (recorded to 0.01 foot accuracy)
    7. Thickness of floating product, if any. (See SOP GW-002 NAPL Measurement.)
    8. Calculation of the linear feet of water in the well by subtracting the depth to ground water from the total depth of the well.
    9. Calculation of the water table elevation in the well by subtracting the depth to ground water from the top-of -casing elevation.

3. Limitations

- Groundwater levels should be obtained from all wells in a network prior to sampling the first well.
- All wells should be sampled.
- Weak batteries in these units frequently produce weak or gradual auditory and/or visual responses, making it difficult to accurately determine when the probe of the unit has come in contact with ground water. As such, it is recommended that electronic ground water-level indicators be tested before they are brought out into the field.
- Note that electronic ground water-level indicators will not respond to distilled water, so distilled water should not be used to test these units.

- Wells that are not plumb may result in probe contact with the side of the well casing providing a false measurement. Once the probe has come in contact with ground water in the well, water may be trapped by capillary action between the probe and the well casing. If this happens, the unit may continue to signal even after the probe has been raised above the ground water surface. The deeper the well, the more likely this problem may occur. To correct this, the cable should be raised several feet above the water and shaken to remove water from the probe. A new ground water-level measurement should then be collected. If the signals from the unit are not abrupt or reproducible, the probe may need to be reeled up to the surface and dried off before re-attempting another measurement.
- Accumulation of sediment, organic material, or floating debris on the probe may also result in gradual or non-reproducible readings. Wells that are constructed with metal inner casings may lead to difficulties in collecting reproducible ground water-level measurements because the inner sides of the well casing are conductive.
- In some cases, a rubber grommet or metal centralizer may need to be placed on the probe so that the probe is not allowed to come in contact with the inner casing. Ground water-level-measuring equipment should be properly decontaminated between wells and piezometers to avoid cross contamination.
- Once a well has been located and properly identified, the field measurements listed below should be noted in a field logbook. Be certain that the proper well is being measured. The misidentification of a sampling point in the field will result in erroneous data that may result in incorrectly constructed contour maps.

4. References

U. S. EPA Environmental Response Team Standard Operating Procedures SOP: 2043,"Water Level Measurement" REV: 0.0, 10/03/94.

U. S. EPA Environmental Response Team Standard Operating Procedures SOP: 2044," Monitor Well Development" REV: 0.1, 10/23/01.

5. Attachments

Attachment A – Monitoring Well Sampling Record

6. Contact

Brian Conte

GEI Consultants

MONITORING WELL SAMPLING RECORD

PID Reading ____________
Job Name ____________
Job Number ____________
By ____________ Date ____________
Location ____________
Measurement Datum ____________
Well Number ____________

Pre-Development Information

Time (start) ____________
Water Level ____________
Total Depth of Well ____________
One Purge Vol ____________
Three Well Volume ____________

Water Characteristics

Color ____________ Clear ____ Cloudy ____
Odor ____ None ____ Weak ____ Moderate ____ Strong
Any films or immiscible material ____ None

Volume (gal)	Time	pH	Temp (EC)	Spec. Conductance (ΦS/cm)	Turbidity (NTU)	DO Conc. (mg/L)	ORP (mV)	TDS

Total Volume Removed (gal) ____________
pH ____________
Temperature (EC) ____________
Specific Conductance (ΦS/cm) ____________
DO Concentration (mg/L) ____________
ORP (mV) ____________
TDS ____________

Post Development Information

Time (Finished) ____________
Water Level ____________
Total Depth of Well ____________
Approximate Volume Removed (gal) ____________

Water Characteristics

Color ____________ Clear ____ Cloudy ____
Odor ____ None ____ Weak ____ Moderate ____ Strong
Any films or immiscible material None ____________

Comments:

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SOP No. GW-002
Revision No. 1
Effective Date: June 2008

STANDARD OPERATING PROCEDURE

GW-002 Light Non-Aqueous Phase Liquid (LNAPL) Measurement

---

1. Objective

Accurate and repeatable measurement of the thickness of Light Non-Aqueous Phase Liquids (LNAPLs) contained in monitoring wells.

2. Execution

Two procedures for measuring LNAPL are provided below: clear bailer and Interface Probe. Neither method is ideal, however, due to difficulties associated with the Interface Probe, use of the clear bailer is the preferred method to identify and estimate thickness of floating product in monitor wells.

2.1. Clear Bailer

- Determine depth to the surface level of the LNAPL layer.
- Record depth.
- Lower a clear bailer into the well and slowly into the product, being careful not to submerge the bailer.
- Raise the bailer and measure product thickness.
- Once the product thickness is known, the depth to ground water may be determined (See calculation below).
- This method has inaccuracies because successful use of the bailer is dependent upon the expertise of the operator and assumes the check valve does not leak upon retrieval.

2.2. Interface Probes

- Decontaminate Interface Probe prior to use.
- Check battery and replace if necessary.
- Check the unit is functioning correctly. Note: De-ionized water will not provide a correct reading.
- Measure the hydrocarbon/air interface first by going from air to the LNAPL surface to prevent dripping hydrocarbons from enhancing the thickness reading.
- Record the reading.
- Measure the hydrocarbon/water reading by lowering the Interface Probe past the LNAPL layer quickly minimizing the contact time of the probe within the hydrocarbon phase.
- DNAPL can also be measured by quickly lowering the Interface Probe past the LNAPL layer and to the bottom of the well noting any audio or visual indications of DNAPL.
- The optical sensor on interface probes may become damaged if solvents are used to clean product from the probes.

- The optical sensor may become smeared when used to measure product, rendering pinpoint accuracy to an estimate at best.
- Close attention to decontamination procedures will improve accuracy, operational life, and reduce the risk of cross contamination with other wells.

3. Limitations

- When a LNAPL thickness is measured in a monitoring well it will usually exhibits an apparent thickness rather than an actual thickness. This apparent thickness is caused when LNAPL from within and above the capillary fringe migrates into the monitoring well causing the ground water-level to become depressed below the surrounding capillary fringe area. As a result, LNAPL will continue to flow into the well until equilibrium is reached causing an apparent LNAPL thickness, which is greater than the actual thickness**.**
- LNAPL thickness can be affected by fluctuations in the water table. In some cases, an LNAPL's thickness may decrease when the water table rises, while its thickness increases as the water table drops. In other cases, fluctuating water tables may cause sudden appearances and disappearances of LNAPL layers.
- Monitoring points with LNAPLs can pose a problem when measuring the level of ground water. Floating LNAPLs can depress the ground water-level in a monitoring well or piezometer and distort the measurement. Therefore, the Corrected Depth (CD) formula shown below should be applied to ground water-level measurements in monitoring points where LNAPLs are present:

CDTW = Static DTW – (PT x G)

CDTW = Corrected Depth to Ground water
DTW = Depth to Ground Water (Static)
PT = Measured Product Thickness
G = Specific Gravity (density of free product / density of water)

4. References

U. S. EPA Environmental Response Team Standard Operating Procedures SOP: 2043,"Water Level Measurement" REV: 0.0, 10/03/94.

5. Attachments

Attachment A - Monitoring Well Sampling Record

6. Contact

Brian Conte

GEI Consultants

MONITORING WELL SAMPLING RECORD

PID Reading ____________ Job Name ____________

Job Number ____________ By ____________ Date ____________

Location ____________ Measurement Datum ____________

Well Number ____________

Pre-Development Information Time (start) ____________

Water Level ____________ Total Depth of Well ____________

One Purge Vol ____________ Three Well Volume ____________

Water Characteristics

Color ____________ ____ Clear ____ Cloudy

Odor ____ None ____ Weak ____ Moderate ____ Strong

Any films or immiscible material None

Volume (gal)	Time	pH	Temp (EC)	Spec. Conductance (ΦS/cm)	Turbidity (NTU)	DO Conc. (mg/L)	ORP (mV)	TDS

Total Volume Removed (gal) ____________ pH ____________

Temperature (EC) ____________ Specific Conductance (ΦS/cm) ____________

DO Concentration (mg/L) ____________ ORP (mV) ____________

TDS ____________

Post Development Information Time (Finished) ____________

Water Level ____________ Total Depth of Well ____________

Approximate Volume Removed (gal) ____________

Water Characteristics

Color ____________ ____ Clear ____ Cloudy

Odor ____ None ____ Weak ____ Moderate ____ Strong

Any films or immiscible material None ____________

Comments:

STANDARD OPERATING PROCEDURE

GW-003 Low Flow (Low Stress) Groundwater Sampling

---

1. Objective

Outline a method to collect groundwater samples that accurately and precisely represent the aquifer conditions. Low-flow purging is limited to wells that, with sustained pumping, exhibit no continuous drawdown.

2. Execution

- Record all activities in the field notebook (see SOP FD-001 Field Notebook) and on Attachment A - Monitoring Well Sampling Record. Use a separate form for each sampling location and event.
- Calibrate PID, pH, temperature, Specific Conductance (SC), turbidity, Dissolved Oxygen (DO), and Oxidation-Reduction Potential (ORP) meters.
- Start at the well known, or believed to have the, least contaminated groundwater and proceed systematically to the well with the most contaminated groundwater. Check the well, the lock, and the locking cap for damage or evidence of tampering.
- Record observations.
- Being careful to not disturb the water column, slowly and gently measure the depth to water with a water level probe and/or oil water interface probe. Do not measure depth to well bottom at this time (wait until sampling has been completed). Measure water level to the nearest 0.01 foot from the top of casing and the highest point (or "V" notch) on the Polyvinyl chloride (PV. If the top of casing cannot be used, note the reference location. Mark the datum point with an indelible marker and note reference location in field book.
- Attach the in-line flow-through the cell at the discharge end of the pump and provide shade for the flow-through cell.
- Slowly and gently insert the pump intake tubing to the middle of the saturated screened interval, open borehole, or to the pre-determined sampling depth. The pump intake must be kept at least two (2) feet above the bottom of the well to prevent disturbance or suspension of any sediment or Non-Aqueous Phase Liquid (NAPL) present in the bottom of the well. Record the depth of the pump intake.
- Start the pump on the lowest setting and increase slowly until flow begins. Adjust the pumping rate so that drawdown in the well is minimal (0.3 feet or less). Use a pumping rate between 100 to 1,000 milliliters per minute (mL/min) (or approximately 0.1 to 1 quarts per minute). Measure rates with a graduated container every 3 to 5 minutes and record. The minimum purge volume will be twice the

combined volumes of the sampling string (i.e. pump, tubing, and flow-through cell).

- While purging, record water levels every 3 to 5 minutes. A steady state flow rate will be maintained that results in a stabilized water level with a drawdown of 0.3 feet or less.
- After pumping at least two volumes of the sampling string, monitor and record, every 3 to 5 minutes, the water quality indicator parameters that include: pH, temperature, specific conductance, and turbidity. If specified in the field sampling plan, also include DO and ORP.
- Purging is complete when, after three consecutive measurements, the water quality parameters have stabilized as follows:
    1. pH (+/- 0.2 standard units)
    2. temperature (+/- 0.2° C)
    3. SC (+/- 5% µmhos/cm)
    4. turbidity (+/- 5 NTU)
    5. DO (+/- 0.2 mg/L or 10%, whichever is greater)
    6. ORP (+/- 20 mV or 10%, whichever is greater)
- Dispose of purge water according to the field plan.
- Collect the samples.
- Following purge, disconnect the flow-through cell and fill all containers from the discharge end of the tubing. Collect samples at a flow rate equal to or less than the steady state purge rate.
- Fill sample containers directly from the sampling device in order of decreasing volatility (i.e., Volatile Organic Compounds (VOC) samples will be collected first; see SOP SC-002 Sampling Handling).
- If not using dedicated equipment, remove sampling device and decontaminate (see SOP QA-001 Equipment Decontamination).
- Store samples in a cooler between 2°C and 6°C for transport to the laboratory.
- Measure depth to bottom of well.
- Secure the well cap.

3. Limitations

- At all times, follow safety procedures as defined in the site-specific Health and Safety Plan.
- Prior to departure for the field, obtain available information on well construction for use in field investigation (i.e., screen and riser material, well diameter and depth, screened interval, optimum sampling depth, etc.).
- If using dedicated equipment, install equipment into well at least 24 hours before sample collection to minimize disturbance of the water column and/or suspension of sediments or NAPL on bottom.

- Measure the depth to water twice.
- Measure the well bottom after sampling to avoid disturbance of water column and/or suspension of sediments or NAPL at the bottom of the well.
- To prevent cross-contamination between wells, it is strongly recommended that dedicated, in-place pumps (and tubing) be used.
- If the water quality indicator parameters do not stabilize after 2 hours, then either continue purging or, contact the Project Manager.
- The key indicator parameter for VOCs is DO. The key indicator parameter for all other samples is turbidity.
- Turbidity and DO usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.
- All sample containers are to be filled with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.
- Field filtering for metals is not necessary if using low-flow sampling (turbidity must be less than 5 NTU). Field filtering is not allowed unless authorized under the project sampling plan.
- Be aware of any preservatives in the sample bottles and handle with care, in accordance with the Health and Safety Plan.

4. References

Standard Reference for Monitoring Wells (April 19, 1991), Massachusetts DEP, DEP Publication No. WSC-310-91.

Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures (1996), R.W. Puls and M.J. Barcelona, U.S. Environmental Protection Agency, EPA/540/S-95/504.

Reproducible Well-Purging Procedures and VOC Stabilization Criteria for Ground Water Sampling (1994), M.J. Barcelona, H. A. Wehram, and M.D. Varljen, Ground Water, Vol. 32, No. 1, 12-22.

Low-Flow Purging and Sampling of Ground Water Monitoring Wells with Dedicated Systems (1995), R.W. Puls, and C.J. Paul, Groundwater Monitoring and Review, Summer 1995 116-123.

Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling, (1998), Ground-Water Sampling SOP, Final, U.S. Environmental Protection Agency, Region II, March 16, 1998.

RCRA Ground-Water Monitoring: Draft Technical Guidance, (1993), U.S. Environmental Protection Agency, EPA/530-R-93-001.

To Filter, or Not to Filter, That is the Question, (1997), Special Topics Subcommittee Letter Report EPA-SAF-EEC-LTR-97-011, April 29, 1997, Meeting, U.S. Environmental Protection Agency, Science Advisory Board Environmental Engineering Committee, September 5, 1997.

Should Filtered or Unfiltered Groundwater and Surface Water Samples be Collected for the Risk Assessment?, (1995), MCP Q&A: Subparts I and J, Special #4, Bureau of Waste Site Cleanup, Massachusetts Department of Environmental Protection (DEP), February, 1995.

5. Attachments

Attachment A - Monitoring Well Sampling Record

6. Contact

Brian Conte

GEI Consultants

MONITORING WELL SAMPLING RECORD

PID Reading ____________ Job Name ____________

Job Number ____________ By ____________ Date ____________

Location ____________ Measurement Datum ____________

Well Number ____________

Pre-Development Information Time (start) ____________

Water Level ____________ Total Depth of Well ____________

One Purge Vol ____________ Three Well Volume ____________

Water Characteristics

Color ____________ ____ Clear ____ Cloudy

Odor ____ None ____ Weak ____ Moderate ____ Strong

Any films or immiscible material ____ None

Volume (gal)	Time	pH	Temp (EC)	Spec. Conductance (ΦS/cm)	Turbidity (NTU)	DO Conc. (mg/L)	ORP (mV)	TDS

Total Volume Removed (gal) ____________ pH ____________

Temperature (EC) ____________ Specific Conductance (ΦS/cm) ____________

DO Concentration (mg/L) ____________ ORP (mV) ____________

TDS ____________

Post Development Information Time (Finished) ____________

Water Level ____________ Total Depth of Well ____________

Approximate Volume Removed (gal) ____________

Water Characteristics

Color ____________ ____ Clear ____ Cloudy

Odor ____ None ____ Weak ____ Moderate ____ Strong

Any films or immiscible material ____ None

Comments:

STANDARD OPERATING PROCEDURE

AR-002 Suspended Particulate Matter in Ambient Air Using the MIE DataRam™ Real-time Aerosol Monitor (Portable)

---

1. Objective

To establish standard procedures for the real-time monitoring of airborne particulate matter in ambient air using an MIE DataRAM™ model DR-2000 real-time aerosol monitor. This Standard Operating Procedure (SOP) establishes the steps to be used by GEI personnel when using the MIE DataRAM™ model DR-2000.

2. Materials

Equipment operation setup can be made in the field. The DataRAM™ must be connected to a computer to download collected data.

- MIE DataRAM™
- Shelter/Enclosure - a pre-constructed enclosure capable of protecting the instrumentation from severe weather conditions during sample collection
- IBM compatible computer loaded with MIE DataRAM™ software
- Field notebook

3. Execution

- Turn on the power by pressing the “on” button on the front display panel of the DataRAM™. “Main Menu I” will appear on the screen.
- Activate the zero mode by pressing the button indicating zero.
- When the screen indicates the zero mode is complete, activate the span check mode by pressing the button indicated, and follow the prompts that appear on the screen.
- Record the time of the zeroing and the calibration difference percent in the appropriate field log book. If the zeroing procedure takes longer than 5 minutes press “exit” and then “off,” and then put the power switch on the rear panel of the instrument in the off position. Wait several minutes, turn on the power and zero the instrument again. If the calibration difference percent is more than ±5% then follow the “Calibr Diff” Resetting Procedure in the DataRAM™ Instruction Manual.
- Set the DataRAM™ to automatically log data. Refer to the Instruction Manual for details on how to set the data logging function.
- Record the instrument flow rate from the parameters menu in the appropriate field log book.
- Set the DataRAM™ at the sampling location in a rain or weatherproof containment, with only the inlet tubing exposed to ambient air.

- Start the run.
- When sampling is completed, terminate run and download data using the RS-232 cable connector and the MIE DR-COM software.
- Once the data file has been successfully downloaded and saved in an appropriate location, clear the data from the instrument memory.

Each instrument must be calibrated using the internal reference standard and zeroed at the start of each sampling event and at a frequency of once per day throughout the duration of the sampling event.

4. Limitations

Daily startup procedures for the DataRAM™ include zeroing and performing a span check on the instrument. Before startup the DataRAM™ should be fully charged and the power selector switch on the rear panel should be in the “on” position.

All of the necessary attachments should be assembled prior to zeroing the DataRAM™. Attachments include the inlet heater, omnidirectional inlet, and PM2.5/PM10 impactor. Please consult the DataRAM™ instruction manual for details on use of the attachments.

Each MIE DataRAM™ is programmed to operate under the predetermine operating conditions as described in the appropriate Work Plan. (The MIE DataRAM™ is capable of monitoring total suspended particulate matter, particulate matter less than 10 microns (PM10), and particulate matter less than 2.5 microns (PM 2.5). The DataRAM can be programmed to collect continuous real-time data, or can collect “averaged” real-time data. These various options should be addressed prior to field operations and must be referenced in an approved work plan. This work plan must be available to all field personnel.

5. References

Code of Federal Regulations, 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM_{10} *in the Atmosphere.*

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Specific Methods (Interim Edition), Addendum to Section 2.11 Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere (High-Volume Sampler Method), US Environmental Protection Agency, Office of Research and Development, Washington, D.C. EPA/600/R-94/038b April 1994.

6. Attachments

None

7. Contact

Brian Skelly

SUMMARY GUIDANCE

SG-001 General Guidance on Soil Vapor Intrusion Evaluations

---

1. Objective

The goal of a soil vapor intrusion evaluation is to assess whether complete exposure pathways of soil vapor to indoor air exist. A complete exposure pathway exists if vapors from constituents are migrating through various pathways into residential or commercial buildings at concentrations that may result in an unacceptable human health risk. If a complete exposure pathway does not exist, then further assessment of soil vapor intrusion is not required.

Depending on the status of investigation performed at the site it may be appropriate to approach an evaluation of soil vapor intrusion at different tiers. If little work has been performed relative to the potential for contaminants to affect soil vapor near a structure, then a screening level assessment is an appropriate first step. However, if a plume is well delineated and the potential for groundwater impacts, or nearby source material, to affect soil vapor near a potential receptor structure is well understood, then it may be more appropriate to directly develop and implement a soil vapor and/or indoor air sampling plan. To accommodate the potential varied states of knowledge when a vapor intrusion evaluation is required, a flexible approach is needed that incorporates the following elements.

- SOP SG-002 Soil Vapor Sample Collection
- SOP SG-003 Sub-Slab Soil Vapor Collection
- Indoor Air Sampling
- SOP SG-004 Ambient Air Sample Collection

Soil vapor intrusion evaluations should be approached on a site-specific basis and depending on the site-specific setting and proximity to impacted groundwater or source material, it may be appropriate to proceed in a hierarchical fashion through each tier of evaluation or a variety of tiers may be combined and implemented simultaneously. The SOPs presented in this SOP address each of these sampling procedures.

2. Execution

2.1. Implementation Triggers

Soil vapor intrusion evaluations may be implemented at various times based on event triggers throughout the Site Characterization (SC), Remedial Investigation (RI), and site remedial action plan. The following event triggers would require the implementation of this soil vapor intrusion investigation.

- Identification of a potential complete exposure pathway
- Private property owner request for sampling
- State or Federal administrative order

2.2. Factors Affecting Soil Vapor Intrusion

Prior to conducting a soil vapor intrusion assessment at a private property, an analysis of the factors contributing to the migration of soil vapor to indoor air should be conducted. The completion of this analysis should take into account the two types of factors: environmental and building factors.

2.2.1. Environmental Factors

Environmental factors include site specific conditions in the subsurface and above the ground surface that may affect the rate and direction at which soil vapor may migrate.

The soil and groundwater conditions between the contamination and the residential/commercial building should be evaluated and recorded in any soil vapor intrusion investigation. If the SC/RI has been completed, then the data are available for this review. If the SC/RI has not been completed, then at a minimum the nature and extent of impacted soil and/or groundwater between the site and the residential/commercial building should be defined.

After compiling the necessary site-specific data, that information should be reviewed to determine groundwater conditions at the site. The potential for man-made or natural preferential pathways for vapor migration in the vadose zone and/or for groundwater migration in the saturated zone should also be determined at this time.

- The depth to groundwater below the residential or commercial building will be determined. For example, in cases where groundwater intersects the foundation there is no vadose zone to collect a sub-slab sample. In cases where the groundwater is close to the foundation, there is a risk of causing/exacerbating groundwater intrusion through the foundation during periods of high groundwater.

Additional Site Observations

1. Direction of groundwater flow from the contaminant source to the residential or commercial building;
2. The location, depth, extent, and concentration of potential constituents in unsaturated soil and groundwater on the property; and,
3. Presence of an overlying water bearing zone that does not have impacts beneath the residential or commercial building. An un-impacted shallow water zone will significantly retard or completely prohibit the potential for deeper impacted groundwater to affect soil vapor.
4. Potential “smear zones” (residual non-aqueous phase liquid (NAPL) present at depths over which the water table fluctuates) should also be identified as they may also affect the rate of soil vapor migration.

5. Location, depth, extent of NAPL if present.

Soils which are highly organic, wet, and/or of low permeability should be identified. If these soils are present beneath a structure and above impacted groundwater or soil, they may effectively shield the building from potential vapor intrusion. Conversely, dry and porous soils underlying a building may provide a less inhibited soil vapor intrusion pathway. The limits of backfill surrounding residential or commercial building should be also noted.

2.2.2. Building Factors

Building Factors include the physical characteristics, such as structure, floor layout, air flow, and physical conditions. These conditions will be documented during the evaluation. The New York State Depatoment of Health (NYSDOH) Center for Environmental Health's Indoor Air Quality Questionnaire and Building Inventory form is presented in Attachment A. At a minimum, the following information should be recorded.

- Building foundation construction characteristics (basement, footers, crawl spaces, etc), including potential preferential vapor intrusion pathways such as foundations cracks and utility penetrations.
- Basement wall materials (hollow block, stone, or poured concrete, etc.)
- Presence of an attached garage.
- Recent renovations to the building such as new paint or new carpet.
- Mechanical heating/cooling equipment that may affect air flow.
- Use and storage of petroleum products such as home heating oil storage tanks, underground storage tanks (USTs), or kerosene heaters.
- Recent use of petroleum-based finish or other products containing volatile organic compounds (VOCs).
- Areas of pavement on the property should also be identified in the event sub slab vapor sampling is not feasible or appropriate due to a high groundwater table. Paved areas could serve as surrogate locations in lieu of sub slab soil vapor sampling if high water table conditions exist.

The construction materials and integrity of the floor of the structure closest to the potential point of entry for soil vapor (basement level or first floor for slab-on-grade constructions) should be identified. In addition to the foundation type and integrity, this survey should note any preferential pathways (utility lines/pipes, sumps, etc.) that may exist within the bottom-most level of the structure.

The operation and presence of heating systems, including fireplaces and clothes dryers, may create a pressure differential between the structure and the outside environment, causing an increase of migration of soil vapor into the building. The NYSDOH guidance document suggests limiting indoor air sampling to the heating season (with the exception of immediate inhalation hazard situations), which is roughly defined as November 15th to March 31st. However, sampling may be completed at any time during the year for any sampling completed in response to a request by a community member. In situations where non-heating season sampling has taken place, consideration should be given to re-sampling the property within the heating season. The operation of HVAC systems should be noted on the building inventory form (Attachment A).

During the initial building assessment and visit, and again when sub-slab soil vapor and/or indoor air sampling are performed, differential pressure measurements between indoor air, ambient air, and soil vapor should be collected and recorded to document the potential effect building conditions have on soil vapor migration.

2.2.3. Property Visit

A property visit will be conducted prior to sampling. During the site visit, technical representatives will complete site visit observations, inventories and occupant questionnaire forms (Appendix A). During the course of the interview, observations will be made to identify any potential areas or issues of concern or the presence of any odors, and if sampling appears necessary, identify potential sampling points and general building characteristics. The questionnaire is also used to identify potential sources and activities that may interfere with sampling results. The questionnaire will specifically address the activities of the occupant's (e.g., smoking, work place activities) that may contribute to indoor air concentrations of volatile chemicals.

The responses to the questionnaire will be evaluated and a determination will be made as to whether additional investigation is required.

2.2.4. Chemical Inventory

The chemical inventory complements the identification of the building factors affecting soil vapor intrusion. The chemical inventory will identify the occurrence and use of chemicals and products throughout the building. These products can be used to develop an indoor environmental profile. A separate inventory should be prepared for each room on the floor being tested as well as any other indoor areas physically connected to the areas being tested. Inventories will include product names, chemical ingredients, or both. If possible, photographs of the products should be taken of the location and condition of the inventoried products and the photographic records should be indexed with the inventory records. The products inventory can also be used to document odors and if possible portable vapor monitoring equipment measurements should be taken and recorded. A product inventory will be repeated prior to each round of testing at the building. If available, the volatile ingredients should be recorded for each product. If the ingredients are not listed on the label, record the manufacturer's name and address or phone number if available. The product inventory form is presented in Attachment A.

2.2.5. Water Table Conditions and Vapor Intrusion Assessment Approach

Sub-slab soil vapor sampling is intended to evaluate the potential for vapor intrusion. However, there are circumstances where collection of sub-slab soil vapor samples may not be feasible if the water table is near, at, or above the elevation of a buildings foundation slab. An evaluation of the water table elevation relative to the building slab should be made before attempting to install a sub-slab vapor sampling point.

If the water table is found to be sufficiently below the building slab and sub-slab vapor sampling can be performed, then the following Low Water Table Scenario should be followed.

2.2.5.1. Low Water Table Scenario

If the water table elevation is lower than the basement slab, then the following samples should be collected.

- Sub-slab soil vapor samples
- Indoor air samples from basement level
- Indoor air samples from main living space (First floor)
- Outdoor ambient air sample

If the water table is deemed to be at too high of an elevation to allow sub-slab vapor sampling, then alternate means of evaluating the potential for vapor intrusion must be employed. If a building has a groundwater sump, the sump should be evaluated to determine if there is water present in the sump and if that water is representative of groundwater or if the water is stagnant. If water in the sump represents groundwater, then a sample from the sump should be collected. The High Water Scenario below summarizes the methods to evaluate potential vapor intrusion if sub-slab vapor sampling cannot be conducted due to high groundwater conditions.

2.2.5.2. High Water Table Scenario

If the water table elevation is higher than the basement slab, then the following tasks should be performed.

- Determine if a sump pump is present and actively pumping water.
- If sump is actively pumping, collect a sample of groundwater from the sump.
- Collect an indoor air sample from basement level.
- Collect an indoor air sample from main living space (first floor).
- Identify exterior soil vapor sample location near foundation (outside of foundation backfill) and preferably beneath a surrogate vapor cap (e.g. paved driveway, patio).

- Collect soil vapor samples from exterior soil vapor location
- Collect an outdoor ambient air sample.

2. References

USEPA modified Method TO-15 and helium via ASTM D-1945.

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006.*

3. Attachments

Attachment A - NYSDOH Center for Environmental Health’s Indoor Air Quality Questionnaire and Building Inventory Form

4. Contact

Chris Berotti

ATTACHMENT A

Off-Site Property Sampling Documentation Form

Property Location/Address: ______________________________

Property: _____________________________

Sampling Date: _____________________________

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

Preparer's Name: ________________________________ Date/Time Prepared: ______________

Preparer's Affiliation: ________________________________ Phone No.: __________________

Purpose of Investigation:____

1. OCCUPANT Interviewed: Yes ☐ No ☐

Last Name: _____________________________ First Name: ____________________________

Address: ____

County: _______________________

Home Phone: ___________________________ Office Phone: __________________________

Number of Occupants/persons at this location _______ Age of Occupants__________________

2. OWNER OR LANDLORD (Check if same as occupant __) Interviewed: Yes ☐ No ☐

Last Name: _____________________________ First Name: ____________________________

Address: ____

County: _______________________

Home Phone: ___________________________ Office Phone: __________________________

3. CONTACT NAME (Check if same as Occupant ____, Owner ____)

Last Name: _____________________________ First Name: ____________________________

Address: ____

County: _______________________

Home Phone: ___________________________ Office Phone: __________________________

4. PROPERTY LOCATION: ____

Relative to Site:

Direction _________ Direction to Nearest Cross Street: __________

Distance _________ Distance to Nearest Cross Street: __________

Surrounding Land Use:

North: _________________ East: _________________

South: _________________ West: _________________

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

5. PROPERTY BOUNDARIES

Delineate the boundaries of the property (on a separate project map, outline property location, private well location, septic/leachfield location, groundwater flow, compass direction, windrose.)

6. BUILDING CONSTRUCTION

Type of Building (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: _________________

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:_______________

If multiple units, how many? ________

If the property is commercial, type?

Business Type(s) _____________________________________

Does it include residences (i.e., multi-use)? Yes ☐ No ☐

If yes, how many? ______

Other characteristics:

Number of floors______ Building age______

Is the building insulated? Yes ☐ No ☐ How air tight? Tight / Average / Not Tight

Construction Material ___________________________________

7. BASEMENT AND CONSTRUCTION CHARACTERISTICS

Does the building have a basement and/or crawl space, or is it slab-on-grade construction?

____

Describe the construction of the basement/crawl space (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other ________

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

c. Basement floor:	concrete	dirt	stone	other ________
d. Basement floor surface:	uncovered	covered	covered with ____________	
e. Concrete floor:	unsealed	sealed	sealed with _____________	
	unpainted	painted	painted with ____________	
f. Foundation walls:	poured	block	stone	other ________
g. Foundation walls:	unsealed	sealed	sealed with _____________	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	

Does your basement have a sump? Yes ☐ No ☐

Is, is there water in the sump? Yes ☐ No ☐

Describe sump conditions:____

____

Have you observed standing water in your basement? Yes ☐ No ☐

If so, what is the frequency of this observation? _____________During rain events? ☐

Have you observed sheen atop the standing water? Yes ☐ No ☐

Basement/Lowest level depth below grade: ________(feet)

Are there any cracks in the floor of your basement? Yes ☐ No ☐

Description: ____

____

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

Description: ____

____

What activities occur in the finished basement?

Description: ____

____

Approximately how many hours per day (or week) do you spend in your basement? __________

8. HEATING, VENTING AND AIR CONDITIONING

Type of heating system(s) used in building: (Circle all that apply – note primary)

Property Location/Address: _____________________________
Property: ____________________________
Sampling Date: ____________________________

Hot Air Circulation
Electric Baseboard
Space Heaters
Hot Water Baseboard
Heat Pump
Radiant Floor
Steam Radiation
Wood Stove
Outdoor wood boiler
Unvented Kerosene Heater
Other ______________________________

The primary type of fuel used is:

Fuel Oil
Kerosene
Wood
Natural Gas
Propane
Coal
Electric
Solar
Other? ____________________

Time of use of each type of heating? ____

Domestic hot water tank fueled by: ____

Boiler/furnace located in: Basement Outdoors Main Floor Other________________

Air conditioning: Central Air Window units Open Windows None

Are there air distribution ducts present? Yes ☐ No ☐

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

____

____

____

____

Type of insulation (e.g. blown, fiber, etc.)? ____

Does building have energy efficient windows (e.g. double paned) Yes ☐ No ☐

Was weather-stripping recently added/upgraded? Yes ☐ No ☐

Particleboard used in construction? Yes ☐ No ☐

9. OCCUPANCY

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

Level General Use of Each Floor (e.g., family room, bedroom, laundry, workshop, storage)

Basement ____

1st Floor ____

2nd Floor ____

3rd Floor ____

4th Floor ____

10. BULK PETROLEUM STORAGE

Aboveground storage tank on the property Yes ☐ No ☐

If yes, how old is tank? _______________ Condition? __________________

Last inspected? _______________ Location: ____________________

Describe conduits to building (type, location, and entry portal condition): _________________

____

Underground storage tank on the property. Yes ☐ No ☐

If yes, how old is tank? _______________ Condition? __________________

Last inspected? _______________ Location: ____________________

Describe conduits to building (type, location, and entry portal condition): _________________

____

11. WATER AND SEWAGE

Water Supply:

Public Water Drilled Well Driven Well Dug Well Other ______________

Is there use of groundwater water for irrigation purposes? Yes ☐ No ☐

Sewage Disposal:

Public Sewer Septic Tank Leach Field Dry Well Other ______________

12. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Yes ☐ No ☐

If not, is there a separate garage or carport? Yes ☐ No ☐

b. Does the garage have a separate heating unit? Yes ☐ No ☐ NA ☐

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, ATV, car)
Yes ☐ No ☐ NA ☐ Please specify__________________

Is gasoline stored in the garage? Yes ☐ No ☐

Quantity? ________________

d. Has the building ever had a fire? Yes ☐ No ☐

When?_________________

e. Is a kerosene or unvented gas space heater present? Yes ☐ No ☐

Where? ________________

f. Is there a workshop or hobby/craft area? Yes ☐ No ☐

Where & Type? ________________

g. Is there smoking in the building? Yes ☐ No ☐

How frequently? _______________

h. Have cleaning products been used recently? Yes ☐ No ☐

When & Type? ________________

i. Have cosmetic products been used recently? Yes ☐ No ☐

When & Type? ________________

j. Has painting/staining been done in the last 6 months? Yes ☐ No ☐

Where & When? _______________

Is house paint stored inside? Yes ☐ No ☐

Where? _______________

k. Is there new carpet, drapes or other textiles? Yes ☐ No ☐

Where & When? _______________

l. Have air fresheners been used recently? Yes ☐ No ☐

When & Type? ________________

m. Is there a kitchen exhaust fan? Yes ☐ No ☐

If yes, where vented?____________

n. Is there a bathroom exhaust fan? Yes ☐ No ☐

If yes, where vented?____________

o. Is there a clothes dryer? Yes ☐ No ☐

If yes, is it vented outside? Yes ☐ No ☐

p. Has there been a pesticide/chemical fertilizer application? Yes ☐ No ☐

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

When & Type?____

Conducted by Owner or Private Yard Service ___________________________

Is yard waste/trash burned on-site? Yes ☐ No ☐

Do any of the building occupants use solvents at work? Yes ☐ No ☐

(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? ____

If yes, are their clothes washed at work? Yes ☐ No ☐

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, Use dry-cleaning regularly (weekly)
Use dry-cleaning infrequently (monthly or less)
Yes, work at a dry-cleaning service
No
Unknown

Is there a radon mitigation system for the building/structure? Yes ☐ No ☐

Date of Installation: ____________

Is the system active or passive? Active ☐ Passive ☐

Are there any recent/past improvements to building? Yes ☐ No ☐

Interior painting? ____

Any landscaping improvements that involved bringing fill on site? Yes ☐ No ☐

Other ____

Approximately when (how long ago) did these improvements occur? ______________

Does anyone living here engage in any of the following activities or hobbies?

a. Art projects (e.g. oil painting, ceramics, pottery, stained glass, metal sculpture)

Yes ☐ No ☐

Name: ____________________________ Age: _________ Sex: _____________

Name: ____________________________ Age: _________ Sex: _____________

Property Location/Address: ______________________________
Property: ______________________________
Sampling Date: ______________________________

b. Furniture refinishing Yes ☐ No ☐

Name: ______________________________ Age: _________ Sex: ______________

Name: ______________________________ Age: _________ Sex: ______________

c. Model building(e.g. planes,boats,cars) Yes ☐ No ☐

Name: ______________________________ Age: _________ Sex: ______________

Name: ______________________________ Age: _________ Sex: ______________

d. Gardening Yes ☐ No ☐

Name: ______________________________ Age: _________ Sex: ______________

Name: ______________________________ Age: _________ Sex: ______________

e. Automotive work Yes ☐ No ☐

Name: ______________________________ Age: _________ Sex: ______________

Name: ______________________________ Age: _________ Sex: ______________

f. Ammunition reloading Yes ☐ No ☐

Name: ______________________________ Age: _________ Sex: ______________

Name: ______________________________ Age: _________ Sex: ______________

Is there a wood burning stove? Yes ☐ No ☐

If so, how frequently is it used?

____

____

Is there a barbeque grill? Yes ☐ No ☐

If so, how frequently is it used? What is the type of fuel?

____

____

Has the building ever had fumigation? Yes ☐ No ☐

Property Location/Address: ____________________________
Property: ___________________________
Sampling Date: ___________________________

If so, when and how frequently? Type?

____

____

13. ODOR SUMMARY

Have the occupants observed any unusual odors? ______________________________

____

____

____

____

History of odor observation – date of onset, duration, severity, etc.

____

____

____

____

____

____

____

14. PRODUCT INVENTORY

Record the specific products found in building that have the potential to affect indoor air quality on the attached product inventory form.

15. INDOOR SKETCH

Draw a plan view sketch (on grid paper) of the basement, first floor, and any other floor where sampling was conducted in the building as well as any outdoor sample locations. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Product Inventory
Off-Site Property Indoor Air Sampling Documentation

Property Address:
Performed by:
Date of Inventory:
Field Instrument Make & Model:

Location	Product Description	Size (units)	Condition *	Chemical Ingredients	Field Instrument Reading (PPM)	Photo** Y/N
See Note 1 below						

Notes:
1 = Various Locations. Products were placed in plastic bins and removed from the residence 24 hours prior to the sampling.
* Condition of the product containers: Unopened (UO) or Used (U)
** Photographs of the front and back of product containers to document chemical ingredients. (Y = Yes; N = No)
PPM = parts per million
NL = Not Listed

STANDARD OPERATING PROCEDURE

SG-002 Soil Vapor Sample Collection

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1. Objective

This procedure outlines the general steps to collect soil vapor samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sample locations, sample depths, and sampling duration.

2. Execution

Permanent and temporary soil vapor probes should be installed using the procedures outlined below. All soil vapor probes should be installed using a direct-push drill rig (e.g., GeoProbe™ or similar), hand auger, or manually using a slide hammer.

2.1. Document Field Conditions

Document pertinent field conditions prior to installation of any probe points.

- Record weather information (precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for the past 24 to 48 hours.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (North);
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Soil Vapor Point Installation Specifications

Each soil vapor point should be constructed as follows:

- Six-inch stainless steel Geoprobe® AT86 series Permanent Implants (soil vapor screens) or equivalent and threaded to an (expendable) stainless steel anchor point.
- The implants should be fitted with inert Teflon or stainless steel tubing of laboratory or food grade quality.
- The annular space surrounding the vapor screen interval and a minimum of 6-inches above the top of the screen should be filled with a

porous backfill material (e.g., glass beads or coarse silica sand) to create a sampling zone 1 foot in length.

For temporary points, a hydrated bentonite surface seal should be created at the surface to minimize infiltration. For permanent points, the additional measures described below should be included.

- The soil vapor points should be sealed above the sampling zone with a bentonite slurry for a minimum distance of 3 feet (or to grade, whichever is smaller) to prevent ambient air infiltration.
- If needed, the remainder of the borehole should be backfilled with clean material.
- A protective casing should be set around the top of the point tubing and grouted in place to the top of the bentonite to minimize infiltration of water or ambient air, as well as to prevent accidental damage to the soil vapor point.
- The tubing top should be fitted with a Swagelok® and cap to prevent moisture and foreign material from infiltrating the tubing.

2.3. Soil Vapor Sample Collection

Soil vapor samples should be collected as indicated in the work plan and in accordance with applicable state or federal guidance documents. Specifically, samples from the points should be collected as follows:

- Permanent soil vapor points should not be sampled or purged for a minimum of 24 hours after installation. Temporary points may be purged and sampled immediately following installation.
- Document pertinent field conditions prior to sampling as described above.
- A suction pump should be used to remove a minimum of three implant volumes from the soil vapor points prior to sampling. Include the volume of any additional tubing added to affix sampling equipment and the annular space between the probe and the native material if sand or glass beads were used.
- The purge rate shall not exceed 0.2 liters per minute.
- Samples should be collected for volatile organic compounds (VOCs) in an individually laboratory certified clean 1-liter SUMMA® canister (or equivalent) using a certified flow controller calibrated for the anticipated sample duration (4 minutes). The regulator flow rate should not exceed 0.2 liters per minute.
- A helium tracer gas should be used to identify any potential migration or short circuiting of ambient air during sampling as described below.
- Remove the protective brass plug from the canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.

- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of-custody form for each sample.
- Connect the tubing from the soil vapor probe to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling.
- Stop sample collection when the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample should be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valve. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Samples should be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.
- All laboratory analytical data should be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II Standard Operating Procedure (SOP) for the Validation of Organic Data modified to accommodate the USEPA Method TO-15 and natural gas analysis by ASTM D-1945.

2.4. Tracer Gas Evaluation

The tracer gas evaluation provides a means to evaluate the integrity of the soil vapor probe seal and assess the potential for introduction of ambient air into the soil vapor sample.

A tracer gas evaluation should be conducted on the each temporary soil vapor probe to be sampled in a sampling event. A tracer gas evaluation should be conducted on the each permanent soil vapor probe during the initial sampling event and a minimum of 10% of the soil vapor probes during subsequent sampling events.

The following tracer gas evaluation procedure uses helium as a tracer gases which can be measured through laboratory analysis or by a portable detector.

Retain the tracer gas around the sample probe by filling an air-tight chamber (such as a plastic bucket) positioned over the sample location.

- Make sure the chamber is suitably sealed to the ground surface.
- Introduce the tracer gas into the chamber. The chamber should have tubing at the top of the chamber to introduce the tracer gas into the chamber and a valved fitting at the bottom to let the ambient air out while introducing tracer gas. Close the valve after the chamber has been enriched with tracer gas at concentrations >10%.
- The chamber should have a gas-tight fitting or sealable penetration to allow the soil vapor sample probe tubing to pass through and exit the chamber.
- After the chamber has been filled with tracer gas, attach the sample probe tubing to a pump that should be pre-calibrated to extract soil vapor at a rate of no more than 0.2 liters per minute. Purge the tubing using the pump. Calculate the volume of air in the tubing and probe and purge one to three tubing/probe volumes prior collecting an analytical sample or using a portable device to measuring the tracer gas concentration.
- Samples collected from vapor points during a tracer gas evaluation should be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Alternately, a tracer gas detector may be used to verify the presence of the tracer gas in the chamber by affixing it to the valve fitting at the bottom of the chamber. The tracer gas detector may also be used to measure the tracer gas concentration in the pump exhaust during purging. If used, then record the tracer gas concentrations in the chamber and in the soil vapor sample.

- Based on the concentrations of the tracer gas detected during analysis or direct measurement, determine whether additional gas tracer evaluations are necessary.

If the evaluation on a probe indicates a high concentration of tracer gas in the sample (>10% of the concentration of the tracer gas in the chamber), then the surface seal is not sufficient and requires improvement via repair or replacement prior to commencement subsequent sample collection.

A non-detectable level of tracer gas is preferred, however, if the evaluation on a probe indicates a low potential for introduction of ambient air into the sample (<10% of the concentration of the tracer gas in the chamber), then proceed with the soil vapor sampling. While lower concentrations of tracer gas are acceptable, the impact of the detectable leak on sample results should be evaluated in the sampling report.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006.*

4. Attachments

None

5. Contact

Chris Berotti

STANDARD OPERATING PROCEDURE

SG-003 Sub-slab Soil Vapor Collection

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1. Objective

This procedure outlines the general steps to collect sub-slab soil vapor samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sample locations, sample depths, and sampling duration.

2. Execution

Permanent and temporary sub-slab soil vapor probes will be installed using the procedures outlined below. All sub-slab soil vapor probes will be installed using a direct-push drill rig (e.g., GeoProbe™ or similar), hand auger, or manually using a slide hammer.

2.1. Document Field Conditions

Document pertinent field conditions prior to installation of any probe locations.

- Record weather information (precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for the past 24 to 48 hours. Record the indoor conditions (temperature, heating/cooling system active, windows open/closed, etc.).
- Measure the differential pressure at the building. Measure the indoor and outdoor barometric pressure using a high resolution device. Where possible, measure the sub-slab barometric pressure at the sampling point.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Indoor floor plan sketches should be drawn that include the floor layout with sampling locations, chemical storage areas, garages, doorways, stairways, location of basement sumps or subsurface drains and utility perforations through building foundations, heating, ventilating and air conditioning (HVAC) system air supply and return registers, compass orientation (North), footings that create separate foundation sections, and any other pertinent information should be completed;
- Outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations (if applicable), compass orientation (north), and paved areas.

- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Sub-Slab Soil Vapor Point Installation Specifications

Each sub-slab soil vapor point will be constructed as follows:

- Drill an approximately 3/8-inch hole through the slab. If necessary, advance the drill bit 2-3 inches into the sub-slab material to create an open cavity.
- Using dedicated inert Teflon or stainless steel tubing of laboratory or food grade quality, insert the inlet of the tubing to the specified depth below the slab. For permanent installation, only stainless steel tubing and fittings will be used.
- For permanent point installations, the annular space surrounding the vapor probe tip will be filled with a porous backfill material (e.g., glass beads or coarse silica sand) to cover 1-inch of the above the tip of the probe.
- Seal the annular space between the hole and the tubing using an inert non-shrinking sealant such as melted 100% beeswax, permagum grout, putty, etc. For permanent installations, cement may be used.
- For permanent points, a protective casing will be set around the top of the point tubing and grouted in place minimize infiltration of water or ambient air, as well as to prevent accidental damage to he permanent point.
- The tubing top will be fitted with a Swagelok® and cap to prevent moisture and foreign material from infiltrating the tubing.

In cases sub-slab sampling is impractical or infeasible, a surrogate location (attached garage, concrete patio, asphalt driveway, etc.) may be used if it is representative of sub-slab conditions. In surrogate locations, the vapor sampling point may be installed in accordance with SOP SG-002 Soil Vapor Collection.

2.3. Sub-Slab Soil Vapor Sample Collection

Sub-slab soil vapor samples will be collected as indicated in the site-specific Sampling and Analysis Work Plan and in accordance with state or Federal guidance documents. Specifically, sub-slab samples from the points will be collected as follows:

- Document pertinent field conditions prior to sampling as described above.
- A suction pump will be used to remove one to three implant volumes from the sub-slab soil vapor points prior to sampling. Include the volume of any additional tubing added to affix sampling equipment and the annular space between the probe and the native material if sand or glass beads were used.

- The purge rate shall not exceed 0.2 liters per minute.
- Samples will be collected in an individually laboratory certified clean 1-liter SUMMA® canister (or equivalent) using a certified flow controller calibrated for the anticipated sample duration (4 minutes). The regulator flow rate will not exceed 0.2 liters per minute.
- A helium tracer gas will be used to identify any potential migration or short circuiting of ambient air during sampling as described below.
- Remove the protective brass plug from the canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.
- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of-custody form for each sample.
- Connect the tubing from the sub-slab soil vapor probe to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling.
- Stop sample collection when the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample will be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valve. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.

- Samples will be analyzed for volatile organic compounds (VOCs) and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.
- All laboratory analytical data will be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II Standard Operating Procedure (SOP) for the Validation of Organic Data modified to accommodate the USEPA Method TO-15 and natural gas analysis by ASTM D-1945.

2.4. Tracer Gas Evaluation

The tracer gas evaluation provides a means to evaluate the integrity of the sub-slab soil vapor probe seal and assess the potential for introduction of indoor air into the sub-slab soil vapor sample. A tracer gas evaluation should be conducted on the each temporary sub-slab soil vapor probe to be sampled in a sampling event. A tracer gas evaluation should be conducted on the each permanent sub-slab soil vapor probe during the initial sampling event and a minimum of 10% of the sub-slab soil vapor probes during subsequent sampling events.

The following tracer gas evaluation procedure uses helium as a tracer gases which can be measured through laboratory analysis or by a portable detector.

- Retain the tracer gas around the sub-slab sample probe by filling an air-tight chamber (such as a plastic bucket) positioned over the sample location.
- Make sure the chamber is suitably sealed to the ground surface.
- Introduce the tracer gas into the chamber. The chamber will have tubing at the top of the chamber to introduce the tracer gas into the chamber and a valved fitting at the bottom to let the ambient air out while introducing tracer gas. Close the valve after the chamber has been enriched with tracer gas at concentrations >10%.
- The chamber will have a gas-tight fitting or sealable penetration to allow the sub-slab soil vapor sample probe tubing to pass through and exit the chamber.
- After the chamber has been filled with tracer gas, attach the sample probe tubing to a pump that will be pre-calibrated to extract sub-slab soil vapor at a rate of no more than 0.2 lpm. Purge the tubing using the pump. Calculate the volume of air in the tubing and purge one to

three tubing volumes prior collecting an analytical sample or using a portable device to measuring the tracer gas concentration.

- Samples collected from vapor points during a tracer gas evaluation will be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Alternately, a tracer gas detector may be used to verify the presence of the tracer gas in the chamber by affixing it to the valve fitting at the bottom of the chamber. The tracer gas detector may also be used to measure the tracer gas concentration in the pump exhaust during purging. If used, then record the tracer gas concentrations in the chamber and in the soil vapor sample.
- Based on the concentrations of the tracer gas detected during analysis or direct measurement, determine whether additional gas tracer evaluations are necessary:

If the evaluation on a probe indicates a high concentration of tracer gas in the sample (>10% of the concentration of the tracer gas in the chamber), then the surface seal is not sufficient and requires improvement via repair or replacement prior to commencement subsequent sample collection.

A non-detectable level of tracer gas is preferred; however, if the evaluation on a probe indicates a low potential for introduction of ambient air into the sample (<10% of the concentration of the tracer gas in the chamber), then proceed with the soil vapor sampling. While lower concentrations of tracer gas are acceptable, the impact of the detectable leak on sample results should be evaluated in the sampling report.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945.

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, dated October 2006.

4. Attachments

None

5. Contact

Chris Berotti

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SOP No. SG-004
Revision No. 1
Effective Date: June 2008

STANDARD OPERATING PROCEDURE

SG-004 Ambient Air Sample Collection

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1. Objective

This set of procedures outlines the general steps to collect ambient air samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sample locations and sampling duration.

2. Execution

The following procedures will be followed for the collection of ambient air samples:

2.1. Document Field Conditions

Document pertinent field conditions prior to sample collection.

- Record weather information (precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for the past 24 to 48 hours.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (North).
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Sample Collection

- Select a location upwind of the building or other area that is being evaluated.
- Samples will be collected in an individually laboratory certified clean SUMMA® canister (or equivalent) using a certified flow controller calibrated for the anticipated sample duration (1-hour, 8-hour, etc.). The regulator flow rate will not exceed 0.2 liters per minute.
- Place the canister at the sampling location. If the sample should be collected from breathing height (e.g., 3 to 5 feet above ground), then mount the canister on a stable platform such that the sample inlet will be at the proper height.
- Remove the protective brass plug from canister. Connect the pre-calibrated flow controller to the canister.

- Record the identification numbers for the canister and flow controller. Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of custody form for each sample.
- Open the valve on the vacuum pressure in the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling. During monitoring, note the vacuum pressure on the gauge.
- Stop sample collection after the scheduled duration of sample collection but make sure that the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample will be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valves. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Samples will be analyzed for volatile organic compounds (VOCs) and naphthalene via modified USEPA modified Method TO-15.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.

All laboratory analytical data will be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II Standard Operating Procedure (SOP) for the Validation of Organic Data modified to accommodate the USEPA Method TO-15.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006.*

4. Attachments

None

5. Contact

Chris Berotti

STANDARD OPERATING PROCEDURE

QA-001 Equipment Decontamination

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1. Objective

This SOP describes methods used for preventing or reducing cross-contamination, and provides general guidelines for sampling equipment decontamination procedures. Preventing or minimizing cross contamination in sampled media and in samples is important for preventing the introduction of error into sampling results and for protecting the health and safety of site personnel. Removing or neutralizing contaminants that have accumulated on sampling equipment ensures protection of personnel from permeating substances, reduces or eliminates transfer of contaminants to clean areas, prevents the mixing of incompatible substances, and minimizes the likelihood of sample cross-contamination.

2. Execution

- Inspect equipment for cleanliness prior to moving onto a site and prior to relocating to each new sampling location. All contractor-provided equipment (augers, rods, spoons, backhoe buckets) shall be decontaminated by steam cleaning **prior to coming on site.**
- Equipment decontamination is a sequential procedure consisting of the following general steps: Alconox-solution wash (or equivalent non-phosphate detergent); potable water rinse; methanol wash, and three distilled-water rinses.
- Alconox solution is a mixture of approximately 1 cup of Alconox per 1 gallon of potable water. Alconox solution wash requires scrubbing the equipment with a brush soaked in Alconox solution and removing any visible contamination or dirt from the equipment.
- Before advancing each boring, drilling equipment (including augers, casing, rods, and washtub) must be decontaminated by steam cleaning.
- Split-spoon samplers must be decontaminated prior to collecting each sample. The split-spoon decontamination procedure includes: a gross wash and scrub in a bucket of Alconox solution; potable water rinse; methanol wash, and three distilled-water rinses.
- Pumps and tubing used for sample collection and well development must be decontaminated by flushing with a minimum of one gallon of potable water; then flushing with a minimum of one pint of methanol and rinsing twice with distilled water.
- For pumps and tubing, perform a final rinse of the sampling equipment with the water being sampled.

3. Limitations

- Do not store the deionized/distilled water in polyethylene bottles, use Nalgene, glass, or Teflon. Polyethylene may leach phthalates.
- Do not attempt to decontaminate string or rope - replace it.
- Due to eye and skin absorption hazards, safety glasses and gloves must be worn when handling decontamination solvents.
- The decontamination procedure may require modification based on site specific conditions and methods used should not interfere with the site-specific chemical analyses. The procedure may also require modification based on state regulations.
- Steam cleaning with potable water is an acceptable decontamination method for drilling equipment (i.e., augers).
- If sampling for metals, the decontamination procedure requires modification to include rinsing with a 1:1 nitric acid and rinsing with deionized water in place of distilled water.
- Dedicated equipment need not be decontaminated beyond initial decontamination prior to field use.

4. References

Environmental Response Team (ERT), US EPA. Sampling Equipment Decontamination, SOP No. 2006, Revision 0.0. August 11, 1994.

US EPA Region 9. Sampling Equipment Decontamination, SOP No. 1230, Revision 1.September 1999.

5. Attachments

None

6. Contact

Brian Conte

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SOP No. QA-002
Revision No. 2
Effective Date: December 2008

STANDARD OPERATING PROCEDURE

QA-002 Field and Laboratory Quality Control Procedures

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1. Objective

Field Quality Control (QC) samples are used to monitor the reproducibility and representativeness of the field activities. The QC samples are handled, transported, and analyzed in the same manner as the associated field samples. QC samples may include trip blanks, field blanks, and field duplicates.

2. Execution

2.1. Trip blanks

- Used to monitor possible sources of contamination from transport, storage, inadequate bottle cleaning, or laboratory methodologies.
- Sample containers filled at the laboratory with analyte-free water, are transported to and from the site, and are not opened until time of analysis.
- Trip blanks are stored with the sample containers prior to and after field activities and remain with the collected samples until analyzed.
- Generally, one trip blank per volatile organic compound (VOC) shipment **AND** when sample shipment is by Fed Ex or other large carrier.

2.2. Field blanks

- Also called equipment blanks, are used to monitor the adequacy of decontamination procedures and possible sources of contamination from inadequate bottle cleaning or laboratory methodologies.
- Field blanks are samples collected by pouring laboratory supplied or distilled or deionized water through a decontaminated piece of field equipment.
- The water is then collected in a sample bottle(s) and stored with the associated field samples and submitted for analysis.
- Generally collected at a frequency of 1/20 samples and when non-dedicated sampling equipment is used. Check project-specific work plan and/or quality assurance project plan for required frequency.

2.3. Equipment Rinseate Blank

- Monitors on-site sampling environment, sampling equipment decontamination, sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions.

- Collect these blanks using sampling equipment that has been cleaned in the field (i.e., between sampling points). The cleaning procedures used for the blank collection must be identical to those used for the field sample collection.
- Prepare field-cleaned equipment blanks immediately after the equipment is cleaned in the field and before leaving the sampling site.
- Prepare equipment blanks by rinsing the sampling equipment set with the appropriate type of analyte-free water and collecting the rinse water in appropriate sample containers.
- For intermediate sampling devices or equipment, site-water rinsing is defined as the decontamination step, if this is the only cleaning that will be performed on the equipment prior to collecting the sample.
- In this case, collect the equipment blank after rinsing the intermediate device 3 times with site water
- Follow the site-water rinses with 3 rinses using analyte-free water.
- Collect the equipment blank with a subsequent rinse of the device using additional analyte-free water to collect sufficient blank volume.

2.4. Field Duplicates

- Used to evaluate the precision and representativeness of the sampling procedures.
- Field duplicates are two samples collected from the same location using the same procedures. Both samples are submitted to the laboratory as individual samples with different sample identification.
- Field duplicates from groundwater sampling are collected by alternating filling sample containers from the same sampling device. Volatile samples must be collected from the same bailer.
- Soil or sediment field duplicates are collected by homogenizing the sample for all analyses except volatiles. The homogenized sample is then divided into two equal portions and placed in separate sample containers. Field duplicates for volatile analysis are collected at two adjacent sampling locations.
- Each sample is assigned different sample identifications.
- Generally collected at frequency of 1/20 samples. Check project-specific work plan and/or quality assurance project plan for required frequency.
- All field QC samples should be labeled in the field and submitted “blind” to the laboratory.

2.5. Matrix-Spike samples (MS/MSD)

- Matrix spike and matrix spike duplicate samples (MS/MSDs) are environmental samples that are spiked in the laboratory or in the field with a known concentration of a target analyte(s) to verify percent recoveries.

- Matrix spike and matrix spike duplicate samples are primarily used to check sample matrix interferences. They can also be used to monitor laboratory performance. However, a data set of at least three or more results is necessary to statistically distinguish between laboratory performance and matrix interference.
- The minimum frequency of MS / MSDs should be 10 percent of the total number of samples being analyzed for the target analyte(s).
- Matrix spike and matrix spike duplicate samples are also used to evaluate error due to laboratory bias and precision.
- One MS/MSD pair per target analyte should be analyzed and the average percent recovery should be calculated to assess bias.
- To assess precision, at least eight matrix spike replicates from the same sample should be analyzed and the standard deviation and coefficient of variation should be determined.

2.6. Typical QA/QC Frequency

- All QA/QC frequency is site-specific and should be verified prior to sample collection

Duplicate Samples	Shall be collected at a frequency of one replicate soil sample per every twenty primary soil samples collected.
Equipment Blanks	Shall be collected at a rate of one per every type of non-dedicated sampling equipment.
Trip Blanks	Shall be collected every day soil samples are collected for volatile analyses.
Field Blanks	Shall be collected every day soil samples are collected for volatile analyses.
MS / MSDs	The laboratory shall be provided sufficient sample volume for select samples so that it can perform project-specific MS/MSD analyses at a rate of one per every 20 samples (project specific MS/MSD analysis is not required for projects in which less than 20 samples are collected).

3. Limitations

- At all times, follow safety procedures as defined in the site-specific Health and Safety Plan.
- Trip blanks must never be opened in the field.
- Trip blanks are usually for VOCs only because less volatile compounds are not likely to cross-contaminate other samples by simply being in close proximity.

- Water of documented quality must be used during the collection of field blanks.
- Field duplicates must have different sample identifications.

4. References

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (November 1986), U.S. Environmental Protection Agency Department of Solid Waste, Washington, D.C.

U.S. Environmental Protection Agency Office of Emergency and Remedial Response, 1990, Quality assurance/quality control guidance for removal activities: EPA/540/G-90/004, Sampling QA/QC Plan and Data Validation Procedures Interim Final, April, 1990.

5. Attachments

Attachment 1 - General Guidelines for selecting equipment on the basis of construction material and target analyte(s)

6. Contact

Brian Conte

Table 2. General Guidelines for selecting equipment on the basis of construction material and target analyte(s)

[✔, generally appropriate for use shown; Si, silica; Cr, chromium; Ni, nickel; Fe, iron; Mn, manganese; Mo, molybdenum; CFC, chlorofluorocarbon; B, boron]

Construction material for sampling equipment		**Target analyte(s)**	
Material	**Description**	**Inorganic**	**Organic**
		Plastics[1]	
Fluorocarbon ploymers[2] (other varies available for differing applications)	Chemically inert for most analytes	✔ (potential source of fluoride)	✔ (Sorption of some organics)
Polypropylene	Relatively inert for inorganic analytes	✔ (not appropriate for Hg)	**Do not use**
Polypropylene (linear)	Relatively inert for inorganic analytes	✔ (not appropriate for Hg)	**Do not use**
Polyvinyl chloride (PVC)	Relatively inert for inorganic analytes	✔ (not appropriate for Hg)	**Do not use**
Silicone	Very porous. Relatively inert for most inorganic analytes	✔ (potential source of Si)	**Do not use**
		Metals	
Stainless steel 316 (SS 316)	SS-316-metal having the greatest corrosion resistance. Comes in various grades. Used for submersible pump casing.	✔ (Potential source of Cr, Ni, Fe, and possible Mn and Mo) **Do not use** for surface water unless encasted in plastic.	✔ Do not use if corroded[3]
Stainless steel 304	Similar to SS-316, but less corrosion resistant	**Do not use**	✔ Do not use if corroded[3]
Other metals: brass, iron, copper, aluminum, galvanized and carbon steels	Refrigeration-grade copper or aluminum tubing are used routinely for collection of CFC samples	**Do not use**	✔ Routinely used for CFCs Do not use if corroded[3]
		Glass	
Glass, borosilicate (laboratory grade)	Relatively inert. Potential sorption of analytes	✔ **Do not use** for trace element analyses. Potential source of B and Si	✔

[1] Plastic used in connection with inorganic trace-element sampling should be uncolored or white. Tubing used for trace metal sampling should be cleaned by soaking in 5-10 percent HCl solution for 8-24 hours, rinsing with reagent water (metals free) and allowed to air dry in mercury-free environment. After drying, the tubing is doubled-bagged in clear polyethylene bags, serialized with a unique number, and stored until used.

[2] Fluorocarbon polymers include materials such as Teflon™, Kynar™, and Tefzel™ that are relatively inert for sampling inorganic or organic analytes. Only fluoropolymer should be used for samples that will analyzed for mercury because mercury vapors can diffuse in or out of other materials, resulting in either contaminated or biased results.

[3] Corroded/weathered surfaces are active sorption sites for organic compounds.

Appendix D

Quality Assurance Project Plan

Quality Assurance Project Plan

Hornell Former MGP Site

Hornell, New York
ACO #A9-0635-02-10
Site #8-51-032

Submitted to:
National Fuel Gas Distribution Corp.
6363 Main Street
Williamsville, NY 14221

Submitted by:
GEI Consultants, Inc.
1301 Trumansburg Road, Suite N
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August 2010
102260

Table of Contents

Table of Contents (cont.)

Tables

H:\TECH\project\National Fuel Gas - Hornell, NY 102260\SC Work Plan\QAPP\Hornell QAPP 8.4.10.docx

Abbreviations and Acronyms

ACO	Administrative Consent Order
ASP	Analytical Service Protocols
BGS	Below Ground Surface
CAS	Chemical Abstract Service
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (aka SuperFund)
CHMM	Certified Hazardous Materials Manager
CMS	Chip Measurement System
CLP	Contract Laboratory Protocol
COC	Chain-of-Custody
DQO	Data Quality Objective
DO	Dissolved Oxygen
DUSR	Data Usability Summary Report
ELAP	Environmental Laboratory Approval Program
GEI	GEI Consultants, Inc.
ICP	Inductively Coupled Plasma
ID	Identification
LCS	Labortory Control Sample
LEL	Lower Explosive Limit
LEP	Licensed Environmental Professional (Connecticut)
MDL	Method Detection Limit
MGP	Manufactured Gas Plant
MPH	Master of Public Health
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PAH	Polycyclic Aromatic Hydrocarbons
P.G.	Professional Geologist
PID	Photo-Ionization Detector
PM	Project Manager
PQL	Practical Quantification Limit
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RL	Reporting Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SC	Site Characterization
SD	Standard Deviation
SOP	Standard Operating Procedures
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List

TCLP	Toxicity Characteristic Leaching Procedure
TCN	Total Cyanide
TIC	Tentatively Identified Compound
U.S. DOT	United States Department of Transporation
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

Quality Assurance Glossary

“Analytical Services Protocol” or “ASP” means the NYSDEC’s compendium of approved U.S. EPA and NYSDEC laboratory methods for sample preparation and analysis and data handling procedures.

“Confirmatory Sample” means a sample taken after remedial action is expected to be complete to verify that the cleanup requirements have been met. This term has the same meaning as “post remediation sample.”

“Contract laboratory program” or “CLP” means a program of chemical analytical services developed by the U.S. EPA to support Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (aka SuperFund) (CERCLA).

“Data Usability Summary Report, (DUSR)” is a document that provides a thorough evaluation of the analytical data to determine whether or not the data, as presented, meets the site/project specific criteria for data quality and use.

“Effective solubility” means the theoretical aqueous solubility of an organic constituent in groundwater that is in chemical equilibrium with a separate phase mixed product (product containing several organic chemicals). The effective solubility of a particular organic chemical can be estimated by multiplying its mole fraction in the product mixture by its pure phase solubility.

“Environmental Laboratory Accreditation Program” or “ELAP” means a program conducted by the NYSDOH, which certifies environmental laboratories through on-site inspections and evaluation of principles of credentials and proficiency testing.

“Intermediate Sample” means a sample taken during the investigation process that will be followed by another sampling event to confirm that remediation was successful or to confirm that the extent of contamination has been defined to below a level of concern.

“Method detection limit” or “MDL” means the minimum concentration of a substance that can be measured and reported with a 99 percent confidence that the analyte concentration is greater than zero and is determined from the analysis of a sample in a given matrix containing the analyte.

“Non-targeted compound” means a compound detected in a sample using a specific analytical method that is not a targeted compound, a surrogate compound, a system monitoring compound or an internal standard compound.

“Practical quantitation level” or “PQL” means the lowest quantitation level of a given analyte that can be reliably achieved among laboratories within the specified limits of precision and accuracy of a given analytical method during routine laboratory operating conditions.

“PAH” means polycyclic aromatic hydrocarbon as defined by U.S. EPA Method 8270.

“Quality assurance” means the total integrated program for assuring the reliability of monitoring and measurement data, which includes a system for integrating the quality planning, quality assessment and quality improvement efforts to meet data end-use requirements.

“Quality assurance project plan” or “QAPP” means a document, which presents in specific terms the policies, organization, objectives, functional activities, and specific quality assurance/quality control activities designed to achieve the data quality goals or objectives of a specific project or operation.

“Quality control” means the routine application of procedures for attaining prescribed standards of performance in the monitoring and measurement process.

“Semi-Volatile organic compound” means compounds amenable to analysis by extraction of the sample with an organic solvent. For the purposes of this section, semi-volatiles are those target compound list compounds identified in the statement of work in the current version of the U.S. EPA “*Contract Laboratory Program*.”

“Target analyte list” or “TAL” means the list of inorganic compounds/elements designated for analysis as contained in the version of the U.S. EPA “*Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration*,” in effect as of the date on which the laboratory is performing the analysis. For the purpose of this chapter, a Target Analyte List scan means the analysis of a sample for Target Analyte List compounds/elements.

“Targeted compound” means a hazardous substance, hazardous waste, or pollutant for which a specific analytical method is designed to detect that potential contaminant both qualitatively and quantitatively.

"Target compound list plus 30" or "TCL+30" means the list of organic compounds designated for analysis (TCL) as contained in the version of the U.S. EPA "*Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration*," in effect as of the date on which the laboratory is performing the analysis, and up to 30 non-targeted organic compounds (plus 30) as detected by gas chromatography/mass spectroscopy (GC/MS) analysis. For the purposes of this chapter, a Target Compound List+30 scan means the analysis of a sample for Target Compound List compounds and up to 10 non-targeted volatile organic compounds and up to 20 non-targeted semi-volatile organic compounds using GC/MS analytical methods. Non-targeted compound criteria should be pursuant to the version of the U.S. EPA "*Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration*," in effect as of the date on which the laboratory is performing the analysis.

"Tentatively identified compound" or "TIC" means a non-targeted compound detected in a sample using a GC/MS analytical method which has been tentatively identified using a mass spectral library search. An estimated concentration of the TIC is also determined.

"Unknown compound" means a non-targeted compound which cannot be tentatively identified. Based on the analytical method used, the estimated concentration of the unknown compound may or may not be determined.

"Volatile organics" means organic compounds amenable to analysis by the purge and trap technique. For the purposes of this chapter, analysis of volatile organics means the analysis of a sample for either those priority pollutants listed as amenable for analysis using U.S. EPA method 624 or those target compounds identified as volatiles in the version of the U.S. EPA "*Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration*," in effect as of the date on which the laboratory is performing the analysis.

"**Waste oil"** means used and/or reprocessed engine lubricating oil and/or any other used oil, including but not limited to: fuel oil, engine oil, gear oil, cutting oil, transmission fluid, oil storage tank residue, animal oil and vegetable oil, which has not subsequently been refined.

1. Purpose

GEI Consultants, Inc. (GEI) has prepared this Quality Assurance Project Plan (QAPP) to address the investigation of the Hornell Former Manufactured Gas Plant (MGP) site located in Hornell, New York. The QAPP is a companion document to the "*Hornell Former MGP Site Characterization Work Plan,*" dated July 2010 (Work Plan) that was prepared by GEI. The project location is shown on Figure 1 of the Work Plan. The QAPP presents the project scope and goals, organization, objectives, sample handling procedures and specific quality assurance/quality control (QA/QC) procedures associated with the Hornell Former MGP Site Characterization.

Furthermore, this QAPP identifies project responsibilities, prescribes guidance and specifications to make certain that:

- Samples are identified and controlled through sample tracking systems and chain-of-custody (COC) protocols;
- Field and laboratory analytical results are valid and usable by adherence to established protocols and procedures;
- Laboratory data are validated so they can be applied to developing a conceptual understanding of the nature and extent of contamination of soils and groundwater at the Hornell Former MGP site; and
- All aspects of the investigation, from field to laboratory are documented to provide data that are technically sound and legally defensible.

The requirements of this QAPP apply to all contractor activities as appropriate for their respective tasks.

This QAPP was prepared based upon guidance provided by the United States Environmental Protection Agency (U.S. EPA) and New York State Department of Environmental Conservation (NYSDEC) including:

- *"DER-10, Technical Guidance for Site Investigation and Remediation,"* New York State Department of Environmental Conservation, May 2010.

2. Project Goals and Objectives

National Fuel Gas Distribution Corporation (National Fuel Gas) is conducting a Site Characterization (SC) at the Hornell Former MGP Site (Site) in Hornell, New York. This SC was prepared to investigate the potential impacts to the Site from the operation of the Hornell Former MGP Site that was used to manufacture and subsequently distribute gas from approximately 1887 until the early 1950s.

The scope of the SC is presented in the Hornell Former MGP Site Characterization Work Plan dated July 2010. The SC will include the following tasks:

- Preliminary site visit;
- Field investigation preparation and mobilization activities;
- Field investigation sampling and analysis;
- Qualitative Human Health Risk Assessment;
- Survey and sample point location;
- Quality assurance/quality control and data validation; and
- SC Report preparation.

The completion of these tasks will help meet the objectives of characterizing the geology of surface and subsurface soils and characterizing the groundwater quality with the ultimate goal of evaluating if the former gas plant operations impacted the soils and groundwater at the site.

3. Project Organization and Responsibility

GEI is responsible for the implementation of the SC Work Plan scope of work, including the supervision of contractors, field activities, and the evaluation and interpretation of data. GEI will direct the sampling activities and coordinate submittal of samples to testing laboratories. The project organization and key personnel for GEI are listed below:

Program Manager: David Terry, P.G. LEP
Project Manager/Field Team Leader: Jennifer Sandorf, P.G. / Drew Blicharz
Senior Geologist: Bruce Coulombe, P.G.
Quality Assurance Officer: Bruce Coulombe, P.G.
GEI Corporate Health & Safety Officer: Robin B. DeHate, MPH, PhD(c), CHMM
Data Validators: Lorie MacKinnon, Lisa McDonough
Data Manager: Karen Swartz

The primary responsibilities of each of these personnel are described in the following table.

Key Project Personnel and Responsibilities

Position	GEI Personnel	Areas of Responsibilities
In-House Consultant	Dennis Unites	▪ Provide strategic guidance of project activities ▪ Client contact regarding strategic issues ▪ Review of project deliverables
Program Manager	David Terry	▪ Overall program oversight ▪ Project management ▪ Project schedule ▪ Client contact regarding project related issues ▪ Personnel and resource management ▪ Review of project submittals ▪ Budgeting
Investigation Manager/ Field Team Leader	Jennifer Sandorf / Drew Blicharz	▪ Client contact regarding project related issues on day to day basis as part of field operations ▪ Coordination of contractors ▪ Technical development and implementation of Work Plan ▪ Personnel and resource management ▪ Preparation and review of project submittals ▪ Preparation of project submittals ▪ Budgeting
Senior Geologist/Project Manager (PM)	Bruce Coulombe	▪ Project management ▪ Client contact regarding project related issues on day to day basis ▪ Personnel and resource management ▪ Preparation and review of project submittals ▪ Preparation of project submittals ▪ Budgeting

Key Project Personnel and Responsibilities		
Position	**GEI Personnel**	**Areas of Responsibilities**
Quality Assurance Officer (QAO)	Lorie MacKinnon	▪ QA/QC for sampling and laboratory performance
Data Validators	Lorie MacKinnon Lisa McDonaugh	▪ Perform data validation activities ▪ Prepare data usability summary reports ▪ Evaluate data with regards to quality objectives
Data Managers	Karen Swartz	▪ Manage raw data from the laboratory

TestAmerica Laboratories (TestAmerica) Inc., located in Shelton, Connecticut, is tentatively selected to perform the following standard analytical chemistry parameters for surface soils, subsurface soil, and groundwater samples including:

- Target Compound List (TCL) volatile organic compounds (VOCs) according to U.S. EPA Method 8260B;
- TCL semi-volatile organic compounds (SVOCs) according to U.S. EPA Method 8270C;
- Target Analyte List (TAL) Metals according to U.S. EPA Method 6000/7000 series
- Total Cyanide (TCN) according to U.S. EPA Method 9012;
- Free Cyanide according to U.S. EPA Method 9013 extraction and micro-diffusion analysis ASTM Method D-4282-02; and
- Disposal Parameters (Toxicity Characteristic Leaching Procedure (TCLP) ZHE extraction, TCLP VOC, TCLP SVOC, TCLP ICP Metals, ignitability, corrosivity, reactivity).

TestAmerica's relevant certifications are summarized in the following table:

TestAmerica Laboratories (TestAmerica) Certifications		
Location	Responsible Agency	Certification
New York	New York State Department of Health (NYSDOH)	Environmental Laboratory Approval Program (ELAP) for potable water/non-potable water, solid and hazardous waste) Contract Laboratory Protocol (CLP)
	New York State Department of Conservation	Analytical Service Protocol (ASP)
United States	United States Environmental Protection Agency	CLP-Lab:10602 [VOCs/ SVOCs/ Inorganics]

Tables 1 and 2 provide a summary of analysis by media (subsurface soil and groundwater). Table 3 provides a summary of quality assurance samples, holding times and analysis for each media.

GeoLogic, located in Homer, New York, was identified as a potential resource to complete subsurface soil boring installation and sampling activities.

4. Quality Assurance Objectives

This section establishes the QA objectives for measurements that are critical to the project. The QA objectives are developed for relevant data quality indicators. These indicators include the method detection limit, reporting limit, precision, accuracy, completeness, representativeness, and comparability. The data quality objectives (DQOs) are based on project requirements and ensure: (1) that the data generated during the project are of known quality and (2) that the quality is acceptable to achieve the project's technical objectives provided in the Work Plan. All analytical data will be provided by the laboratory using the New York State ASP Category B deliverable format.

Quantitation Limits are laboratory-specific and reflect those values achievable by the laboratory performing the analyses. However, in order to ensure that the analytical methodologies are capable of achieving the DQOs, measurement performance criteria have been set for the analytical measurements in terms of accuracy, precision, and completeness. The analytical methods to be used at this site will provide a level of data quality and can be used to evaluate potential impacts to soil and groundwater from the former holder operation, compared to New York State Standards, Criteria and Guidance values, and also for purposes of risk assessment.

The overall QA objective is to develop and implement procedures for field sampling, COC, laboratory analysis, and reporting which will provide results that are scientifically valid, and the levels of which are sufficient to meet DQOs. Specific procedures for sampling, COC, laboratory instruments calibration, laboratory analysis, reporting of data, internal quality control, and corrective action are described in other sections of the QAPP.

The data quality indicators are presented in subsections 4.1 through 4.6. Procedures to assess the data quality indicators are given below in Section 13.

4.1 Required Quantification Limit

The required quantification limit is the quantitative analytical level for individual analytes needed to make decisions relative to the objectives of the project. Quantitative limits may be expressed as the method detection limit or some quantitative level defined in terms relative to the program. It should be noted that there is some ambiguity in the definitions and use of terms that define quantification limits. The method detection limit (MDL) presented herein is a well-defined and accepted entity, although attainable only under ideal laboratory conditions.

Method Detection Limit: The MDL is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. MDL is determined from analysis of a sample in a given matrix type containing the analyte.

Practical Quantitation Limit: The practical quantitation limit (PQL) [also referred to as the reporting limit (RL)] is the concentration in the sample that corresponds to the lowest concentration standard of the calibration curve.

Laboratory MDLs and PQLs for soils, groundwater, and soil vapor/indoor air are located on Tables 5, 6, and 7, respectively.

4.2 Accuracy

Accuracy is the closeness of agreement between an observed value and an accepted reference value. The difference between the observed value and the reference value includes components of both systematic error (bias) and random error.

Accuracy in the field is assessed through the adherence to all field instrument calibration procedures, sample handling, preservation, and holding time requirements, and through the collection of equipment blanks prior to the collection of samples for each type of equipment being used (e.g., sample liners, drilling shoe, or stainless-steel sampling implements).

The laboratory will assess the overall accuracy of their instruments and analytical methods (independent of sample or matrix effects) through the measurement of “standards,” materials of accepted reference value. Accuracy will vary from analysis to analysis because of individual sample and matrix effects. In an individual analysis, accuracy will be measured in terms of blank results, the percent recovery (%R) of surrogate compounds in organic analyses, or %R of spiked compounds in matrix spikes (MSs), matrix spike duplicates (MSDs) and/or laboratory control samples (LCSs). This gives an indication of expected recovery for analytes tending to behave chemically like the spiked or surrogate compounds. The laboratory accuracy will be evaluated in accordance with the laboratory’s Quality Assurance Manual and standard operating procedures which can be supplied upon request.

4.3 Precision

Precision is the agreement among a set of replicate measurements without consideration of the “true” or accurate value: i.e., variability between measurements of the same material for the same analyte. In environmental sampling, precision is the result of field sampling and analytical factors. Precision in the laboratory is easier to measure and control than precision in the field. Replicate laboratory analyses of the same sample provide information on analytical precision; replicate field samples provide data on overall measurement precision.

The difference between the overall measurement precision and the analytical precision is attributed to sampling precision. Precision is measured in a variety of ways including statistically, such as calculating variance or standard deviation. The difference between the overall measurement precision and the analytical precision is attributed to sampling precision.

Precision in the field is assessed through the collection and measurement of field duplicates. Field duplicates will be collected at a frequency of one per twenty investigative samples per matrix per analytical parameter, with the exception of the waste characterization parameters. Precision will be measured through the calculation of relative percent differences (RPDs) as described below in subsection 13.2. The resulting information will be used to assess sampling and analytical variability. Duplicate samples are described in below in subsection 5.1.5. Table 3 summarizes the number of duplicates per media sampled.

Precision in the laboratory is assessed through the calculation of RPD for duplicate samples. For organic analyses, laboratory precision will be assessed through the analysis of MS/MSD samples and field duplicates. For the inorganic analyses, laboratory precision will be assessed through the analysis of matrix duplicate pairs and field duplicate pairs. MS/MSD samples or matrix duplicate pairs will be performed at a frequency of one per twenty primary samples per matrix. Duplicate samples are described in below in subsection 5.1.5. Table 3 summarizes the number of duplicates per media sampled

4.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. “Normal conditions” are defined as the conditions expected if the sampling plan was implemented as planned. The objective for completeness is a sufficient amount of valid data to achieve a predetermined statistical level of confidence. Critical samples must be identified and plans must be formulated to secure requisite valid data for these samples.

Field completeness is a measure of the amount of (1) valid measurements obtained from all the measurements taken in the project and (2) valid samples collected. The field completeness objective is greater than 90 percent.

Laboratory completeness is a measure of the amount of valid measurements obtained from all valid samples submitted to the laboratory. The laboratory completeness objective is greater than 95 percent.

To ensure that these percentages are met, materials for crucial parameters will be retained if re-sampling is required and strict adherence to holding times will be required.

4.5 Representativeness

Representativeness is a qualitative parameter that expresses the degree to which data accurately and precisely represents either 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. To ensure representativeness, the sampling locations have been selected to provide coverage over a wide area and to highlight potential trends in the data.

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the Work Plan is followed and that proper sampling, sample handling, and sample preservation techniques are used.

Representativeness in the laboratory is ensured by using the proper analytical procedures, appropriate methods, and meeting sample-holding times. A copy of TestAmerica Laboratory's Quality Assurance Manual can be supplied upon request.

4.6 Comparability

Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared to another. Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the Work Plan is followed and that proper sampling techniques are used. Maximization of comparability with previous data sets is expected because the sampling design and field protocols are consistent with those previously used.

Comparability is dependent on the use of recognized U.S. EPA or equivalent analytical methods and the reporting of data in standardized units. To facilitate data comparison, the data-reporting format as presented below will be used:

- Conventions (units reported as): for solids (weight/unit weight [i.e., mg/kg]); for liquids (weight/unit volume [i.e., mg/L]); for air (weight/unit volume [i.e., mg/m^3]).
- Use common chemical name with corresponding chemical abstract service (CAS) code.
- Report all data for soils on a dry-weight basis.

5. Sampling Plan

Environmental sampling will include subsurface soil, surface soil, groundwater and waste characterization sampling. Direct push drilling (Geoprobe®) will be the preferred method for obtaining subsurface soil samples. Groundwater samples will be collected utilizing low-flow sampling methods, peristaltic pumps, bailers, whale pumps, or bladder pumps. Performing grab or composite sampling by appropriate hand-held sampling equipment will be the preferred method for waste characterization sampling. Analytical samples and analysis methods are described in the Work Plan. Sampling methods and procedures are described in the Standard Operating Procedures (SOPs) found in the Work Plan.

5.1 Sample Type, Location, and Frequency

5.1.1 Subsurface Soil Samples

Nine (9) subsurface sample locations will be sampled using Geoprobe® drilling methods. If difficult drilling conditions are encountered, alternative drilling methods such as hollow stem auger drilling methods may be considered. The borings will be drilled to at approximately 30 feet bgs (below ground surface). The actual number of subsurface soil samples and their location may be modified based upon subsurface utilities and property access. The number and location of samples will vary based upon access and subsurface obstructions. Soils will be evaluated through visual, olfactory, and field screening observations in accordance with the SOPs. Soil samples will be collected and submitted for laboratory analysis in general accordance with the Work Plan. A summary of subsurface soil samples and analysis are located on Table 1.

5.1.2 Groundwater samples

Four (4) monitoring well samples will be collected. The four monitoring wells will be sampled using low-flow methods. Groundwater samples will be collected from wells screened across the water table at the proposed sample locations. Groundwater samples will be collected and submitted for laboratory analysis in general accordance with the Work Plan. Water quality parameters including temperature, pH, turbidity, dissolved oxygen (DO), and specific conductance, will be collected prior to laboratory analysis in general accordance with the Work Plan. A summary of groundwater samples and analysis are located on Table 2.

5.1.3 Soil Vapor Samples

One soil vapor sample will be installed and a sample will be collected in general accordance with the New York State Department of Health's "*Guidance for Evaluating Soil Vapor Intrusion in the State of New York*." Within buildings, sub-slab soil vapor points will be installed to evaluate the soil vapor conditions. Soil vapor samples will be collected in certified clean SUMMA® canisters and submitted for laboratory analysis in general accordance with the Work Plan. A summary of the soil vapor sample is located on Table 3.

5.1.4 Ambient Air Samples

One indoor air sample and one outdoor ambient air sample are proposed to be collected as part of the Hornell Work Plan. The ambient air samples will be used to assess the potential for soil vapor intrusion into the building. The proposed locations are shown on Figure 4 of the Work Plan.

The proposed ambient air samples will be collected from the approximate breathing height (approximately 3 to 5 feet above ground). The indoor air and outdoor air samples will be collected utilizing an individually certified 6-Liter SUMMA® canister with a laboratory-supplied flow controller that is calibrated to an 8-hour period. The regulator flow rate will not exceed 0.2 liters per minute. Each SUMMA® canister will be shipped to an approved-NYSDOH ELAP registered laboratory for analysis. The samples will be analyzed for VOCs and naphthalene by the modified U.S. EPA Method TO-15.

5.1.5 Investigation-Derived Waste Sample Collection

Waste classification sampling will be conducted for soils and liquid wastes. The purpose of characterizing a waste is for its proper off-site disposal. Composite samples will be collected from the on-site waste storage vessels (drums or roll-off) for parameters required by the approved disposal facility. Soil samples will be collected utilizing stainless steel sampling tools, shovel, or auger that had been decontaminated. Liquid samples will be collected utilizing disposable bailer, peristaltic pump, a pump with tubing, or other similar methods. These samples will be handled in general accordance with sample handling procedures presented in the SOPs. Investigation derived waste samples will be analyzed for parameters listed in Section 3 or other analyses that are required by the National Fuel Gas-approved facility.

5.1.6 Field QC Sample Collection

Field QC samples are used to monitor the reproducibility and representativeness of field sampling activities. The field QC samples are handled transported and analyzed in the same manner as the associated field samples. Field QC samples will include equipment blanks, trip blanks, field duplicates and MS/MSDs. The quantity, field QC sample type and analysis are detailed on Table 4.

Equipment Blank Samples are used to monitor the adequacy of decontamination procedures and possible sources of contamination such as potential laboratory methodologies. Equipment blanks will consist of laboratory-supplied, distilled or de-ionized water and will be used to check for potential contamination of the equipment, which may cause sample contamination. Equipment blanks will be collected by routing the distilled water through decontaminated piece of sampling equipment or disposable sampling equipment into laboratory supplied bottles. Non-dedicated field equipment will be decontaminated as specified below in subsection 4.3. Equipment blanks will be submitted to the laboratory at a frequency of one per 20 samples per matrix per type of equipment being used per parameter. Equipment blanks will not be completed for waste characterization sampling activities.

Trip Blank Samples will consist of analyte free water and will be prepared by the laboratory. (Trip blanks are used to assess the potential for VOC contamination of samples due to contaminant migration during sample shipment and storage. Trip blanks will be transported to the project location unopened, stored with the site characterization samples, and kept closed until analyzed by the laboratory. Trip blanks will be submitted to the laboratory at a frequency of one per cooler which contains samples submitted for VOC analysis.

Field Duplicate Samples, also referred to as blind duplicate samples, are two samples that are submitted from the same interval using the same sample procedures. Field duplicates will be used to assess the sampling and analytical reproducibility. Both samples are collected utilizing the same methods and are submitted for the same laboratory analysis however different sample identification numbers are used. Field duplicates will be submitted at a frequency of one per 20 samples for all matrices and all parameters. Field duplicates will not be completed for waste characterization sampling activities.

MS/MSD Samples are two additional aliquots of the same sample submitted for the same parameters as the original sample. However, the additional aliquots are spiked with the compounds of concern. Matrix spikes provide information about the effect of the sample matrix on the measurement methodology. MS/MSDs will be submitted at a frequency of one per 20 investigative samples per matrix for organic and inorganic parameters. MS/MSDs will not be completed for waste characterization sampling activities.

Refer to Table 4 for a summary of QC sample preservation and container requirements.

5.2 Sample Preservation and Containerization

The analytical laboratory will supply the sample containers for the chemical samples. These containers will be cleaned by the manufacturer to meet or exceed all analyte specifications established in the latest U.S. EPA's Specifications and Guidance for Contaminant-Free Sample Containers. Certificates of analysis are provided with each bottle lot and maintained on file to document conformance to U.S. EPA specifications. The containers will be pre-preserved, where appropriate (Table 4).

5.3 Equipment Decontamination

All non-dedicated sampling equipment shall be cleaned between each use in the following manner:

- Wash/scrub with a biodegradable degreaser ("Simple Green") if there is oily residue on equipment surface;
- Tap water rinse;
- Wash and scrub with Alconox (or non-phosphate soap) and water mixture;
- Tap water rinse;
- All equipment used to collect samples for VOCs and SVOC analysis will then receive a methanol rinse followed by a de-ionized water rinse;
- All equipment used to collect samples for metals analysis will then receive a 10% nitric acid solution rinse followed by a de-ionized water rinse; and
- Equipment will be wrapped in polyethylene plastic or aluminum foil for storage or transportation from the designated decontamination area to the sampling location, where appropriate.

The drilling equipment will be decontaminated in general accordance with methods described in the SOPs.

Decontamination fluids will be containerized into United States Department of Transportation (U.S. DOT)/UN-approved 55-gallon drums or containment vessels and will be characterized and disposed of by National Fuel Gas at an approved disposal facility.

6. Documentation and COC

6.1 Sample Collection Documentation

6.1.1 Field Notes

Field notes documenting field activities will be maintained in a field notebook in general accordance with the SOPs. Field logbooks will provide the means of recording the chronology of data collection activities performed during the investigation. The logbook will be a bound notebook with water-resistant pages. Logbook entries will be dated, legible, and contain accurate and inclusive documentation of the activity. Each page of the logbook will be signed in permanent ink and dated. No erasures or obliterations of field notes will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, which is signed and dated by the sampler. The correction shall be written adjacent to the error.

Field logbooks will be reviewed at regular intervals by the field team leader, site manager and project manager for completeness and representativeness. Logbooks will be supported by daily activity reports as described in the SOPs.

6.1.2 COC Records

Sample custody is discussed in detail below in subsection 6.2. The samplers in the field initiate COC records. The field portion of the custody documentation should include:

- The project name;
- Signature(s) of sampler (s) responsible for sample custody;
- Sample ID number;
- Date and time of collection;
- Whether the sample is grab or composite;
- Names of individuals involved in sampling; and
- Air bill or other shipping number (if applicable).

On a regular basis (daily or on such a basis that all holding times will be met), samples will be transferred to the custody of the respective laboratories, via third-party commercial carriers or via laboratory courier service. Sample packaging and shipping procedures, and field COC procedures are described below in subsection 6.2.1 of this Plan. Sample receipt and log-in procedures at the laboratory are described below in subsection 6.2.2 of this Plan.

6.1.3 Sample Labeling

Each sample will be labeled with a pre-printed adhesive label using indelible ink. The label should include the date and time of collection, sampler's initials, tests to be performed, preservative (if applicable), and a unique identification. The following identification scheme will be used:

PRIMARY SAMPLES TYPES	QA/QC SAMPLE TYPES
SOIL SAMPLES Boring -ID (SAMPLE DEPTH-FEET) SB-1 (10-15) **GROUNDWATER SAMPLES** Monitoring Well-ID MW-1	**FIELD BLANKS** SAMPLE-ID – [DATE] MW-FB071310 GW-FB071310 FB071310 **MATRIX SPIKE/DUP** SAMPLE [ID] [DEPTH] [EITHER MS OR MSD] MW-1 (10-15) MS/MSD GW-1 (10-15) MS/MSD **TRIP BLANKS** SAMPLE- ID [DATE] TB071310 **BLIND DUPLICATES** SAMPLE -ID[XX][DATE] MW-XX-071310 GW-XX-071310 DUP071310

This sample label contains the authoritative information for the sample. Inconsistencies with other documents will be settled in favor of the vial or container label unless otherwise corrected in writing from the field personnel collecting samples or the Data Manager and/or the GEI Project QA Officer.

6.1.4 Sample Handling

Samples will be handled in general accordance with the SOPs.

6.2 Sample Custody

The COC provides a record of the custody of any environmental field sample from the time of collection to the delivery to the laboratory. Custody is one of several factors that are necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files.

A sample is considered to be under a person's custody if

- The item is in the actual possession of a person
- The item is in the view of the person after being in actual possession of the person
- The item was in the actual physical possession of the person but is locked up to prevent tampering
- The item is in a designated and identified secure area

6.2.1 Field Custody Procedures

Samples will be collected following the sampling procedures indicated in the Work Plan and the SOPs. A summary of samples and collection methods are provided above in Section 5 of this QAPP. Documentation of sample collection is described above in subsection 6.1. Sample COC and packaging procedures are summarized below. These procedures will ensure that the samples will arrive at the laboratory with the COC intact.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or dispatched properly. Field procedures have been designed such that as few people as possible will handle the samples.
- All bottles will be identified by the use of sample labels with sample numbers, sampling locations, date/time of collection, and type of analysis. The sample numbering system is presented above in subsection 6.1.3.
- Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions.
- Samples will be accompanied by a completed COC form. The sample numbers and locations will be listed on the COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents the transfer of custody of samples from the sampler to another person, to a mobile laboratory, and to the laboratory facility.
- All shipments will be accompanied by the COC record identifying the contents. The original record will accompany the shipment, and copies will be retained by the sampler and placed in the project files.
- Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be secured with strapping tape and custody seals for shipment to the laboratory. The custody seals will be attached to the cooler and covered with clear plastic tape after being signed by field personnel.
- If the samples are sent by common carrier, the air bill will be used. Air bills will be retained as part of the permanent documentation. Commercial carriers are not required to sign off on the custody forms since the custody forms will be sealed inside the sample cooler and the custody seals will remain intact.
- Samples remain in the custody of the sampler until transfer of custody is completed. This consists of delivery of samples to the laboratory sample custodian, and signature

of the laboratory sample custodian on COC document as receiving the samples and signature of sampler as relinquishing samples.

6.2.2 Laboratory Custody Procedures

After accepting custody of the shipping containers, the laboratory will document the receipt of the shipping containers by signing the COC record. The laboratory will:

- Examine the shipping containers to verify that the custody tape is intact;
- Examine all sample containers for damage;
- Determine if the temperature required for the requested testing program has been maintained during shipment and document the temperature on the COC records;
- Compare samples received against those listed on the COC;
- Verify that sample holding times have not been exceeded;
- Examine all shipping records for accuracy and completeness;
- Determine sample pH (if applicable) and record on COC forms;
- Sign and date the COC immediately (if shipment is accepted) and attach the air bill;
- Note any problems associated with the coolers and/or samples on the cooler receipt form and notify the laboratory project manager, who will be responsible for contacting the GEI data manager;
- Attach laboratory sample container labels with unique laboratory identification and test; and
- Place the samples in the proper laboratory storage.

Following receipt, samples will be logged in according to the following procedure:

- The samples will be entered into the laboratory tracking system. At a minimum, the following information will be entered: project name or identification, unique sample numbers (both client and internal laboratory), type of sample, required tests, date and time of laboratory receipt of samples, and field ID provided by field personnel.
- The completed COC, air bills, and any additional documentation will be placed in the final evidence file.

7. Calibration Procedure

7.1 Field Instruments

Field instruments will be calibrated according to the manufacturer's specifications. Air monitoring instruments will be calibrated to a known reference gas standard and ambient air outside the work zone. Calibration will be completed daily. If concentrations of VOCs are encountered above the reference gas standard, the soil screening photoionization detectors (PIDs) may be calibrated or re-checked against the reference gas standard. Water quality meters will be calibrated with known reference solutions. All calibration procedures performed will be documented in the field logbook and will include the date/time of calibration, name of person performing the calibration, reference standard used, and the readings. The following equipment has been identified for use to implement the Work Plan.

Subsurface Soil Sampling Activities:

- RAE Systems MultiRAE Plus equipped with VOC (10.6 eV lamp), lower explosive limit (LEL), percent oxygen, hydrogen sulfide and hydrogen cyanide;
- RAE Systems MiniRAE 2000 PID with 10.6 eV lamp;
- Draeger Chip Measurement System (CMS) and compound specific chips (including benzene, hydrogen sulfide, hydrogen cyanide, etc.);
- MIE pDR 1200 with cyclone and pump [particulate monitor];
- MSA LC Pump or SKC 224-PCXR4 [air pump for dust monitoring]; and
- BIOS Dry Cal DC Lite Primary Flow Meter Model ML [air pump calibration].

Groundwater Sampling Activities:

- In-Situ Multi-Parameter Troll 9000;
- YSI 6280 XLM water quality meter; and
- Horiba U-52 water quality meter.

Similar field equipment can be substituted that perform the same functions can be substituted if selected equipment is not available from equipment supplier.

7.2 Laboratory Instruments

Calibration procedures for a specific laboratory instrument will consist of initial calibrations, initial calibration verifications, and/or continuing calibration verification. Detailed descriptions of the calibration procedures for a specific laboratory instrument are included in the laboratory's quality assurance plan, which describe the calibration procedures, their frequency, acceptance criteria, and the conditions that will require recalibration. These procedures are as required in the respective analytical methodologies summarized in Tables 1 through 4 of this QAPP.

8. Sample Preparation and Analytical Procedures

Analytical samples will be collected in general accordance with the SOPs and as specified in the Work Plan. Tables 1 through 3 provide a sample collection matrix that is separated by media. Analytical samples will be collected into laboratory-preserved sample containers and will be preserved as indicated in Table 4.

9. Data Reduction, Validation, and Reporting

Appropriate QC measures will be used to ensure the generation of reliable data from sampling and analysis activities. Proper collection and organization of accurate information followed by clear and concise reporting of the data is a primary goal in this project. Complete data packages suitable for data validation to support the generation of a Data Usability Summary Report (DUSR) according to NYSDEC requirements will be provided by the analytical laboratory.

9.1 Field Data Evaluation

Measurements and sample collection information will be transcribed directly into the field logbook or onto standardized forms. If errors are made, results will be legibly crossed out, initialed and dated by the person recording the data, and corrected in a space adjacent to the original (erroneous) entry. Reviews of the field records by the field team leader, site manager, and project manager will ensure that:

- Logbooks and standardized forms have been filled out completely and that the information recorded accurately reflects the activities that were performed.
- Records are legible and in accordance with good record keeping procedures, i.e., entries are signed and dated, data are not obliterated, changes are initialed, dated, and explained.
- Sample collection, handling, preservation, and storage procedures were conducted in accordance with the protocols described in the SOPs and Work Plan, and that any deviations were documented and approved by the appropriate personnel.

9.2 Analytical Data Validation

GEI will be responsible for performing an independent validation of the analytical data. Project-specific procedures will be used to validate analytical laboratory data. The basis for the validation will be the "*U.S. EPA CLP National Functional Guidelines for Organic Data Review*," dated January 2005, and the "*U.S. EPA CLP National Functional Guidelines for Inorganic Data Review*," dated October 2004, modified to accommodate the criteria in the analytical methods used in this program, and "*Region II Standard Operating Procedures (SOPs) for CLP Organic Data review*," (Revision 11, June 1996) and "*Evaluation of Metals for the CLP Program*," (Revision 11, January 1992). Critical functions for determining the validity of generated data are: (1) strict adherence to the analytical methods, (2) assurance that the instrumentation employed was operated in accordance with defined operating procedures, (3) assurance that quality parameters built into the analytical procedures have been adhered to, and (4) confirmation that the DQOs have been met.

Table 4 highlights the QC criteria and holding time requirements for all analyses conducted under this program. These criteria will be used to evaluate and qualify the data during validation.

GEI or qualified contracted personnel will validate all analytical samples collected as part of the Hornell Former MGP Site Characterization. Samples collected for waste classification will not be validated. Validation will include all technical holding times, as well as QC sample results (blanks, surrogate spikes, laboratory duplicates, MS/MSDs, and LCSs), tunes, internal standards, calibrations, target compound identification, and results calculations.

For all analyses, the laboratory will report results that are below the laboratory's reporting limit; these results will be qualified as estimated (J) by the laboratory. The laboratory may be required to report tentatively identified compounds (TICs) for the VOC and SVOC analyses; this will be requested by GEI on an as-needed basis

The overall completeness of the data package will also be evaluated by the data validator. Completeness checks will be administered on all data to determine whether full data deliverables were provided. The reviewer will determine whether all required items are present and request copies of missing deliverables.

Upon completion of the validation, a DUSR will be prepared. This report will summarize the samples reviewed, elements reviewed, any nonconformance with the established criteria, and validation actions. Data qualifiers will be consistent with U.S. EPA National Functional Guidelines.

9.3 Analytical Data Validation

Laboratory deliverables will consist of an original hard copy data package that is in general accordance with NYSDEC ASP Category B data deliverable requirements.

10. Internal Quality Control

Laboratory and field quality internal control checks will be used to ensure the data quality objectives. At a minimum, this will include:

- Matrix spike and/or matrix spike duplicate samples;
- Matrix duplicate analyses;
- Laboratory control spike samples;
- Instrument calibrations;
- Instrument tunes for VOC 8260B and SVOC 8270C analyses;
- Method and/or instrument blanks;
- Surrogate spikes for organic analyses;
- Internal standard spikes for VOC 8260B and SVOC 8270C analyses; and
- Detection limit determination and confirmation by analysis of low-level calibration standard.

A copy of TestAmerica Laboratory's Quality Assurance Manual can be supplied upon request.

Field quality control samples will include:

- Equipment blanks as outlined in Table 4;
- Field duplicate samples as outlined in Table 4;
- Trip blanks as outlined in Table 4; and
- MS/MSDs as outlined in Table 4.

11. Performance and System Audits

Audits are an independent means of: 1) evaluating the operation or capability of a measurement system, and 2) documenting the use of QC procedures designed to generate data of know and acceptable quality.

Field audits may be completed to assess sample collection protocols, determine the integrity of COC procedures, and evaluate sample documentation and data handling procedures. Field audits may be scheduled by the QA officer, PM, site manager or in-house consultant, at their discretion. Written records of audits and any recommendations for corrective action will be submitted to the PM.

The QA officer is the interface between management and project activities in matters of project quality. The QA officer will review the implementation of the QAPP. Reviews will be conducted at the completion of field activities and will include the results of any audits and an evaluation of the data quality.

12. Preventative Maintenance

Preventative maintenance will be performed on field equipment in accordance with the manufacturer's recommendations. Preventative maintenance to field will be provided by equipment vendor, Pine Environmental Services, U.S Environmental Rental Corporation, or other selected vendors. The following equipment has been identified for use to implement the Work Plan.

Subsurface Soil Sampling Activities:

- RAE Systems MultiRAE Plus equipped with VOC (10.6 eV lamp), LEL, percent oxygen, hydrogen sulfide and hydrogen cyanide;
- RAE Systems MiniRAE 2000 PID with 10.6 eV lamp;
- RAE Systems VRAE Surveying Monitor with LEL, hydrogen cyanide, hydrogen sulfide, carbon monoxide, and percent oxygen;
- Draeger Chip Measurement System (CMS) and compound specific chips;
- MIE pDR 1200 with cyclone and pump;
- MSA LC Pump; and
- BIOS DCL-5k pump calibrator.

Groundwater Sampling Activities

- In-Situ Troll 9000;
- YSI 600 XLM; and
- Horiba U-52.

Similar equipment will be substituted that perform the same functions can be substituted if selected equipment is not available from equipment supplier.

Laboratory equipment calibration and maintenance procedures are specified in TestAmerica Laboratory's Quality Assurance Manual, which can be supplied upon request.

13. Specific Procedures to Assess Data Quality Indicators

QC analyses conducted as a part of the testing program will provide a quantitative quality assessment of the data generated and their adherence to the data quality indicators. The data quality indicators ensure that the quality assurance objectives for the project are met.

13.1 Detection Limits

13.1.1 Method Detection Limit

The MDL is defined as follows for all measurements:

MDL = (t[n-1,1-a=0.99]) x (s)

where: s = standard deviation of the replicate analysis,
t(n-1, 1-a=0.99) = student's t-value for a one-sided, 99 percent confidence level and a standard deviation estimate with n-1 degrees of freedom

The MDLs calculated by the laboratory are determined under ideal conditions. MDLs for environmental samples are dependent on the sample aliquot, the matrix, the concentration of analyte, and interference present in the matrix, the percent of moisture, dilution factor, etc. The MDL for each sample analysis will be adjusted accordingly.

13.1.2 *Reporting Limit*

The reporting limit (RL) is the concentration of an analyte in the sample that corresponds to the lowest concentration standard of the calibration curve. As with the MDLs, the RLs are dependent on the sample aliquot, the final sample volume, the percent of moisture, dilution factor, etc.

The RL is determined as follows:

$$RL = \frac{Lowest\ conc.\ std\ (ng)}{Volume\ injected\ (uL)}\ x\ \frac{Sample\ aliquot\ (mL\ or\ g)}{Final\ volume\ (mL)}\ x\ DF\ x\ \frac{100}{(100 - \%M)}$$

where: DF = dilution factor, including all dilutions or lost samples not accounted for in a sample aliquot/final volume ratio
%M = percent moisture for solid samples.

13.2 Precision

Variability will be expressed in terms of the relative percent difference (RPD) when only two data points exist. The RPD is calculated as:

$$RPD = \frac{(Larger\ Value - Smaller\ Value)}{[(Larger\ Value + Smaller\ Value)/2]}\ x\ 100\%$$

For data sets greater than two points, the percent relative standard deviation (percent RSD) is used as the precision measurement. It is defined by the equation:

$$Percent\ RSD = \frac{Standard\ Deviation}{Mean}\ x\ 100\%$$

Standard deviation (SD) is calculated as follows:

$$SD = \sqrt{\sum_{i=1}^{n} \frac{(y_i - y)^2}{n - 1}}$$

where: SD = standard deviation
yi = measured value of the ith replicate
y = mean of replicate measurements
n = number of replicates

For measurements such as pH, where the absolute variation is more appropriate, precision is usually reported as the absolute range (D) of duplicate measurements:

$$D = \left| \text{first measurement - second measurement} \right|$$

or as the absolute standard deviation previously given. RPD, %RSD, and D are independent of the error of the analyses and reflect only the degree to which the measurements agree with each other, not the degree to which they agree with the true value for the parameter measured.

13.3 Accuracy

Accuracy is related to the bias in a measurement system. Accuracy describes the degree of agreement of a measurement with a true value. Accuracy will be expressed as percent recovery for each matrix spike analyte by using the following equation:

$$\%\ Recovery = \frac{Css - Cus}{Csa}\ X\ 100\%$$

where: Css = measured concentration in spiked sample
Cus = measured concentration in unspiked sample
Csa = known concentration added to the sample

Accuracy for a measurement such as pH is expressed as bias in the analysis of a standard reference sample according to the equation:

$$\text{Bias} = pH_m - pH_t$$

where: pH_m = measured pH
pH_t = the true pH of the standard reference sample

13.4 Completeness

Data completeness is a measure of the amount of usable data resulting from a measurement effort. For this program, completeness will be defined as the percentage of valid data obtained compared to the total number of measurements necessary to achieve our required statistical level of confidence for each test. The confidence level is based on the total number of samples proposed in the Work Plan.

Data completeness is calculated as:

$$Completeness = \frac{Number\ of\ valid\ data\ points}{Number\ of\ data\ points\ necessary\ for\ confidence\ level} x\ 100\%$$

The completeness goal is to generate a sufficient amount of valid data. GEI anticipates that 95 percent of the data will be complete. Data validation criteria discussed in the work plan and Section 10 of this QAPP will be used to determine data completeness. Any data deficiencies and their effect on project goals will be evaluated in the DUSR.

13.5 Representativeness

Representativeness is a qualitative statement that expresses the extent to which the sample accurately and precisely represents the characteristics of interest of the study. Representativeness is primarily concerned with the proper design of the sampling program and is best ensured by proper selection of sampling locations and the taking of a sufficient number of samples. It is addressed by describing the sampling techniques, the matrices sampled, and the rationale for the selection of sampling locations, which are discussed in the field sampling plan and Work Plan

13.6 Comparability

Comparability is a qualitative parameter expressing the confidence that one set of data can be compared to another. Comparability is possible only when standardized sampling and analytical procedures are used.

14. Corrective Action

If unacceptable conditions are identified as a result of audits or are observed during field sampling and analysis, the PM, Field Team Leader, and QA officer will document the condition and initiate corrective procedures. The specific condition or problem will be identified, its cause will be determined, and appropriate action will be implemented.

The entire sampling program will be under the direction of the PM and QA officer. The emphasis in this program is on preventing problems by identifying potential errors, discrepancies, and gaps in the data collection, laboratory analysis, and interpretation process. Any problems identified will be promptly resolved. Likewise, follow-up corrective action is always an option in the event that preventative corrective actions are not effective.

The acceptance limits for the sampling and analyses to be conducted in this program will be those stated in the method or defined by other means in the Work Plan. Corrective actions are likely to be immediate in nature and most often will be implemented by the contracted laboratory analyst or the PM. The corrective action will usually involve recalculation, reanalysis, or repeating a sample run.

14.1 Immediate Corrective Action

Corrective action in the field may be needed when the sample requirements are changed (i.e., more/less samples, sampling locations other than those specified in the Work Plan), or when sampling procedures and/or field analytical procedures require modification, etc. due to unexpected conditions. The field team may identify the need for corrective action. The Field Team Leader, Site Manager, and PM will approve the corrective action and notify the QA officer. The PM and QA officer will approve the corrective measure. The Field Team Leader and Site Manager will ensure that the corrective measure is implemented by the field team.

Corrective actions will be implemented and documented in the field record book. Documentation will include:

- A description of the circumstances that initiated the corrective action;
- The action taken in response;
- The final resolution; and
- Any necessary approvals.

No staff member will initiate corrective action without prior communication of findings through the proper channels.

Corrective action in the laboratory will be completed in accordance with the laboratory's quality assurance procedures which can be supplied upon request. Any corrective actions completed by the laboratory will be documented in both the laboratory's corrective action files, and the narrative data report sent from the laboratory to the PM. If the corrective action does not rectify the situation, the laboratory will contact the PM, who will determine the action to be taken and inform the appropriate personnel.

If potential problems are not solved as an immediate corrective action, the contractor will apply formalized long-term corrective action if necessary.

Tables

Table 1
Subsurface Soil Field Sampling Matrix
Hornell Former MGP Site
Site Characterization
Hornell, New York

SAMPLE SELECTION PROTOCOL:
1. Subsurface soils within heaviest observed impacts (if present)

IF NO IMPACTS ARE OBSERVED:
1. Water table interface

Sample I.D.	Sample Location	Sample Number			Sample Zone Depths		Analysis (Method[1])				
		Number Samples Proposed	Number Samples Collected	Date Collected	Heaviest Impacted Zone below 5 feet (if present)	Water Table Interface	VOCs (8260B)	SVOCs (8270C)	TAL Metals (6000/7000)	Total Cyanide (9012)	Free Cyanide (9013/D-4282-02)
Test Pit TP-1	Purifier and Retort Building	1					X	X	X	X	X
Test Pit TP-2	Former Gas Holder A	1					X	X	X	X	X
Boring SB1	Former Retort	1					X	X	X	X	X
Boring SB2	Former Purifier House	1					X	X	X	X	X
Boring SB3	Former Gas Holder A	1					X	X	X	X	X
Boring SB4	Former Large Retort	1					X	X	X	X	X
Boring SB5	Former Gas Holder B	1					X	X	X	X	X
Well MW1	Adjacent to Former Purifier House	1					X	X	X	X	X
Well MW2	Adjacent to Former Gas Holder B	1					X	X	X	X	X
Well MW3	Adjacent to Former Gas Holder C	1					X	X	X	X	X
Well MW4	Upgradient of Hotel	1					X	X	X	X	X

[1] Chemical analysis test methods specified are from U.S. EPA SW-846 test methods.

Table 2
Groundwater Field Sampling Matrix
Hornell Former MGP Site
Site Characterization
Hornell, New York

Sample I.D.	Sample Location	**SAMPLE SELECTION PROTOCOL:** Collect one groundwater sample at the water table or installed monitoring well depth:				Water Quality Measurements						Analysis (Method[1])				
		Sample Number			Sample Zone	pH	Specific Conductance	Temperature	Oxidation Reduction Potential (ORP)	Turbidity	Dissolved Oxygen	VOCs (8260B)	SVOCs (8270C)	TAL Metals (6000/7000)	Total Cyanide (9012)	Free Cyanide (9013/D-4282-02)
		Number Samples Proposed	Number Samples Collected	Date Collected	Water Table											
MW1	Adjacent to former purifier house	1				X	X	X	X	X	X	X	X	X	X	X
MW2	Adjacent to former gas holder B	1				X	X				X	X	X	X	X	X
MW3	Adjacent to former gas holder C	1				X	X					X	X	X	X	X
MW4	Upgradient of hotel	1				X	X					X	X	X	X	X

[1] Chemical analysis test methods specified are from U.S. EPA SW-846 test methods.

Table 3
Soil Vapor and Ambient Air Field Sampling Matrix
Hornell Former MGP Site
Site Characterization Work Plan
Hornell, New York

Sample I.D.	Sample Location	SAMPLE SELECTION PROTOCOL: 1. Collect one soil vapor sample at the installed soil vapor point depth. 2. Collect indoor air and outdoor air samples from the height of the breathing zone, approximately 3-5 feet above the ground surface.			Analysis (Method)
		Sample Number			VOCs (expanded) (modified TO-15)
		Number Samples Proposed	Number Samples Collected	Date Collected	
Soil Vapor					
SV-1	Inside the Comfort Inn	1			X
Indoor Air					
IA-1	Inside the Comfort Inn	1			X
Outdoor Air					
AA-1	Outside the Comfort Inn, downgradient of previous soil boring B-7	1			X

Notes:

VOCs - Volatile Organic Compounds

Table 4
Analytical Methods/Quality Assurance Summary Table
Hornell Former MGP Site
Site Characterization
Hornell, New York

Media	Number of Primary Samples	QA/QC Samples				Total Number of Samples	Analytical Parameters	Method	Preservative	Holding Time	Container
		TB	FB[2]	DUP	MS/MSD						
Subsurface Soil	11	3	1	1	1	17	VOCs	8260B	Cool to 4°C	14 days to analysis	Wide mouth 2-oz. VOA, clear glass jar
	11	0	1	1	1	14	SVOCs	8270C	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis	Wide mouth 8-oz. clear glass jar[1]
	11	0	1	1	1	14	TAL Metals	6000/7000	Cool to 4°C	28 days to analysis for mercury; 6 months to analysis for other metals	Wide mouth 8-oz. clear glass jar[1]
	11	0	1	1	1	14	Total Cyanide	9012	Cool to 4° C	28 days to analysis	Wide mouth 8-oz. clear glass jar[1]
	11	0	1	1	1	14	Free Cyanide	9013/D-4282-02	Cool to 4° C	28 days to analysis	Wide mouth 8-oz. clear glass jar[1]
Groundwater	4	1	1	1	1	8	VOCs	8260B	pH<2 with HCl, Cool to 4°C	14 days to analysis	(2) 40 mL VOA vials
	4	0	1	1	1	7	SVOCs	8270C	Cool to 4°C	7 days to extraction; 40 days from extraction to analysis	(2) 1 L amber glass jar
	4	0	1	1	1	7	TAL Metals	6000/7000	pH<2 with HNO_3; Cool to 4°C	28 days to analysis for mercury; 6 months to analysis for other metals	(1) 500 mL polyethylene container
	4	0	1	1	1	7	Total Cyanide	9012	NaOH to pH>12/Cool to 4°C	14 days to analysis	(1) 500 mL polyethylene container
	4	0	1	1	1	7	Free Cyanide	9013/D-4282-02	NaOH to pH>12/Cool to 4°C	14 days to analysis	(1) 500 mL polyethylene container

[1] SVOC, Total Cyanide, TAL metals will be collected from the (1)- 8 oz jar

[2] Soil field blanks will include bottles listed in groundwater section of the table.

VOCs - Volatile Organic Compounds
SVOCs - Semi-Volatile Organic Compounds
TAL - Target Analyte List
°C- Degrees Celsius
L - Liter
oz. - ounce

mL - Milliliter
HNO3 - Nitric Acid
HCl - Hydrochloric Acid
NAOH-Sodium Hydroxide

Table 5
Quantification Limits for Subsurface Soils
Hornell Former MGP Site
Site Characterization
Hornell, New York

	Reporting Detection Limit	Method Detection Limit	Units
Subsurface Soil			
Cyanide by U.S. EPA Method 9012			
Cyanide, Total	500	53	ug/Kg
Cyanide by U.S. EPA Method 9013			
Cyanide, Free			ug/Kg
Metals by U.S. EPA Method 6000/7000 series			
Aluminum	258	20	mg/Kg
Antimony	11.7	1.14	mg/Kg
Arsenic	8	1.22	mg/Kg
Barium	2	0.18	mg/Kg
Beryllium	2	0.5	mg/Kg
Cadmium	3	1	mg/Kg
Calcium	85	11.6	mg/Kg
Chromium	3	0.34	mg/Kg
Cobalt	2	0.42	mg/Kg
Copper	5	0.8	mg/Kg
Iron	145	10.2	mg/Kg
Lead	9	0.76	mg/Kg
Magnesium	35	9.2	mg/Kg
Manganese	2.5	0.64	mg/Kg
Mercury	0.05	0.02	mg/Kg
Nickel	6.25	0.44	mg/Kg
Potassium	200	40	mg/Kg
Selenium	16	1.6	mg/Kg
Silver	3	0.32	mg/Kg
Sodium	94	20	mg/Kg
Thallium	20	4.17	mg/Kg
Vanadium	4	0.36	mg/Kg
Zinc	20	3.8	mg/Kg
Semi-Volatile Organic Compounds (SVOCs) by U.S. EPA Method 8270C			
1,2,4-Trichlorobenzene	333	55.96	ug/Kg
1,2-Dichlorobenzene	333	56.43	ug/Kg
1,2-Diphenylhydrazine	333	32.86	ug/Kg
1,3-Dichlorobenzene	333	50.49	ug/Kg
1,4-Dichlorobenzene	333	52.75	ug/Kg
2,2-oxybis (1-chloropropane)	333	47.18	ug/Kg
2,4,5-Trichlorophenol	1667	120.96	ug/Kg
2,4,6-Trichlorophenol	333	85.18	ug/Kg
2,4-Dichlorophenol	333	108.95	ug/Kg
2,4-Dimethylphenol	333	172.3	ug/Kg
2,4-Dinitrophenol	1667	114.87	ug/Kg
2,4-Dinitrotoluene	333	60.09	ug/Kg
2,6-Dinitrotoluene	333	60.57	ug/Kg
2-Chloronaphthalene	333	48.46	ug/Kg
2-Chlorophenol	333	86.27	ug/Kg
2-Methylnaphthalene	333	52.92	ug/Kg
2-Methylphenol	333	89.03	ug/Kg
2-Nitroaniline	1667	42.32	ug/Kg
2-Nitrophenol	333	115.71	ug/Kg
3,3-Dichlorobenzidine	667	88.96	ug/Kg

Table 5
Quantification Limits for Subsurface Soils
Hornell Former MGP Site
Site Characterization
Hornell, New York

	Reporting Detection Limit	Method Detection Limit	Units
Subsurface Soil			
Semi-Volatile Organic Compounds (SVOCs) by U.S. EPA Method 8270C (Cont'd)			
3-Nitroaniline	1667	68.54	ug/Kg
4,6-Dinitro-2-methylphenol	1667	239.28	ug/Kg
4-Bromophenyl phenyl ether	333	51.16	ug/Kg
4-Chloro-3-methylphenol	333	112.76	ug/Kg
4-Chloroaniline	333	107.34	ug/Kg
4-Chlorophenyl phenyl ether	333	45.74	ug/Kg
4-Methylphenol	333	179.39	ug/Kg
4-Nitroaniline	667	48.17	ug/Kg
4-Nitrophenol	1667	141.69	ug/Kg
Acenaphthene	333	55.32	ug/Kg
Acenaphthylene	333	40.59	ug/Kg
Aniline	333	73.83	ug/Kg
Anthracene	333	54.55	ug/Kg
Benzidine	3333	1134.9	ug/Kg
Benzo(a)anthracene	333	45.31	ug/Kg
Benzo(a)pyrene	333	41.16	ug/Kg
Benzo(b)fluoranthene	333	93.11	ug/Kg
Benzo(ghi)perylene	333	36.99	ug/Kg
Benzo(k)fluoranthene	333	37.12	ug/Kg
Benzoic acid	1667	90.33	ug/Kg
Benzyl alcohol	333	62.93	ug/Kg
Bis(2-chloroethoxy)methane	333	57.03	ug/Kg
Bis(2-chloroethyl)ether	333	44.86	ug/Kg
Bis(2-ethylhexyl)phthalate	333	44.37	ug/Kg
Butyl benzyl phthalate	333	43.04	ug/Kg
Carbazole	333	48.63	ug/Kg
Chrysene	333	41.6	ug/Kg
Dibenzo(a,h)anthracene	333	36.71	ug/Kg
Dibenzofuran	333	52.67	ug/Kg
Diethyl phthalate	333	48.88	ug/Kg
Dimethyl phthalate	333	51.27	ug/Kg
Di-n-butyl phthalate	333	43.98	ug/Kg
Di-n-octyl phthalate	333	34.97	ug/Kg
Fluoranthene	333	41.87	ug/Kg
Fluorene	333	43.39	ug/Kg
Hexachlorobenzene	333	48.52	ug/Kg
Hexachlorobutadiene	333	67.85	ug/Kg
Hexachlorocyclopentadiene	333	247.96	ug/Kg
Hexachloroethane	333	59.22	ug/Kg
Indeno(1,2,3-cd)pyrene	333	33.74	ug/Kg
Isophorone	333	60.02	ug/Kg
Naphthalene	333	56.66	ug/Kg
Nitrobenzene	333	40.4	ug/Kg
n-Nitrosodimethylamine	333	48.87	ug/Kg
n-Nitroso-di-n-propylamine	333	44.63	ug/Kg
n-Nitrosodiphenylamine	333	49.76	ug/Kg

Table 5
Quantification Limits for Subsurface Soils
Hornell Former MGP Site
Site Characterization
Hornell, New York

	Reporting Detection Limit	Method Detection Limit	Units
Subsurface Soil			
Semi-Volatile Organic Compounds (SVOCs) by U.S. EPA Method 8270C (Cont'd)			
Pentachlorophenol	1667	287.85	ug/Kg
Phenanthrene	333	38.58	ug/Kg
Phenol	333	96.98	ug/Kg
Pyrene	333	45.56	ug/Kg
Pyridine	667	39.9	ug/Kg
Volatile Organic Compounds (VOCs) by U.S. EPA Method 8260B			
1,1,1-Trichloroethane	5	0.84	ug/Kg
1,1,2,2-Tetrachloroethane	5	1.21	ug/Kg
1,1,2-Trichloroethane	5	1.04	ug/Kg
1,1-Dichloroethane	5	0.81	ug/Kg
1,1-Dichloroethene	5	1.09	ug/Kg
1,2,3-Trichloropropane	5	1.62	ug/Kg
1,2,4-Trichlorobenzene	5	0.61	ug/Kg
1,2-Dichloroethane	5	0.99	ug/Kg
1,2-Dichloropropane	5	1.06	ug/Kg
2-Butanone (MEK)	10	1.78	ug/Kg
2-Chloroethylvinylether	5	1.37	ug/Kg
2-Hexanone	10	2.53	ug/Kg
4-Methyl-2-pentanone (MIBK)	5	1.18	ug/Kg
Acetone	20	3.15	ug/Kg
Acrolein	20	3.1	ug/Kg
Acrylonitrile	5	1.19	ug/Kg
Benzene	5	0.86	ug/Kg
Bromodichloromethane	5	0.84	ug/Kg
Bromoform	5	0.99	ug/Kg
Bromomethane	5	0.82	ug/Kg
Carbon disulfide	5	0.61	ug/Kg
Carbon tetrachloride	5	0.78	ug/Kg
Chlorobenzene	5	0.79	ug/Kg
Chloroethane	5	1.89	ug/Kg
Chloroform	5	0.53	ug/Kg
Chloromethane	5	0.9	ug/Kg
cis-1,2-Dichloroethene	5	1.04	ug/Kg
cis-1,3-Dichloropropene	5	0.78	ug/Kg
Dibromochloromethane	5	0.41	ug/Kg
Dichlorodifluoromethane	5	1.25	ug/Kg
Ethylbenzene	5	0.79	ug/Kg
Isopropyl ether	5	0.44	ug/Kg
Methylene chloride	20	2.21	ug/Kg
Methyl-tert-butyl-ether (MTBE)	5	0.93	ug/Kg
Styrene	5	1.06	ug/Kg
tert-Butyl alcohol	20	4.69	ug/Kg
Tetrachloroethene	5	0.7	ug/Kg
Toluene	5	0.84	ug/Kg
trans-1,2-Dichloroethene	5	0.58	ug/Kg
trans-1,3-Dichloropropene	5	0.92	ug/Kg
Trichloroethene	5	0.68	ug/Kg
Trichlorofluoromethane	5	0.6	ug/Kg
Trichlorotrifluoroethane	5	0.63	ug/Kg
Vinyl acetate	10	2.7	ug/Kg
Vinyl chloride	5	0.87	ug/Kg
Xylenes (total)	5	1.96	ug/Kg

Table 6
Quantification Limits for Groundwater Samples
Hornell Former MGP Site
Site Characterization
Hornell, New York

	Reporting Detection Limit	Method Detection Limit	Units
Groundwater			
Cyanide by U.S. EPA Method 9012			
Cyanide, Total	10	1	ug/L
Cyanide by U.S. EPA Method 9013			
Cyanide, Free			ug/L
Metals by U.S. EPA Method 6000/7000 Series			
Aluminum	500	92	ug/L
Antimony	20	5.4	ug/L
Arsenic	40	3.9	ug/L
Barium	5	0.74	ug/L
Beryllium	5	0.54	ug/L
Cadmium	10	1.1	ug/L
Calcium	300	56	ug/L
Chromium	10	1.3	ug/L
Cobalt	10	1.8	ug/L
Copper	10	4.3	ug/L
Iron	100	54	ug/L
Lead	10	3	ug/L
Magnesium	100	26	ug/L
Manganese	15	6.9	ug/L
Mercury	0.4	0.07	ug/L
Nickel	10	1.9	ug/L
Potassium	400	191	ug/L
Selenium	30	5	ug/L
Silver	6	1.1	ug/L
Sodium	400	98	ug/L
Thallium	40	10	ug/L
Vanadium	6	1.5	ug/L
Zinc	50	11	ug/L
Semi-Volatile Organic Compounds (SVOCs) by U.S. EPA Method 8270C			
1,2,4-Trichlorobenzene	10	0.68	ug/L
1,2-Dichlorobenzene	10	0.74	ug/L
1,2-Diphenylhydrazine	10	0.84	ug/L
1,3-Dichlorobenzene	10	0.68	ug/L
1,4-Dichlorobenzene	10	0.46	ug/L
2,2-oxybis (1-chloropropane)	10	0.62	ug/L
2,4,5-Trichlorophenol	50	0.78	ug/L
2,4,6-Trichlorophenol	10	0.79	ug/L
2,4-Dichlorophenol	10	0.84	ug/L
2,4-Dimethylphenol	10	0.73	ug/L
2,4-Dinitrophenol	50	5.13	ug/L
2,4-Dinitrotoluene	10	0.8	ug/L
2,6-Dinitrotoluene	10	0.59	ug/L
2-Chloronaphthalene	10	0.73	ug/L
2-Chlorophenol	10	0.6	ug/L
2-Methylnaphthalene	10	0.64	ug/L
2-Methylphenol	10	0.59	ug/L
2-Nitroaniline	50	1.12	ug/L

Table 6
Quantification Limits for Groundwater Samples
Hornell Former MGP Site
Site Characterization
Hornell, New York

	Reporting Detection Limit	Method Detection Limit	Units
Groundwater			
Semi-Volatile Organic Compounds (SVOCs) by U.S. EPA Method 8270C (Cont'd)			
2-Nitrophenol	10	0.75	ug/L
3,3-Dichlorobenzidine	10	0.98	ug/L
3-Nitroaniline	50	0.67	ug/L
4,6-Dinitro-2-methylphenol	50	4.24	ug/L
4-Bromophenyl phenyl ether	10	0.91	ug/L
4-Chloro-3-methylphenol	10	0.51	ug/L
4-Chloroaniline	10	0.43	ug/L
4-Chlorophenyl phenyl ether	10	0.82	ug/L
4-Methylphenol	10	0.33	ug/L
4-Nitroaniline	20	1.05	ug/L
4-Nitrophenol	50	1.85	ug/L
Acenaphthene	10	0.8	ug/L
Acenaphthylene	10	0.75	ug/L
Aniline	10	0.63	ug/L
Anthracene	10	0.99	ug/L
Benzidine	100	2.15	ug/L
Benzo(a)anthracene	10	1.19	ug/L
Benzo(a)pyrene	10	1.08	ug/L
Benzo(b)fluoranthene	10	1.54	ug/L
Benzo(ghi)perylene	10	1.04	ug/L
Benzo(k)fluoranthene	10	0.91	ug/L
Benzoic acid	50	5.88	ug/L
Benzyl alcohol	10	0.99	ug/L
Bis(2-chloroethoxy)methane	10	0.87	ug/L
Bis(2-chloroethyl)ether	10	0.87	ug/L
Bis(2-ethylhexyl)phthalate	10	1.31	ug/L
Butyl benzyl phthalate	10	0.96	ug/L
Carbazole	10	1.11	ug/L
Chrysene	10	0.97	ug/L
Dibenzo(a,h)anthracene	10	1.34	ug/L
Dibenzofuran	10	0.82	ug/L
Diethyl phthalate	10	0.82	ug/L
Dimethyl phthalate	10	0.63	ug/L
Di-n-butyl phthalate	10	1.14	ug/L
Di-n-octyl phthalate	10	1.3	ug/L
Fluoranthene	10	1.08	ug/L
Fluorene	10	0.77	ug/L
Hexachlorobenzene	10	1.07	ug/L
Hexachlorobutadiene	10	0.84	ug/L
Hexachlorocyclopentadiene	10	2.21	ug/L
Hexachloroethane	10	1.06	ug/L
Indeno(1,2,3-cd)pyrene	10	1.17	ug/L
Isophorone	10	0.66	ug/L
Naphthalene	10	0.66	ug/L
Nitrobenzene	10	0.79	ug/L
n-Nitroso-di-n-propylamine	10	0.7	ug/L

Table 6
Quantification Limits for Groundwater Samples
Hornell Former MGP Site
Site Characterization
Hornell, New York

	Reporting Detection Limit	Method Detection Limit	Units
Groundwater			
Semi-Volatile Organic Compounds (SVOCs) by U.S. EPA Method 8270C (Cont'd)			
n-Nitrosodiphenylamine	10	1.08	ug/L
n-Nitrosomethylethylamine	10	0.5	ug/L
Pentachlorophenol	50	5.04	ug/L
Phenanthrene	10	0.66	ug/L
Phenol	10	0.35	ug/L
Pyrene	10	1.01	ug/L
Pyridine	20	2.31	ug/L
Volatile Organic Compounds (VOCs) by U.S. EPA Method 8260B			
1,1,1-Trichloroethane	5	0.4	ug/L
1,1,2,2-Tetrachloroethane	5	0.4	ug/L
1,1,2-Trichloroethane	5	0.6	ug/L
1,1-Dichloroethane	5	0.6	ug/L
1,1-Dichloroethene	5	0.7	ug/L
1,2,3-Trichloropropane	5	1.1	ug/L
1,2,4-Trichlorobenzene	5	0.9	ug/L
1,2-Dichloroethane	5	0.6	ug/L
1,2-Dichloropropane	5	0.9	ug/L
1,3-Dichloropropane	5	0.4	ug/L
2-Butanone (MEK)	5	1.2	ug/L
2-Chloroethylvinylether	5	0.6	ug/L
2-Hexanone	5	0.8	ug/L
4-Methyl-2-pentanone (MIBK)	5	0.7	ug/L
Acetone	5	1.4	ug/L
Acrolein	10	7.8	ug/L
Acrylonitrile	5	1.6	ug/L
Benzene	5	0.4	ug/L
Bromodichloromethane	5	0.4	ug/L
Bromoform	5	0.8	ug/L
Bromomethane	5	1.2	ug/L
Carbon disulfide	5	0.9	ug/L
Carbon tetrachloride	5	1	ug/L
Chlorobenzene	5	0.4	ug/L
Chloroethane	5	0.8	ug/L
Chloroform	5	0.7	ug/L
Chloromethane	5	0.5	ug/L
cis-1,2-Dichloroethene	5	0.6	ug/L
cis-1,3-Dichloropropene	5	0.5	ug/L
Dibromochloromethane	5	0.5	ug/L
Dichlorodifluoromethane	5	0.6	ug/L
Ethylbenzene	5	1	ug/L
Isopropyl ether	5	N/A	ug/L
Methylene chloride	5	0.4	ug/L
Methyl-tert-butyl-ether (MTBE)	5	0.3	ug/L
Styrene	5	0.5	ug/L
Tetrachloroethene	5	0.5	ug/L
Toluene	5	0.3	ug/L

Table 6
Quantification Limits for Groundwater Samples
Hornell Former MGP Site
Site Characterization
Hornell, New York

	Reporting Detection Limit	Method Detection Limit	Units
Groundwater			
Volatile Organic Compounds (VOCs) by U.S. EPA Method 8260B (Cont'd)			
trans-1,2-Dichloroethene	5	0.5	ug/L
trans-1,3-Dichloropropene	5	0.3	ug/L
Trichloroethene	5	0.7	ug/L
Trichlorofluoromethane	5	0.6	ug/L
Trichlorotrifluoroethane	5	0.5	ug/L
Vinyl acetate	5	0.2	ug/L
Vinyl chloride	5	0.8	ug/L
Xylenes (total)	5	1	ug/L

Table 7
Quantitation Limits for Soil Vapor and Ambient Air
Hornell Former MGP Site
Site Characterization
Hornell, New York

Compound	Reporting Limit [a] (ppbv)[C]	Reporting Limit (ug/m^3)[d]
1,1,1-Trichloroethane	0.20	1.1
1,1,2,2-Tetrachloroethane	0.20	1.4
1,1,2-Trichloroethane	0.20	1.1
1,1-Dichloroethane	0.20	0.81
1,1-Dichloroethene	0.20	0.79
1,2,3-Trimethylbenzene	0.20	0.98
1,2,4,5-Tetramethylbenzene	2.5	14
1,2,4-Trichlorobenzene	0.20	1.5
1,2,4-Trimethylbenzene	0.20	0.98
1,2-Dibromoethane	0.20	1.5
1,2-Dichlorobenzene	0.20	1.2
1,2-Dichloroethane	0.20	0.81
1,2-Dichloropropane	0.20	0.92
1,3,5-Trimethylbenzene	0.20	0.98
1,3-Butadiene	0.20	0.44
1,3-Dichlorobenzene	0.20	1.2
1,4-Dichlorobenzene	0.20	1.2
1,4-Dioxane	0.20	0.72
1-Methylnaphthalene	1.0	5.8
2,2,4-Trimethylpentane	0.20	0.93
2-Butanone	0.20	0.59
2-Chlorotoluene	0.20	1.0
2-Ethylthiophene	0.20	0.92
2-Hexanone	0.20	0.82
2-Methylnaphthalene	2.5	14
2-Methylthiophene	0.20	0.80
3-Chloropropene	0.20	0.63
3-Methylthiophene	0.20	0.80
4-Ethyl toluene	0.20	0.98
4-Methyl-2-pentanone	0.20	0.82
Acetaldehyde	1.0	1.8
Acetone	1.0	2.4
Acrolein	0.20	0.46
Benzene	0.20	0.64
Benzothiophene	2.5	14
Bromodichloromethane	0.20	1.3
Bromoform	0.20	2.1
Bromomethane	0.20	0.78
Butane	0.20	0.48
Carbon disulfide	0.20	0.62
Carbon tetrachloride	0.20	1.3
Chlorobenzene	0.20	0.92
Chloroethane	0.20	0.53
Chloroform	0.20	0.98
Chloromethane	0.20	0.41

Table 7
Quantitation Limits for Soil Vapor and Ambient Air
Hornell Former MGP Site
Site Characterization
Hornell, New York

Compound	Reporting Limit [a] (ppbv)[C]	Reporting Limit (ug/m^3)[d]
cis-1,2-Dichloroethene	0.20	0.79
cis-1,3-Dichloropropene	0.20	0.91
Cyclohexane	0.20	0.69
Decane	0.20	1.2
Dibromochloromethane	0.20	1.7
Dichlorodifluoromethane	0.20	0.99
Dodecane	0.20	1.4
Ethanol	1.0	1.9
Ethylbenzene	0.20	0.87
Freon-113	0.20	1.5
Freon-114	0.20	1.4
Heptane	0.20	0.82
Hexachlorobutadiene	0.20	2.1
Hexane	0.20	0.70
Indan	0.20	0.97
Indene	0.20	0.95
Isopropyl Alcohol	0.20	0.49
Methylene chloride	0.20	0.69
MTBE	0.20	0.72
Naphthalene	0.20	1.0
Nonane	0.20	1.0
Octane	0.20	0.93
o-Xylene	0.20	0.87
p+m-Xylene	0.40	1.7
Pentane	0.20	0.59
Styrene	0.20	0.85
Tertiary butyl Alcohol	0.20	0.61
Tetrachloroethene	0.20	1.4
Thiophene	0.20	0.69
Toluene	0.20	0.75
trans-1,2-Dichloroethene	0.20	0.79
trans-1,3-Dichloropropene	0.20	0.91
Trichloroethene	0.20	1.1
Trichlorofluoromethane	0.20	1.1
Undecane	0.20	1.3
Vinyl bromide	0.20	0.87
Vinyl chloride	0.20	0.51

Notes:

a. Actual reporting limits of field samples may be higher due to sample dilution by the laboratory to quantify compounds at elevated concentrations. (see note b)

b. The laboratory must notify KeySpan prior to sample dilution.

c. ppbv = part per billion by volume

d. ug/m 3 = microgram per cubic meter

Appendix E

NAPL Contingency Plan

NAPL Contingency Plan
Hornell Former MGP Site

If DNAPL is encountered during drilling at the site, this section specifies the procedures to be followed to limit the potential for remobilization and downward migration of DNAPL. These procedures apply to the soil borings and monitoring wells to be completed for the SC.

Procedures during Drilling

Soil samples will be taken continuously during drilling. Sampling procedures and soil-characterization requirements are outlined in the SOPs (Appendix C). These procedures include geologic descriptions and field-screening photoionization detector (PID) measurements to gauge the relative concentrations of organic vapors in soil samples. In addition, the field geologist will carefully review each sample for the presence of sheens, staining, and NAPL. Indications that soil may be MGP-impacted will be documented in the field notes.

If NAPL is observed, the field staff will first judge if the NAPL is lighter or denser than water (LNAPL or DNAPL). If an easy determination cannot be made, a representative sample will be selected for a shake test. To perform a shake test, the field staff will place a small sample of NAPL-containing soil in a clear jar. The jar will then be filled ¾ full with water, closed, and manually shaken for several seconds. The jar will then be allowed to sit for up to five minutes, if needed, to allow any potential emulsions to settle. Determination of light or dense NAPL can be made by observing whether the NAPL floats or sinks.

If the NAPL is judged to be denser than water, the field staff will make a qualitative judgment whether the apparent quantity of DNAPL represents a mobilizable volume or is immobile (residual) DNAPL. The presence of a DNAPL pool would be suggested by an apparent DNAPL volume of greater than 5% to 10% of the total soil sample volume.

If a DNAPL pool is interpreted, drilling may continue through the DNAPL-impacted interval to determine the approximate vertical extent, except where continued drilling would risk breaching a confining unit or MGP-related structure (confining with respect to DNAPL). If DNAPL is encountered immediately above a potential confining unit or MGP structure and the confining unit/structure has been identified through soil sampling, then one of the following four possible actions will be taken upon consultation with National Fuel Gas and the NYSDEC:

1) If deeper drilling and characterization are desired at such locations where a confining unit is identified, the borehole may be properly abandoned and an alternate nearby location will be selected. A change order will be submitted to continue drilling with a hollow stem auger drill rig. Drilling will proceed at the alternate location by casing off the interval from the bottom of the probable DNAPL pool to the land surface by grouting a casing in place. (Should the borehole diameter of the original boring be adequate for installing casing and grout, an alternate drilling location would not be required.) Drilling will resume inside the casing once the grout has set (after a minimum of 24-hours). If a DNAPL pool is identified

below the potential confining unit, and no deeper confining unit has been identified in which an outer casing may be set, the borehole will be abandoned and grouted.

2) If deeper drilling and characterization are desired at such locations where a former MGP-related structure is identified (e.g., gas holder floor) with significant accumulations of NAPL above the structure, the borehole will be properly abandoned and an alternate nearby location will be selected immediately outside of the footprint of the former structure.

3) If deeper drilling and characterization are not desired at such locations, the borehole should be properly abandoned by tremie-grouting from the bottom of the borehole to land surface.

4) If NAPL characterization data or NAPL recovery are desired at such locations, a monitoring well may be installed inside the borehole with a grouted-in, 2-foot sump (at a minimum).

If a confining unit or former MGP-related structure is not observed, drilling should be discontinued when approximately 5 feet of visually clean soil (or the top of bedrock) has been observed below the DNAPL-impacted interval. One of the four actions discussed above will be taken under this scenario.

Procedures during Test Pit Excavations

The general procedures described above for drilling will also be employed during the excavation of the test pits at the site. If NAPL is observed in the fill soil or silty soil unit above the sand and gravel unit at the site, the test pit excavation will be immediately terminated in order to prevent full penetration of the silt unit and the potential release of NAPL to the sand and gravel unit below.

NAPL Monitoring

If intervals containing potentially free-phase NAPL are encountered while drilling, NAPL monitoring wells may be installed at these locations, based on the boring’s location and the nature of the NAPL-impacted interval. The determination of potentially free-phase NAPL at boring locations will be made by visual and olfactory observations, as well as by completing a shake test on selected soil samples (as specified above).

The length and slot size of NAPL-monitoring-well screens will depend on the nature of the stratigraphic interval containing NAPL. Per NYSDEC requirements, the default slot size for wells at MGP sites is 0.020 inches (20-slot). If NAPL accumulates in a monitoring well, then recovery tests can be performed to assess the recoverability of the NAPL. The schedule and procedures for NAPL recovery (if required) will be agreed upon by National Fuel Gas and the NYSDEC should it become necessary. For groundwater monitoring wells that contain NAPL, the groundwater phase within the well will not be collected and analyzed during the first sampling event unless such data is needed to aid in characterization of site conditions.